KATHOLIEKE UNIVERSITEIT
LEUVEN

Faculty of Economics and
Applied Economics

Department of Economics

Liquidity Constraint and the Demand for Food: Income Elasticity of Calorie in Rural Ethiopia.

by

Tekabe AYALEW

Develoment Economics

Center for Economic Studies
Discussions Paper Series (DPS) 00.27
http://www.econ.kuleuven.be/ces/discussionpapers/default.htm

December 2000

DISCUSSION
PAPER

Liquidity Constraint and the Demand for Food:
Income Elasticity of Calorie in Rural Ethiopia

Tekabe Ayalew
Department of Economics, KU Leuven,
Naamsestraat 69, Leuven, Belgium.
Tel: (+32)16326622
Fax: (+32)16326796
Email: Tekabe.AyalewBelay@econ.kuleuven.ac.be

Abstract. In this study we attempt to add to the empirical literature by estimating the income elasticity of calorie intake for rural Ethiopia. We have extend the existing literature in two directions. First, using data collected from rural Ethiopia during 1994-95, efforts were made to separate the effects of permanent and transitory income on calorie consumption. Second, on the grounds that income elasticity of calorie consumption differs between those who can smooth their consumption and those who can not do so due to inability to borrow against future income, we considered these two groups explicitly. The results revealed that the calorie elasticity with respect to income (permanent, transitory and total) is consistently higher for credit constrained households. Specifically the elasticity with respect to permanent income ranges from 90 percent for constrained to 42 percent for constrained households, depending on the source of income and estimation procedure. Not surprisingly, the elasticity with respect to both permanent and transitory incomes is not different from zero for non constrained households. For the constrained households, calorie consumption responds to even transitory income, though the figure is less than the corresponding figure for permanent income. Apparently, differentiating households in terms of their ability to smooth consumption, and decomposing observed income into permanent and otherwise partly explains why the evidence on the estimates of the income elasticity of calorie intake are so diverse.

Introduction

In the literature there are two strands of inquiries about the relationships between nutrition and income. On the one hand, nutrition explains income by determining ability to work productively. In the extreme, lack of adequate food is considered as a cause of poverty, because a poor person does not get enough food to enable him to work productively. Employers are not willing to employ these individuals even at a wage below the prevailing wage, because they are insufficiently productive (due to inadequate intake) to make their employment worth while. Such vicious circle was proposed to explain poverty and taken as an obstacle to economic growth (see Dasgupta 1993 and Fogel 1994). The relevant theory is the efficiency-wage hypothesis, which explains involuntary unemployment in terms of the relationship between productivity and nutrition. On the other hand, there are studies where nutrition is conditioned by income. To the extent income determines access to food, the former it explains nutritional status.

Both inquiries attracted a great deal of attention in addressing whether undernutrition is the cause or the consequence of poverty. Some studies dealt with these two issues simultaneously while others tackled the problems separately. The focus of this paper is on the latter aspect of the relationship where nutrition is dependent on income.

Empirical studies aimed at measuring the effect of income on nutrition do not agree on the degree to which nutrition is determined by income. For some, calorie intake (measuring nutrition) does not respond to income, while for others there is a significant response (see section II). The implication of these findings is quite drastic: If one accepts the position that the response of calorie intake to income is negligible, it means that policies aimed at increasing income of the poor do not imply the elimination of hunger.

In this study we attempt to add to the empirical literature by estimating the income elasticity of calorie intake for rural Ethiopia. We have extend the existing literature in two directions. First, using data collected from rural Ethiopia during 1994-95, efforts were made to separate the effects of permanent and transitory income on calorie consumption. Second, on the grounds that income elasticity of calorie consumption differs between those who can smooth their consumption and those who can not due to inability to borrow against future income, we considered these two groups explicitly.

We found that the calorie elasticity with respect to income (permanent, transitory and total) is consistently higher for credit constrained households. Specifically the elasticity with respect to permanent income ranges from 90 percent for constrained to 42 percent for constrained households, depending on the source of income and estimation procedure. As expected the elasticity with respect to both permanent and transitory incomes is not different from zero for non constrained households. For the constrained households, calorie consumption responds to even transitory income, though the figure is less than the corresponding figure for permanent income. Apparently, differentiating households in terms of their ability to smooth consumption, and decomposing observed income into permanent and otherwise partly explains why the evidence on the estimates of the income elasticity of calorie intake are so diverse.

The remainder of the paper is structured as follows. A general overview of nutritional indicators in the country is presented as a background. Section II reviews some of the literature while section III deals with the methodological aspect. The results are presented in section IV and in the final part we conclude and remark on the implications of our findings.

I. Background

Generally food intake is very low among both rural and urban households in Ethiopia. According the Central Statistical Authority (CSA), 90 percent of the rural households are food deficit, either chronically or transitorily (CSA, 1993). The picture for urban households is not much better: 80 percent of their income is used to meet 71 percent of their daily calorie requirement.

Malnutrition is one of the major causes of under five mortality (MOH, 1996). The level of malnutrition in Ethiopia, as measured by anthropometric indicators, is among the highest in the world (Zewdie, 1992). According to the report by CSA (1993), 64 percent of children aged 6-59 months, were stunted (low height for age), 8 percent were wasted (low weight for height) and 47.7 percent were underweight. A high level of stunting among 6-11 months old infants, coupled with the fact that stunted height at a certain age persists with age, suggests that the causes of overall high level of stunting could be inherited from their mothers during pregnancy and/or may be operating during infancy.

Though wasting is lower than stunting, the observed 8 percent is still high even by developing countries standards. During weaning periods it increase up to 13 percent for boys and 10 percent for girls, reflecting the increase in the likelihood and the burden of infection.

Both levels of stunting and wasting vary from one locality to another, where localities are classified by their major agricultural produces. Stunting was high among coffee producers (76.6%), followed by root crop (66.6%) and cereal producers (64.7%). The lowest level of stunting was observed among cattle producers (48.3%) followed by chat producers, daily laborers and civil servants. However, wasting was high among cattle producers (11.6%) and root crop producers (11.4%).

