Economic shocks and early childhood nutritional achievements: a case in 20 villages of rural and urban Ethiopia

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Abstract

While the Ethiopian national emergency and food security programs support farmers hit by area-wide shocks such crop failure brought by drought, insects and pests, the idiosyncratic shocks such as illness and death of household member, lose of assets and separation of family or divorce are not covered by any of the social assistance programs. The absence of assistance program to support vulnerable households may lead to serious problem of malnutrition among poor children.

Using longitudinal data of children collected at the age of one and five years (younger cohort data of Young Lives Study), we have examined the effect of area-wide and idiosyncratic economic shocks on nutritional achievement of five-year old children measured by height for age, change in height for age and stunting. The economic shocks considered are those occurred before and after the birth of the child. We have controlled for initial nutritional achievements (at the age of one year), household wealth and household compositions when we regress nutritional achievements on shocks. The serious shocks reported by the respondents that occurred before the birth of the child are (1) decrease in food availability; (2) crops failure; (3) death of livestock death, (4) severe illness or injury; (5) job loss/source of income/family enterprise; (6) birth of new household member, (7) death of household members. The shocks that occurred after the child was borne are (1) illness and death of household members, (2) drought, (3) crop failure, (4) pests and diseases, (5) place employment shutdown or job loss, (6) natural disaster such as drought and flooding (7) divorce or separation of family, (8) death of livestock, (9) increased input prices, (10) decreased output prices, (11) theft and robbery, (12) having to pay for education, and (13) birth or new household member. we found significant effect of shocks not only shock that occurred after the child was born, but also shocks that occurred five years before the child was born implying the long-term consequence of shocks on children growth performance. In addition to the area-wide shocks such as crop failure brought by drought, insects and pests, idiosyncratic shocks such as separation of family, death of breadwinners are important determinants of malnutrition. Although the area-wide economic shocks are very important on which government need to focus more, the idiosyncratic shocks have also considerable contribution to the improvement of children's height for age and consequently to the reduction of stunting and sever stunting in Ethiopia. Therefore, it is still worth if government assistance programs are inclusive of idiosyncratic shocks such as death and illness of household members and separation of family or divorce.

1. Introduction

Reductions in child mortality' and episodes of illness are often considered as main indicators of social development. As a result, one of the targets of millennium development goals is reducing child and infant mortality rates by two-thirds. In the Ethiopian context, the target set by the Ethiopian national survival strategy is to reduce under-five mortality rate from 140 to 85 per 1000 and infant mortality rate from 97 to 45 per 1000 births between 2005/06 to 2009/10 (MoFED, 2006a, 2006b). Thus Ethiopia has to reduce mortality rate substantially in order to achieve millennium development goals. Nutritional achievement of children is a key in reducing these mortality rates. As a result stunting (long-run nutritional achievement) is also considered as indicators of social development. In this connection, a main question that remains to be answered is that "what are the mechanisms of reducing stunting and child mortality in Ethiopia?"

In Ethiopia it is common that households are hit by shocks which are area-wide such as drought and crop failure and idiosyncratic shocks such as illness and death of household members, increase in food prices, and lose of employment. While these shocks are common in Ethiopia, there is no clear evidences to what level the shocks have persistent effect on children's nutritional achievements.

Therefore, determining the long-term consequences of shocks on children's nutritional achievement at a later period are requires careful analysis. Analysing nutritional achievements and childhood mortality are also useful in identifying health programs that are effective in reducing child mortality.

Moreover, according to Ethiopia's Health Sector Development Program (FMoH, 2005), the major causes of child mortality are pneumonia, neonatal conditions, malaria, diarrhea, measles, malnutrition and HIV/AIDS. In order to reduce child mortality, therefore, ways have to be found that effectively improve the sanitation, nutritional and health seeking behavior of children in the country. Although improvements in nutrition achievement in Ethiopia over the last 10 years have been observed, episodes of illness have increased and health service consultations have decreased over this period (Woldehanna, et al. 2008). As a result reducing child mortality may be problematic. Hence studying the underlying causes of episodes of illness, health seeking behavior, and malnutrition is crucial in order to know more about the underlying causes if child mortality.

In developing countries, economic shocks or crises have been shown to negatively impact child health (Paxson and Schady 2004, Hill et al 1993 and Pongou et al 2005). Many of these studies have been mainly concerned with the health effects of economic downturns in the short run (Dercon and Hoddinott, 2003) and at household level (Behrman and Rosenzweig, 2004; Haddad et al. 2003). Obviously shocks can have short-term effect on child growth, but as long as social assistances are in place and effective (Yamano, Alderman and Christiansen, 2005), a onetime economic shock should not have long-term impact on children's nutritional

achievements. In this regard, there are no studies so far conducted in Ethiopia regarding the long-term consequences of shocks.