According to the national survey by the CSA, both stunting and wasting significantly decrease as area cultivated increase. But in regions where coffee is the major crop, the situation is reversed. These farmers are relatively rich and there is evidence showing that, in rural Ethiopia, rich households tend to employ their children at farm more often (Asfaw 1995, Ayalew 1996). Such workload at early stages of growth may explain why stunting is high in these areas. One can also resort to intra-household preferences or bargaining in explaining such differences. The production of more cash crops, for a given amount of land, is at the expense of food production. Increase in income from more cash crops production would have been used to compensate for reduced household food production. However when preferences are not uniform across members within the household the preference of the person controlling the resource determines whether the extra cash is to be used for food or other items[1]. When husbands control the resource, it is more likely that the extra cash is spent on individual goods (alcohol, cigarettes, etc) consumed by himself or other adult male members. In this case a decrease in own food production may not be compensated by purchases from the market (see Gracia 1994, and Rogers 1996 for empirical evidences on the Philippines and Dominican Republic respectively). As a result increase in cash crop production is positively associated with poor nutritional status.

II. The literature

The literature on the income elasticity of demand for calories provides mixed results, ranging from no income effect on nutrient (caloric) intake to an elasticity slightly greater than one (see Pitt 1983, Bouis and Haddad 1992, Strauss and Thomas 1995 for summary of estimates). Much of this difference is attributable to a number of methodological differences. First, some estimated the income elasticity directly from a caloric demand equation (Behrman and Deolalikar 1987, Sahn 1988), while others attempted to estimate it indirectly from food demand equations (Behrman and Deolalikar 1987, Kumar and Hotchkiss 1988, Alderman 1989, Ravallion 1990, Pitt, Rosenzweig and Hassan 1990, Bhargava 1991)[2]. Second, there exist a wide variation in estimation techniques, that includes 2SLS (Pitt, Rosenzweig and Hassan 1990, Bouis and Haddad 1992), fixed effects (Behrman and Deolalikar 1987), Heckman selection (Sahn 1988) OLS and non-parametric (Ravallion 1990, Strauss and Thomas 1990, Bouis and Haddad 1992, Subramanian and Deaton 1996). Finally, the measurement of variables is also a source of variation in the estimates. Calories are measured via either the availability of food (based on food purchases and/or changes in stock) or intake based on food consumption recall for the last 7 days or 24 hours. Income is measured as household income or as expenditure.

---

[1] There is ample evidence indicating that differences in preferences within the household (especially between husband and wife) is quite a possibility (see Thomas1990, Chiaporri 1992, Ayalew 1997).

[2] Direct estimation involves using calories consumed as a left hand side variable, while in the indirect method it is the food expenditure which is used as a dependent variable. Therefore the latter is essentially a food group expenditure elasticity converted into calorie elasticity using group specific calorie conversions.

A recent study by Subramanian and Deaton (1996) argue that estimates notably that of Bouis and Haddad (1992) and Behrman and Deolalikar (1987) are either very small or non significant to allow for direct link between income and the elimination of hunger. They argue that if the results are accepted, then ‘’[E]conomic policies that are good for growth do not imply the elimination of hunger. Indeed, even policies that increase the income of the poorest may not improve their nutrition’’ (Sibramanian and Deaton (1996)). The estimates provided by Subramanian and Deaton ranges form 37 to 55 percent.

In studies where expenditure is used as a dependent variable, results are mixed. Increase in income may shift preferences towards expensive food groups that were previously unaffordable. However, these food groups may not be superior in terms of caloric content; other features of the food would be important in shifting the preference (see Behrman, Deolalikar and Wolfe 1988). If food items are grouped and denoting a typical group by G, the elasticity of calories to expenditure (x), ε_{cx} , is given by [3], as in Subramanian and Deaton,

[3] Denoting

$$c = \sum_G \sum_{i \in G} q_{Gi} k_{Gi}; \quad \sigma_G = \frac{\sum_{i \in G} q_{Gi} k_{Gi}}{\sum_G \sum_{i \in G} q_{Gi} k_{Gi}}; \quad \mu_{iG}^c = \frac{q_{Gi} k_{Gi}}{\sum_G q_{Gi} k_{Gi}}; \quad \eta_G = \frac{\partial \ln x_G}{\partial \ln x}; \quad \eta_{iG} = \frac{\partial \ln x_{iG}}{\partial \ln x_G}$$

$$\varepsilon_{cx} = \sum_G \underbrace{\left(\frac{\sum_{i \in G} q_{Gi} k_{Gi}}{\sum_G \sum_{i \in G} q_{Gi} k_{Gi}} \right)}_{A} \underbrace{\left(\frac{\partial \ln x_G}{\partial \ln x} \right)}_{B} \sum_{i \in G} \left[\underbrace{\left(\frac{q_{Gi} k_{Gi}}{\sum_G q_{Gi} k_{Gi}} \right)}_{C} \underbrace{\left(\frac{\partial \ln x_{iG}}{\partial \ln x_G} \right)}_{D} \right]$$

where:

c *total calorie*

q_{Gi} *quantity of good i in group G*

k_{Gi} *calorie content of good i in group G*

x_{iG} exp*enditure on good i of group G*

Intuitively, the flow of the operation can be described as follows. The calorie elasticity of expenditure depends on both the responsiveness of expenditure on food group G to total expenditure (i.e. expression A in the above equation) and the calorie contribution of food group G to total calorie (i.e. expression B in the above equation). These two expressions in turn depend on both the expenditure elasticity of food item i with respect to total group expenditure (i.e. expression D in the above equation) and the calorie contribution of food item i to total group calorie (i.e. expression C in the above equation)

$$e_{cx} = \sum_{G} h_G s_G \left(\sum_{i \in G} h_{iG} m_{iG}^{c} \right) \tag{1}$$

where

s_G *is the share of calories obtained from group G*

h_G – *the total* exp*enditure elasticity of* exp*enditure on group G*

m_{iG}^{c} – *the share of group G's calories that come from good i*

h_{iG} – *the elasticity of* exp*enditure on good i with respect to* exp*enditure on the group*

Apparently, increases in food expenditure imply either increase in calories available, increase in price per calorie or both. This phenomenon makes the price per calorie endogenous. The endogeniety of prices per calorie can be expressed in terms of the elasticity of group G's price per calorie with respect to total expenditure (X), $\frac{¶\ln(x_G / c_G)}{¶\ln X}$, which is given by

$$y_G = h_G \left(1 - \sum_{i \in G} h_{iG} m_{iG}^{c} \right) \tag{2}$$

Where c_G and x_G are group calorie and expenditure, respectively.
using (2) into (1), we get the expression for calorie elasticity as

$$e_{cw} = \sum_{G} s_G \left(h_G - y_G \right) \tag{3}$$

Equation (2) captures the extent consumers substitute expensive non-nutrient characteristics for nutrients within the group, as they get richer. The higher the substitution the larger y_G will be, so that the overall expenditure elasticity of calories will be muted. An indirect estimation of (food group) calorie elasticity essentially presumes that each y_G is zero. Even if y_G is zero, there is still a room for the direct and indirect estimates to differ as far as the between group substitution is non zero.

The indirect procedure involves estimating a demand for group of food items and converting it in to calories using standard food composition tables. Implicit in such computation is the assumption of homothetic preferences within a particular food group and between groups. In terms of equation (1), it means both the between as well as the within group shares of expenditures are kept constant. Apparently, the higher the level of aggregation, the more unrealistic the assumption is. Higher level of aggregation would result in inflated estimates (Behrman and Deolalikar 1987).

When income is used instead of expenditure, the possible endogeneity of the former is apparent: Caloric intake, through labour supply (hours worked) or the productivity (intensity of work) affects income. To this end, some employed IV/2SLS method (Behrman and Deolalikar 1987, Bouis and Haddad 1992, Strauss and Thomas 1990). Even then the use of non-earned income, as used by many, as an instrument is justified only for short run static models; otherwise the source of income itself would be endogenous in a dynamic sense.

The other issue revolving around the expenditure nutrient relationship is that of food leakage introduced by Bouis and Haddad (1992). This refers to the food outflow from and the inflow to the household: richer households are likely to give out food for non family members (workers, relatives etc) while poorer households are likely to have a net food inflow. If one considers the expenditure on food, availability is higher than the purchases for poor household while the reverse is true for the relatively rich households. The situation would be much worse if the measurement error in purchases (measuring availability) is transferred to the expenditure. This is due to the fact that both expenditure and availability are computed from one and the same response indicated by the respondent: availability is quantity while expenditure is the value of the same quantity. For this, some considered a calorie intake (based on recall), rather than calorie availability (Ravallion 1990, Strauss and Thomas 1990, Bouis and Haddad 1992).

Empirical testing of these propositions was constrained by the choice of functional forms. However, non-parametric estimates of the relationship, requiring no a priori assumption about the functional forms, provide a good basis to test the assumed functional forms in the parametric estimations. Strauss and Thomas (1995) and Subramanian and Deaton (1996) provided such tests. They concluded that the assumed linear functional forms are generally valid.

Thus, in terms of variable selection there are six possible combinations. Either household income or its expenditure can be used as explanatory. The explained variable is represented by either calorie availability, food intake or calorie availability corrected for the food leakage. The empirical result to a greater extent depends upon the combinations of variables considered and the estimation techniques employed.

III. Methodology

3.1 Theoretical framework

Income of a typical farm household in rural areas of developing countries is characterised by its volatility. The variability poses a deep concern if saving and borrowing behaviour of the household does not offset it. The ability to borrow to a large extent determines the extent of the impact of current income on consumption. Past studies put emphasis on the measurement of income elasticity of calorie intake without taking into account the sources of changes in income (permanent or transitory changes) and households' ability to borrow against future income and their preferences towards risk.

In this study we present the measurement of the income elasticity of calorie in the context of inter- temporal consumption decisions under uncertainty. Moreover efforts were made to separate the effects of a permanent income change from that of a transitory shock. A typical household is assumed to solve:

[4] $$\underset{(C_{ft})}{Max}\ \mathrm{E}_t \sum_{t=0}^{T} \frac{1}{(1+d)^t} U(c_{ft}) \qquad (4)$$

[4] Assuming additively separable utility function, of the form ∅ $(c_t) = u(c_{ft}) + v(c_{nft})$, we are able to separate the food consumption component (c_{ft}) from the non food consumption (c_{nft}). However, these two components are related through the budget constraint, $c_t = c_{ft} + c_{nft}$. Unless explicitly stated, in the text by consumption we refer to food consumption.

Subject to:

A_{t+1}= (1+r){A_t+y^T_t +(y^P_t- C_t)}

A_t -C_t ≥0

A_{T+1}= 0

Where, E is the expectation operator;r interest rate; δ time preference; A_t assets at time t; y^T_t-Transitory income and y^P_t- Permanent income.

Expectations depend on the information at time t. The most referred way to derive optimal conditions for consumption implied by the preference and budget constraints is via backward solving of this dynamic programming problem. This involves solving the last period (T) first and then working backwards to the next period up to time t. In the last period all assets plus income should be spent on consumption, assuming no bequest (hence the constraint A_{T+1}= 0). During the last but one period (T-1), there is a choice between consumption now and transferring assets to period T, whose value and marginal value is already determined. By solving the problem for these two periods, one establishes the value and the marginal value of assets carried into the last but one period. In this way the problem is reduced to two period problems. Accordingly, the optimal consumption path is obtained from maximising

$$U(C_{ft}) + \frac{1}{(1+d)} EV(A_{t+1}) + l_t(A_t - C_t) \qquad (5)$$

Subject to

$$A_{t+1} = (1+r)\left\{A_t - C_t + y_t\right\}$$

where $y_t = y^P_t + y^T_t$ and λ_t is the lagrangian multiplier. The second constraint implies that current consumption can not be greater than current assets. This inequality in each period represents constraints in borrowing.

The first order condition yields

$$U'(C_{ft}) = \frac{1+r}{(1+d)} EU'(C_{ft+1}) + l_t \qquad (6)$$

If an individual would like to transfer additional resources from tomorrow to today but is constrained from doing so, then the marginal utility of consumption must be higher today relative to tomorrow. Put differently, the lagrangean multiplier associated with the borrowing constraint should be strictly positive.