The main objective this paper is to assess the long-term impact of economic shocks on child nutritional of nutritional achievement (measured by height for age and stunting). Using the concept of health production function, we analysed the relationship between child malnutrition on the one hand and economic shocks on the other hand. Child's health production function is usually derived from a household's utility maximisation problem subject to income and time constraints (Becker, 1965; Grossman, 1972a, b; Cropper, 1977; Rosenzweig and Schultz, 1983). We used two rounds of Young Lives Survey data of the younger cohort (one and 5-year-old cohort) which follows 2000 such children every 3-4 years starting from 2002. Both round one (conducted in last quarter of 2002) and round two data (collected in last quarter 2006) contain information on height for age of the one year and five years old children, respectively, and on the incidence of economic shocks that hits households up to five years before the surveys. The information on initial height for age of children and on economic shocks that hit household before and after the child was born helped us to assess the short and long run effect of economic shocks on children's nutritional achievement and stunting. The detail information on households' initial wealth and household composition also enables to find the effect of economic shocks controlling for initial conditions of household in which the children live in.

The rest of the chapter is organized as follows. Section two briefly reviews literature on determinants of malnutrition, and the role of shocks. Methodologies of the study and data sources are described in section three. A section four presents the results along with discussions. Concluding remarks are provided in section five.

2. Brief review of literature on shocks and child malnutrition

Impact of Child malnutrition

Malnutrition is currently the single leading cause of the global burden of disease (Ezzati et al. 2002) and has been identified as the underlying factor in about 50% of deaths of children under 5 years of age in developing countries (Frimpong and Pongou, 2006; Black et al 2003). Nearly a third of these children are stunted and a quarter are underweight, a situation which is expected to worsen in some parts of the world including sub-Saharan Africa (Frimpong and Pongou, 2006; De Onis et al 2000).

Malnutrition in children leads to permanent effects and to their having diminished health capital as adults (Strauss and Thomas, 1998; Alderman, Hoddinott, and Kinsey, 2006; Linnemayr et al. 2008). Young children are believed to be especially vulnerable to shocks that lead to growth faltering (Smith et al. 2003; Beaton, 1993; Martorell et. al, 1994, 1998). Children are particularly susceptible to shocks in their first two to three years of life, and there are several potential reasons

for this observation (Omitsu and Yamano, 2006; Martorell, 1999; Behrman, Alderman, and Hoddinott, 2004). First, the growth rate is the highest in infancy, thus adverse factors have a greater potential for causing retardation at this time. Second, younger children have higher nutritional requirements per unit (e.g. kilogram) of their body weight and are also more susceptible to infections. Third, they are also less able to make their needs known and are more vulnerable to the effects of poor care practices (Omitsu and Yamano, 2006).

There is a growing literature that explores whether health shocks have permanent or transitory effects on child health status. This is especially important in light of the epidemiological evidence that stature by age three is strongly correlated with attained body size at adulthood (Dercon and Hoddinott, 2003; Martorell, 1995, 1999). Children that experience slow height growth are found to perform less well in school, score poorly on tests of cognitive function, have poorer psychomotor development and fine motor skills; interact less frequently in their environment, fail to acquire skills at normal rates, and tend to have lower activity levels (Grantham-McGregor et al, 1997, 1999; Johnston et. al., 1987; Lasky et. al., 1981; Dercon and Hoddinott, 2003). They also tend to delay school enrollment, and score less well on cognitive tests (Martorell, 1997).

Moreover, the detrimental effects of slow height growth during early childhood may be long lasting. Alderman, et al. (2002) find that in Zimbabwe lowered stature as a preschooler following exposure to the 1982-84 drought resulted in a permanent loss of stature of 2.3 cm, a delay in starting school of 3.7 months, and 0.4 grades less of completed schooling. The combined effect of these factors was estimated to reduce lifetime earnings by 7 per cent (Yamano et al, 2005). Hoddinott and Kinsey (2001) have found that children aged 12 to 24 months have lost 1.5-2cm of growth in the aftermath of droughts in Zimbabwe in 1994 and 1995, although they did not find a similar negative loss among older children. Yamano et al. (2005) also find a negative shock on child growth in height only among children aged 6 to 24 months, not older children (Omitsu and Yamano, 2006). Using longitudinal data with information at national and sub national levels, Pelletier and Frongillo (2003) found a significant relationship between child mortality and weight-for-age after controlling for socioeconomic factors and changes in policy.