A discount rate less than the returns on savings implies, given no borrowing constraint (i.e.λ_t =0), a higher marginal utility of consuming today is higher than deferring it to the next period. Given risk aversion behaviour, this means is that current consumption is below its expected future level. In the literature such consumers are referred to as a patient consumer. The role of credit constraint is that it limits the ability of an individual to transfer resources from the future in order to increase current consumption. If borrowing constraint is not binding (i.e. the household is able to borrow against future income or have enough savings), then the optimal consumption path will be declining. But if borrowing is not possible,λ in equation (6) is positive, implying that even if the time preference of the household is equal to the returns from savings, its current consumption is less than its expected future consumption. Thus, the household does increase current consumption whenever there is a possibility.

However, the time preference of the household could depend on its current consumption level. Consumption below a certain 'minimum'[5][6] level (set by either the society or the household itself) might make the household more impatient than otherwise.

But households, who just satisfied its 'minimum' level, borrowing constraint could still be binding (if they want to increase the current consumption above the 'minimum'). However, they may value future consumption more than that part of current consumption which is above the 'minimum' (i.e. are patient for that level which is above the 'minimum'). This

[5] Since it is a subjectively defined level, it may differ across households.

[6] A household whose consumption is below the 'minimum' level may rather prefer to increase its current consumption than future. But once the 'minimum' level is attained, the weight attached to the increase in current consumption relative to the future will be less than the weight given otherwise.

could be true, as they are highly risk averse for gambling between more current consumption above the ‘minimum’ and decreasing it below the ‘minimum’ (in the case of a bad draw) in the future. Therefore, though the constraint is not binding currently, the positive probability attached to the presence of constraint that will bind in the future will lower current consumption of any risk averse individual (Zeldes, 1989).

3.2 Empirical specification

In testing the presence of credit constraint we strictly follow Zeldes (1989) and Morduch (1990). Consider a utility function characterised by a constant relative risk aversion of the form

$$V_{it} = U(C_{ift}; \gamma_{it}) = \frac{1}{1-\alpha}\left\{\left(\frac{C_{ift}}{F_{it}}\right)^{1-\alpha} \exp(\gamma_{it})\right\} \qquad (7)$$

C_{ift} food consumption by household i at time t

γ_{it} household specific characteristics relevant to taste formation at time t

α coefficient of relative risk aversion

F_{it} adult equivalent family size

Taking the derivative of (7) and substituting into the Euler equation (6) and using rational expectations and rearranging terms, we get

$$\frac{C^{-\alpha}_{i,t+1,f} F^{\alpha-1}_{i,t+1} \exp\{\gamma_{i,t+1}\}(1+r)}{C^{-\alpha}_{itf} F^{\alpha-1}_{it} \exp\{\gamma_{it}\}(1+\delta_i)}(1+\theta_{it}) = 1+\varepsilon_{i,t+1} \qquad (8)$$

where

$e_{i,t+1}$ is the expectation error whose mean is zero and is orthogonal to all variables known at time t $\qquad \theta_{it} = \frac{\lambda_t}{E\left[U'_{i,t+1}(1+r)/(1+\delta_i)\right]}$ the sign of θ is determined by the sign of λ_t. Borrowing constraint implies λ_t is strictly greater than zero which in turn implies θ >0.

Taking Log, collecting terms together and rearranging them, yields

$$Ln(\frac{c_{i,t+1,f}}{c_{i,t,f},}) = \frac{a-1}{a} Ln(\frac{F_{i,t+1}}{F_{it}}) + \frac{1}{a}\{(g_{i,t+1} - g_{it}) - Ln(1+d_i) + Ln(1+r) + Ln(1+q_{it}) - Ln(1+e_{i,t+1})\} \quad (9)$$

Substituting the expression $(b_0 + b_1) + 2b_1 age_{it} + (m_{t+1} - m_t)v_i + (u_{i,t+1} - u_{it})$ for $g_{i,t+1} - g_{it}$ [7], and excluding variables that are constant over time we get

$$Ln(\frac{c_{i,t+1,f}}{c_{itf}}) = \frac{1}{a} hhdummy + \frac{a-1}{a} Ln(\frac{F_{i,t+1}}{F_{it}}) + \frac{1}{a}\{2b_1 age_{it} + (m_{t+1} - m_t)v_i + (u_{i,t+1} - u_{it}) + Ln(1+q_{it}) - Ln(1+e_{i,t+1}) \quad (10)$$

Adding and log income as over identifying restriction, village specific time dummies and expectation errors, gives the estimating equation

$$Ln(\frac{c_{i,t+1,f}}{c_{itf}}) = hhdummy + timedummy + \frac{a-1}{a} Ln(\frac{F_{i,t+1}}{F_{it}}) + \frac{2}{a} b_1 age_{it} + bLn(income)_{it} + V_{it} \quad (11)$$

$$where V_{it} = \frac{1}{a}\{\ln(1+q_{it}) + (u_{i,t+1} - u_{it}) - [\ln(1+e_{i,t+1}) - E(-\ln(1+e_{i,t+1}))]\}$$

If borrowing constraints is not binding, and assuming the unconditional expectation of changes in the taste of the household ($u_{i,t+1}$-u_{it}) is zero and that their distribution is stationary, then we obtain that v_{it} will has zero mean. Income would be significant only if it carries the effect of the omitted q_{it} (which is non zero only when credit constraint is binding). Thus for the interpretation of the income coefficient, we heavily relay on the assumption that the components of the error term, except the ln (1+q_{it}), are orthogonal to the included

---

[7] g_{it} can be specified as $b_0 age_{it} + b_1 age_{it}^2 + b_2 edu_{it} + I_i + m_t v_i + u_{it}$ where μ_t is time effects common to all households in a given village v_i is dummy for village and u_{it} is unobserved component which is assumed to be orthogonal to the rest of the variables. Thus

$$g_{i,t+1} - g_{it} = b_0(age_{i,t+1} - age_{it}) + b_1(age_{i,t+1}^2 - age_{it}^2) + (edu_{i,t+1} - edu_t) + (m_{t+1} - m_t)v_i + (u_{i,t+1} - u_{it})$$

We assume that the education of the household head is completed before the data collection, so that the term $edu_{i,t+1} - edu_t$ disappears.

variables. The sign of the coefficient of income is expected to be negative, since an increase in income is negatively related to the tightening of the constraint.