Child height has proven to be an informative and longer-run indicator of nutritional status of children (Waterlow et al., 1977; Falkner and Tanner, 1986). While height is clearly determined by the time an individual reaches adulthood (apart from shrinking later in life), there is some debate in the literature about the extent to which adult stature is completely determined by the time the child has progressed beyond early childhood (Strauss and Thomas, 1998). Nevertheless, to the extent that height does affect labor outcomes, it will clearly reflect returns to human capital investments made during early childhood and, perhaps, return to strength (Strauss and Thomas, 1998).

Dercon and Hoddinott, 2003 found adult height to be correlated with earnings and productivity, poorer cognitive outcomes and premature mortality due to increased risk of cardiovascular and obstructive lung disease. An increasing body of evidence

links adult weight or Body Mass Index (BMI) to agricultural productivity and wages (Dasgupta, 1993; Dercon and Krishnan, 2000; Strauss and Thomas, 1998; Pitt, Rosenzweig and Hassan, 1990). Low BMI is correlated with a large number of health-related indicators, including early onset of chronic conditions and increased risk of premature mortality (Waaler, 1984; Higgins and Alderman, 1997). Taller women are also found to experience fewer complications during child birth, typically have children with higher birth weights and experience lower risks of child and maternal mortality (Strauss and Thomas, 1998).

Weight varies in the short run and so provides a more current indicator of nutritional status (Strauss and Thomas, 1998). Since a light person may also be small, and thus not underweight given height (and, conversely, a heavy, tall person may not be overweight), nutritionists have found it convenient to analyze weight given height (Strauss and Thomas, 1998).

Determinants of Child Malnutrition

Malnutrition in children is evidently shown to lead to permanent effects and to result in diminished health capital as adults. Linnemayr et al. (2008) further argue that there may also be an intergenerational cycle of malnutrition as a worse health capital stock may be passed on from adults to their children. Thomas and Frankenberg (2002) argue that there is ample evidence at the macroeconomic as well as the microeconomic level that health is positively associated with other dimensions of economic prosperity, and that causality goes both directions: people with higher income invest more in their human capital and become healthy while healthier workers tend to be more productive and receive higher earnings.

Case and Paxson (2002) examine parental behavior in both the prenatal period and childhood in an attempt to document the ways in which parental behavior and socioeconomic status affect children's health. They present evidence on the correlation of this behavior with income and parents' socioeconomic status, and on the ways in which parents' actions affect children's health. They conclude that while health insurance coverage and advances in medical treatment may be important determinants of children's health, they cannot be the only pillars: Protecting children's health also calls for a broader set of policies that target parents' health-related behavior.

Linnemayr et al. (2008) empirically show that mothers' education and access to clean drinking water are important determinants for the nutritional status of children. They found evidence of a positive impact of female education at the primary level on nutrition, as well as a negative effect of weak social status of the mother measured as a significant age difference to the head of the household.

Frimpong and Pongou, 2006 used data from Ghana and conclude that malnutrition could be associated with health care system and maternal factors. They further argue that it is also important to note that macro-level economic growth that may lead to improvements in household economies may not necessarily translate into improvement in child health and nutrition. The findings from the study reiterate the

importance of interventions that address characteristics associated with specific populations within communities. Policy and interventions should emphasis individual, community and governmental level approaches. Empowering parents with necessary tools and information concerning the importance of proper nutrition could potentially overcome differences in occupation, employment status, and mechanisms of decision-making that negatively impacts child malnutrition.

By applying the conditional or quasi-reduced nutrition demand approach to household data from three consecutive welfare monitoring surveys over the period 1996–98, Christiaensen and Alderman (2004) identify household resources, parental education, and food prices as key determinants of chronic child malnutrition in Ethiopia. Though largely consistent with findings from other malnutrition studies, they claim that, their empirical results with respect to the community sanitation, health, and communication infrastructure are less robust, possibly because of confounding factors, such as the quality of health care or lack of variation in the variables. Their results further indicate that it is quite plausible that maternal nutritional knowledge, as measured by the community's diagnostic capability of growth faltering, also plays an important role in the determination of child malnutrition. For example, increasing the community's ability to rightly diagnose stunted and non-stunted children, respectively, as stunted and non-stunted by 25 percentage points has similar effects as does providing at least one female adult per household with primary education. When community-based programs to enhance knowledge are implemented in addition to the more general development interventions, such as income growth and increased primary schooling, the authors anticipate that chronic child malnutrition in Ethiopia could be reduced by up to 31%.