Increase in income at any given period will relax the constraint so that λ will fall. Consumption will rise today compared to tomorrow thereby lowering the growth of consumption.

Tastes may differ across families and with time. Allowance is made for both observed and unobserved tastes. As indicated above, the observed parts are captured through household size, age and age squared. The unobservable parts include both those common to all households but vary with time and time invariant household specific features. Both of these effects are handled by the estimation procedure where household specific constant and time effects are included.

We presume that the impact of transitory income depends whether the household is borrowing constraint or not.

Estimating the elasticity of calorie intake with respect to the permanent component of income has important policy relevance. For example, the impact of a temporary change in income compared to that of a policy changes resulting in a relatively permanent change in income could be analysed with the help of estimates that discriminates between permanent and transitory income.

The income elasticity of calorie intake is estimated for the two groups where grouping is based on liquidity constraint. Moreover, In addition to the income both permanent and transitory components are considered explicitly.

The estimated equation for the elasticity with respect to permanent and transitory income is

$$Lnc_{irt} = \beta_r + \beta_1 \ln Y_{irt}^{P} + \beta_2 LnY_{irt}^{T} + \gamma X_{irt} + \varepsilon_{irt} \qquad (12)$$

We assume that the household cares about per capita consumption than total consumption, so that the dependent variable is expressed in terms of per capita.

Where,

The subscript irt represent household i in region r at time t and Lnc is log of calorie consumption per adult equivalent. Regional and household fixed effects are captured by β_r or β_i respectively. Y^p is household's permanent income, while Y^T is the transitory part; X is a vector of household characteristics.

The household characteristics included are household size and household headship indicator (i.e. whether the household is headed by male or female). Household size controls for the economies of scale in food purchases, preparation and consumption. Large household size provides an opportunity to share household public goods thereby release income to be used for other purposes including food consumption. When large number of individuals share same food stock, kitchen and eat together, then purchases of varieties of food items would be relatively possible and waste in preparation and consumption will be reduced. On the other hand, large household tends to lower per capita consumption as the available resource is thinly distributed among household members.

Female control of household resources is often associated with consumption preference that favours basic needs. This effect is found to be significant in a number of countries when a cross-section of households are considered (Gracia 1994, Rogers 1995). However this effect is expected to disappear when a panel of households are considered.

In this study we follow Paxson's (1992) formulation in decomposing the observed income into permanent and transitory. The permanent component is obtained by regressing the observed income on variables determining permanent income. Specifically, Permanent income is obtained from the following regression where the observed income is regressed on a number of explanatory variables:

$$Y_{irt} = \beta_{or} + \beta_t^p + X'_{irt}\,\beta_i + \varepsilon_{irt} \qquad (13)$$

Where the subscript $_{irt}$ represent household i in region r at time t.

Y is observed income and X is a vector of explanatory variables determining permanent income.

Regional and time fixed effects are captured by β_{or} and β^{p}_{t} respectively.

The transitory component of income is obtained by taking the unexplained part of the total income. This is likely to overestimate the transitory component because all parts of income not captured by the variables in the permanent income equation are ascribed to transitory income.

If the income elasticity of food expenditure decreases as income increase and if higher income favours more expensive nutrient sources, the income elasticity of nutrient intake should decrease as income increase. Thus we expect the income elasticity of calorie consumption to be higher for poor households. Because these households are more likely to be credit constrained, it follows that income elasticity is expected to be higher for credit constrained households. Regarding the components of income, calorie elasticity with respect to transitory income is expected to be not different from zero for non credit constrained households.

The data: In estimating the empirical part we used a data set collected by the Addis Ababa University and Centre for the Study of African Economies, Oxford University during 1994-95 period. The data was collected in three rounds covering fifteen rural sites representing the main agro-ecological zones throughout the country (for details on the data set see Bereket, 1994 and Dercon and Krishnan 1997).

Crop income is computed after converting production, reported in various local conversion units, into a standard one. The conversion into a standard unit was done using conversion rates obtained from a survey in a nearby market. After the quantities are converted into standard units, we valued them using prices obtained from the market where the conversion rates were collected. However, price data from the Central Statistical Authority was also used to value those items for which local prices were not available. Still, for some produces we were unable to get conversion rates and/or prices so that these items are excluded from the computation.

In an attempt to contain some of the errors in the computation, observations with either extremely low or highly inflated income were excluded from our analysis.

IV. Results

4.1 Descriptive

Households are grouped based on the value of livestock they hold. The groups are listed in ascending order of asset possession, where the last group belong to the 'wealthier' class, while the first refers to the 'poorest'.

Consumption from own production is more or less the same for the first three groups, but significantly higher for the wealthy (confirmed by a simple one way ANOVA test). Comparing across rounds, that of round two is high for all groups, but the difference between this and the other rounds is higher for the wealthy household. The same pattern is observed in the consumption of purchased food. The fluctuation in the consumption of own food is accompanied by same fluctuation in the consumption of purchased food, for wealthier households. However, such movements were not observed for the rest of the groups. These fluctuations could be a reflection of price variation that is observed during the three rounds (see Dercon and Krishnan 1998 for the variation of prices among the rounds).

Table_1. Consumption of own produced, purchased and gift foods per adult equivalent/week by asset group

	Seasons (rounds) (N=4310)		
Asset group*	Round 1	Round 2	Round 3
Own produced food per capita (mean in Birr)			
Group 1	13.919	18.343	18.549
Group 2	12.859	19.148	17.324
Group 3	13.470	20.777	18.095
Group 4	18.679	26.004	21.728
Purchased food per capita (mean in Birr)			
Group 1	8.419	8.062	7.140
Group 2	7.912	8.955	7.392
Group 3	7.298	8.928	8.493
Group 4	9.523	13.414	8.892
Food gift -over the three rounds (mean in Birr)			
Group 1	14.94		
Group 2	13.46		
Group 3	12.24		
Group 4	8.11		

* We grouped households into four based on their assets holdings. See the next section for details.

Apart from purchase and own production, the third source of food consumption in our sample is gift from other households, the government and non-governmental organisations. We have considered only inter-household transfers, so that the pattern of flow among households would be identified. As expected poor households receive more gifts, and this difference is not significantly pronounced among the three groups making up the poor category.

One has to be cautious in interpreting this data. It only helps to give a general idea of the difference between groups, not more than that. If the interest is to look at the seasonal variation in consumption and the relevant coping strategies, one has to go deeper than what we have done here using weekly consumption data.

Table_2. Distribution of calorie per capita per day by rounds (excluding the top 20 percent)

	Mean calories per adult equivalent per day			
Decile	Average (N= 4310)	Round 1	Round 2	Round 3
1	386.75	371.43	370.05	409.41
2	921.87	918.50	918.93	926.63
3	1352.01	1354.66	1356.39	1345.94
4	1851.37	1835.77	1871.86	1842.99
5	2427.19	2448.78	2402.16	2432.72
6	3153.27	3173.78	3158.86	3123.41
7	4153.93	4138.97	4159.41	4164.67
8	5593.46	5539.85	5681.34	5573.54

More than 45 percent of the surveyed households on average consume less than what is required to sustain a daily life (which fluctuates between 2100 and 2500 kilocalorie). The calorie consumption of the lowest decile is only around two percent of that of the top 10 percent. This is consistent with the income inequality observed in the villages (see Ayalew and Bekele 1997 for detail on income inequality). No pattern in variation, if any, among rounds is observed.

4.2 Estimation

4.2.1 Wealth and access to credit

The first step in estimating the Euler equation was measuring the wealth of the households', which was to be used as a group indicator. In rural Ethiopia land and livestock are the most important indicators of wealth. A community level survey by Bevan and Bereket (1996) on the same villages indicated that the community use livestock ownership as the most important indicator of wealth. Due to this and lack of other more convincing[8] indicator, the value of livestock owned was used to group households. Once the households are grouped into four categories (in each quartile)[9] the Euler equation was estimated accounting for household size and composition, age and education.

Table_3. Estimates of the Euler equation (Equation 11)

Variables	Coefficients	t-ratio
Lnadeqhhsize	0.272E-03	1.931*
Hhhage	-0.80E-04	-0.851
Income of group 1	-0.1455	-2.277**
Income of group 2	-0.39E-04	-1.716*
Income of group 3	-0.60E-04	-2.617**
Income of group 4	-0.19E-04	-0.838
Adjusted R^2 = .2481		
Sample size= 2884		

[8] Land in Ethiopia is owned by the government; individuals are only given the right to use it, with no right to sell. There is an implicit understanding that the government can redistribute land whenever it feels necessary. As a matter of fact there was a redistribution of land in some regions of the country during early last year , which make the theoretical possibility into a real possibility.

[9] The lowest quartile contains those households whose livestock worth 106 birr; the second lowest group lies between 106 and 900 birr; while the second top contains those between 900 and 2332; and the top includes those above 2332 birr.

***= significant at 1%;** =significant at 5%; *= significant at 10%

The result in Table_3 provide clear categorisation of households to credit constrained and the rest. As expected only income of the 'wealthy' farmers is found to be non-significant in explaining the growth of consumption. The coefficient is increasing (becoming less and less negative) as one move from the poor to the 'wealthy' reflecting the fact that the constraint is becoming less and less tight. The signs of the coefficients are negative, indicating the inverse relationship between rise in income and tightening of the constraint. Increase in income relaxes the constraints thereby increases current consumption relative to that of the future. Consumption is responsive to household size, but not to the age of the household.

4.2.2. Credit constraint and income elasticity of calorie

Based on the groupings in section 4.2.1, we estimated elasticities of calorie intake with respect to income for the constrained and non-constrained groups.

The village effects controls for regional differences in consumption habits[10] that maintains permanent differences in calorie and other nutrient consumption. The household fixed effects controls for variables that are specific to the household. Failure to account for these two effects overestimates elasticities.

Empirical estimates of income elasticity of calorie intake ranges from zero (Behrman and Deolalikar 1987) to slightly higher that one half (Subramanian and Deaton 1996) and to 0.9 (Strauss 1982, Pitt 1983). Our estimate for the overall sample seems reconciliatory in that it is neither zero nor as high as one half. Moreover the magnitude of the estimates drops significantly when household features are controlled for. Rather important insight is obtained when one splits the sample into two, based on their status in terms of access to credit. For the constrained households we obtained an elasticity somewhat greater than that of the

[10] A wide variation in consumption habit is observed in the sampled regions: In the northern part of the country the staple grain is teff (a fine grain which is used to make a local 'bread' called *injera)*, while in the south the staple is enset (a root crop). In the eastern part sorghum and maize are the most commonly consumed items. The content of these food items in terms of calorie (or nutritional value in general)) is

overall sample, 0.16 versus 0.14 respectively (Table_4). However the estimate for non-constrained households is not significantly different from zero. Thus depending on the sample of households, income elasticity of calorie is either zero or different from zero but still well below one half.

Table_4. Estimates of Elasticities based on the grouping

Explanatory variable	Estimation procedure	
	Village fixed effect	Household fixed effect
	All households (N=3099)	
Lnhhsize	-1.3106 (-16.218)***	-1.2559 (6.071)***
Headship	0.0068 (0.459)	-0.0120 (-0.273)
Lninc	0.1388 (3.820)***	0.0857 (1.772)*
	Adjusted R^2= 0.2006	F (17, 3081)= 46.73***
	Constrained households (Households whose livestock worth less than 2332 birr. A total of 2328 households)	
Lnhhsize	-1.3180 (-14.086)***	1.4093 (-5.593)***
Headship	0.0130 (0.761)	-0.0213 (-0.389)
Lninc	0.1635 (3.829)***	0.1091 (1.876)*
	Adjusted R^2= 0.1994	F (17, 2310) =35.09***
	Non constrained households (Households whose livestock worth greater than 2332 birr. A total of 771 households)	
Lnhhsize	-1.3476 (-6.917)***	-1.6657 (-1.112)
Headship	0.0112 (0.258)	-0.1229 (-0.510)
Lninc	0.0374 (0.533)	0.0038 (0.037)

Dependent variable = log of calorie consumption per day per adult equivalent.

	Adjusted R^2= 0.1994	F (17,753) =11.35***

so different not to be in to account.

t-ratios in parenthesis. ***= significant at 1%;** =significant at 5%; *= significant at 10%

Apart from income, household size is the most important determinant of calorie consumption. Large household size provides an opportunity to share household public good and economies of scale in consumption that relieves resources for the consumption of food and other items. However, household size may also depress calorie per capita consumption especially when resources are scarce and what ever available has to be shared (or the household is unable to increase its consumption proportionally). In rural Ethiopia, the latter effect seems to dominate. Thus, excluding household size from the estimated equation would bias the income elasticity[11].

4.2.3. Permanent income and the elasticity of calorie consumption

We defined permanent income in a short term perspective: it is the expected income for period t conditional on the resources of the household at the beginning of the period. Such definition leaves room for permanent income to fluctuate from period to period, given that the household expects it. This is important particularly for our data set, which includes periods of both high (first and third rounds) and low income (round two), which of course is anticipated by the households. Thus, we allow permanent income during these seasons to vary without loss of generality.

[11] The extent and the sign of the bias depend on the coefficient of income from auxiliary regression of household size on income; as in standard omitted variable bias effect. Income has dual effect. It increases the demand for children, where children are normal goods. On the other hand, when rise income is associated with increased cost of parental time, it has a negative effect on fertility .

Table_5. Estimates of the permanent income equation (Equation (13))

(Village fixed effects estimates)

Explanatory variables	Coefficient	Standard error	t-ratio
Total land area	42.930	23.943	1.793*
hhhage	0.7668	0.6029	1.262
Age Squared	0.0072	0.0193	0.371
Female b/n 5-15 years	20.584	28.801	0.715
Male b/n 5-15 years	56.799	27.881	2.037**
Headship	-209.35	76.647	-2.731**
Land type	43.991	42.934	1.025
Value of Oxen and Bull	0.0137	0.0371	0.366
Maladu	-36.655	28.169	-1.298
Femadu	14.707	27.173	0.541
Constant	1194.4	144.07	8.291**

Dependent variable = Crop income per household season

Adjusted R^2 0.2096

F (26,2860) = 33.94 ***

***= significant at 1%;** =significant at 5%; *= significant at 10%

The coefficients of the permanent income equation are jointly significant and in most of the cases the signs are in line with the a priori expectation. As expected, land area owned by the household is one of the major factors determining the permanent component of household income. In rural Ethiopia where crop income is the major source of household earnings, land plays a significant role. Apart from the area, the type of the land (fertile or not) owned by the household also determines the yields. The coefficient of the latter has the expected positive sign, but it is not significant partly because the estimation procedure controls for regional differences (which partly captures differences in land type). Sex of head of the household also has a significant effect on permanent income. Female headship is mostly a result of either death or disability of the husband. Due to such loss of primary source of labour, female heads tend to rent out their land (see Krishnan 1995). Thus, being a female headed household, given all other things, depresses household income. The number of adult female in the household tends to increase household income, as they are likely to involve in off-farm income generating activities. This is true also for male children aged between 5 and 15 years, while female of the same age usually tend to help in domestic works.

Table_6. Elasticity of calorie with respect to permanent and transitory income by access to credit

	Estimation procedure	
Explanatory variables	Village fixed effect	Household fixed effect
	All households (N=2845)	
Lnhhsize	-26007 (15.091)***	-48087 (-6.789)***
Headship	1449.7 (0.573)	4908 (0.555)
PerInc	15.468 (2.506)**	19.000 (2.222)**
TransInc	1.4343 (2.505)**	0.9990 (1.246)
	Adjusted R^2 =0.1372	F (17, 2827)= 27.59***
	Constrained households (N= 2117)	
Lnhhsize	-25193 (-13.006)***	-73323 (-4.603)***
Headship	2525.7 (0.902)	22748 (0.908)
PerInc	21.184 (3.062)***	19.702 (1.900)*
TransInc	1.4609 (2.126)**	1.508 (1.648)*
	Adjusted R^2 =0.1317	F (17, 2160)= 20.42***
	Non constrained households (N=695)	
Lnhhsize	-27777 (-7.107)***	-44768 (-4.728)***
Headship	139.26 (0.026)	3984.4 (0.335)
PerInc	7.9121 (0.688)	23.959 (1.301)
TransInc	1.3059 (1.250)	0.80827 (0.449)
	Adjusted R^2 =0.1353	F (17, 677)= 7.9***
Dependent variable =Calorie consumption per day per adult equivalent.		

***= significant at 1%;** =significant at 5%; *= significant at 10%

Generally, the elasticity with respect to permanent income is expected to be higher than the corresponding figure for transitory income. Our estimate confirms this expectation, and is consistent for all estimation procedures and all wealth groups. The estimate (at the mean) of elasticity of calorie consumption of the credit constrained households with respect to permanent income is somewhat higher (0.58 and 0.79 in the village and household fixed effects, respectively) than what is reported by Subramanian and Deaton (1996).

The estimates are significant only for the sample of poor and credit-constrained households. Both permanent and transitory incomes have significant effect on the calorie consumption of this group. However, elasticity with respect to the permanent income is higher than that of transitory income. But still, the effect of transitory income is significant for constrained households, as their consumption traces current income.

The figure is consistently not significant for non-poor households. As income rise there is a tendency to shift to more expensive nutrient sources so that price per calorie increases with income. In terms of equation (3), it means the increase in income induce a rise in ψ_G thereby the effect on calorie consumption (i.e. ε_{cw}) is suppressed. Thus, for a group of relatively well off households calorie intake might not be that responsive to income. Rather the increase in income would enable these households to afford to shift to superior and expensive nutrient sources, where superiority implies other features of the food than nutrient content including ease of preparation, odour, taste social status, and others.

In the course of decomposing income, we practically instrumented income that addresses the problem of endogeneity of income resulting from a two-way causation between income on the one hand and calorie consumption on the other. Moreover using regional and household fixed effects enabled us to control for community and household heterogeneity that might result in inconsistent estimate if neglected.

V. Implications

Determining the magnitude of the response of calorie intake to income change is crucial for policy decisions. The evidence is very much diverse, implying quite different policy directions. When income changes do not induce change in calorie intake, improvements in nutritional status would be unlikely even when income rises. This statement is at odds with the ‘conventional’ wisdom that income is necessary and, sometimes, sufficient condition for improving nutritional status in developing countries. However, if policies were aimed at improving nutritional levels in the face of no or insignificant income response, a more direct intervention would be required.

This study is partly motivated by such practical reasons to provide aimed at providing estimates of the magnitude of the response in rural Ethiopia.

An attempt was made to separate the response of poor credit constrained households, who have difficulty in smoothing their consumption through time, from that of the better off. What difference will it make if we pool the two groups as if they are homogeneous? Also the effect of permanent income was separated from that of transitory income shocks.

Generally the results are within the range provided in the literature, much of the variation in the estimates is attributable to both to the component of income and to the groupings households. Estimates are lower for transitory income than for permanent and the estimates for non-constrained households are consistently not significantly different from zero. It is likely that non-significant results would be obtained when either the proportion of non-constrained households is higher or in a situation where income is very erratic or both.

Reference

Asfaw, Alemu. 1995. *Child labour in the rural villages of Ethiopia*, Memo.

Ayalew, Tekabe. 1996. *The demand for children and their economic contribution in rural Ethiopia*, Memo.

Ayalew, Tekabe. 1997. *Household labour supply and fertility decisions: unitary or bargaining models, evidence from urban Ethiopia*, Memo.

Ayalew, Tekabe and Bekele Trufat. 1997. *Income inequality in rural Ethiopia,* memo.

Behrman, Jere and Anil Deolalikar. 1987. *Will developing country nutrition improve with income? A case study for rural South India,* **J. Polit. Econ**, 95:3.

Bouis, Howarth and Lawrence Haddad. 1992. *Are estimates of calorie-income elasticities too high: A recalibration of the plausible range,* **J. Dev. Econ.,**32.

Chiappori, P-A. 1988. *Rational Household Labour Supply,* **Econometrica**, 56.

Dasgupta, Partha. 1993. *An Inquiry into Well-being and Destitution,* Oxford:Clarendon.

Fogel, Robert. 1994. *Economic Growth, Population Theory and Physiology: The bearing of Long-Term Processes on the Making of Economic Policy,* **Amer. Econ. Review,** 84.

Kumar, Shubh and David Hotchkiss. 1988. *Consequences of deforestation for women's time allocation, agricultural production and nutrition in hill areas of Nepal,* Research report 69, IFPRI, Washington DC.

Morduch, Jonathan. 1990. *Risk, production and saving: Theory and evidence from Indian households,* Memo, Harvard University.

Paxon, C. 1992. *Using Weather Variability to Estimate the Response of Savings to Transitory Income in Thailand,* **Amer. Econ. Review,** 82:1.

Pitt, Mark. 1983. *Food preferences and Nutrition in rural Bangladesh,* **Rev. Econ. and Stat.** 65:1.

Pitt, mark, Mark Rosenzweig and Md Nazmul Hassan. 1990. *Productivity, health and inequality in the intrahousehold distribution of food in low income countries,* **Amer. Econ. Review**, 80:5

Ravallion, Martin. 1990. *Income effects on undernutrition,* **Econ. Dev. and Cult. Change**, 38:3.

Rogers, Beatrice lorge.1996. *Implication of female household headship for food consumption and nutritional status in The Dominican Republic*, **World Development.** 24:1.

Sahn, David. 1988. *The effects of price and income changes on food-energy intake in Sri-Lanka*, **Econ. Dev. and Cult. Change**, 36:2.

Strauss, John. 1982. *Determinants of Food Consumption in Rural Sierra Leone: Application of the Quadratic Expenditure System to the Consumption-Leisure component of Household-Firm Model,* **J. Dev. Econ.** 11:3.

Strauss, John. 1984. *Joint determination of food consumption and production in rural Sierra Leone: Estimates of a household-firm model,* **J. Dev. Econ,** 14:1/2

Strauss, John and Duncan Thomas. 1989. *The shape of the expenditure-calorie curve*, Manuscript. Santa Monica,Calif. Rand corporation.

Strauss, John and Duncan Thomas. 1990. *Human resources: Empirical modelling of household and family decisions*, In Jere Behrman and T.N Srinivasan (eds), **Hand book of development economics**, vol 3. Amsterdam, North Holland.

Subramanian, Shankar and Angus Deaton. 1996. *The Demand for Food and Calories*, **J. Polit. Econ,** 104:1

Thomas, J. 1990. *Intrahousehold Resource Allocation: An Inferential Approach*, **J. Hum. Res,** 25:4 .

Zeldes, S. 1989. *Consumption and Liquidity Constraints: An Empirical Investigation*, **J. Polit. Econ**, 97.

Appendix 1. Variable definition

Hhhage	- Age of the household head
Age squared	- Age of the household head squared
Lnhhsize	- Log of household size
Lnadeqhhsize	- Log of adult equivalent household size
Femadu	- Number of female adult household members
Female b/n 5-15 years	- Number of female household member aged between 5 and 15
Maladu	- Number of male adult household members
Male b/n 5-15 years	- Number of male household member aged between 5 and 15
Headship	- Dummy for female headship; = 1 if female head = 0 otherwise
Total land area	- Area of total land owned by the household. This include cultivated land, land set aside for grazing and land rent out currently.
Land type	- Dummy for land fertility; =1 if at least one fertile plot is present = 0 otherwise
Value of oxen and bull	- The value of oxen and bull owned by the household
Lninc	- Log of income
PerInc	- Permanent income
TransInc	- Transitory income.