Using quintile regressions, Aturupane, Deolalikar, and Gunewardena (2006) explored the effects of variables such as a child's age, sex and birth order; household expenditure per capita; parental schooling; and infrastructure on child weight and height at different points of the conditional distributions of weight and height. They find that OLS estimates of the determinants of child weight and height, which effectively estimate the effects of intervention variables at the mean, can be misleading. The results of their quintile regressions indicate that the belief that increases in income are associated with strong nutritional improvements is generally true only at the upper end of the conditional weight and height distributions. Over much of the lower end of the distributions, household expenditure per capita is not a significant determinant of child weight or height. What this means is that income-generating interventions, while very important for a number of other social outcomes, are unlikely to be effective in raising the nutritional levels of those at the greatest risk of malnutrition. They also found evidence asserting discrimination against girls at the lower end of the weight and height distribution, suggesting that even though on average girls are not nutritionally-disadvantaged relative to boys, among children at the highest risk of malnutrition girls are disadvantaged relative to boys. Policy interventions to address child malnutrition need to be sensitive to this reality, and need to especially target girls at high risk of under-nutrition.

The quintile regressions further show that most of the explanatory variables of child malnutrition considered in their study (such as parental education, electricity access, and even availability of piped water) tend to have larger and more significant effects on child weight and height at the higher quintiles than at the lower quintiles. The implication for policy is that since these general interventions are not as effective in raising the nutritional status of children in the lower tail of the conditional weight and height distributions, it may be important to target direct nutritional interventions, such as food supplementation programs to at-risk children (Aturupane, Deolalikar, and Gunewardena, 2006).

Shocks and child malnutrition

The available empirical evidence to date on the effect of income shocks on child growth suggests pervasive growth retardation (Martorell, 1999; Hoddinott and Kinsey, 2001). As such temporary income shocks may cause permanent damage to children's future welfare and cognitive abilities (Yamano et al, 2005). Using three nationally representative surveys conducted during 1995-96, Yamano et al (2005) find that income shocks, measured by crop damage, reduce child growth substantially, especially among children aged 6 to 24 months. Children in this age group may lose 1 cm growth over a six-month interval when half of their crop area is damaged (Yamano et al, 2005). As early child growth faltering may cause permanent damage, appropriate insurance mechanisms to help households protect their consumption from income shocks are crucial. This holds especially in Ethiopia, where stunting among pre-school children has persisted at alarming levels over the past decades and where droughts are a recurrent phenomenon.

The common feature across both child and adult studies is that temporary shocks can have permanent effects (Dercon and Hoddinott, 2003). As such, conventional studies that focus on the short-term welfare losses associated with reduced consumption following shocks that are not fully insured against may understate the full consequences of these shocks. Dercon and Hoddinott (2003), hence, explored the impact of shocks on health status, making particular use of evidence from Ethiopia and Zimbabwe on the impact of droughts and other serious shocks. They find that health status, as measured by height and body mass, is affected by these shocks, suggesting that they are imperfectly insured against. Livestock and other assets play a role in mitigating these shocks. The evidence also suggests that poor people are using their body as a store of energy, in ways consistent with poorly functioning asset and food markets. This implies welfare losses and puts them at risk of further ill-being. The authors further disclose that the impact of shocks is not uniform within the household. Younger preschoolers are more adversely affected than older preschoolers. Adult women are more often adversely affected than adult men. Amongst adult women, daughters of the household head are more vulnerable than other women. The shocks can have long-term consequences, reducing final attained stature and schooling outcomes. This adversely affects the employment prospects and productivity of these young people. Further, taller (and better educated) women have,

on average, taller (and healthier) children, and so the impact of these transitory shocks may well be felt for several generations.

Economic shocks at birth have lasting impacts on children's health several years after the shock. Akresh, Verwimp, and Bundervoet (2007) calculate height for age z-scores for children under age five using data from a Rwandan nationally representative household survey conducted in 1992. They exploit district and time variation in crop failure and civil conflict to measure the impact of exogenous shocks that children experience at birth on their height several years later using a two-by-two difference-in-differences table. They find that boys and girls born after the shock in regions experiencing civil conflict are both negatively impacted with height for age z-scores 0.30 and 0.72 standard deviations lower, respectively. Conversely, only girls are negatively impacted by crop failure, with these girls exhibiting 0.41 standard deviation lower height-for-age z-scores and the impact worsening for girls in poor households. The authors claim their results to be robust to using sibling difference estimators, household level production, and rainfall shocks as alternative measures of crop failure.

Similarly, using two nationally representative surveys from Nicaragua conducted during 1998 and 2001, Omitsu and Yamano (2006) find that children who experienced a shock (Hurricane Mitch) when they were younger than 2.5 years old have 0.35 points lower height-for-age Z-scores and have 6.6 percent higher probability of stunting than expected in 2001, more than two years after experiencing the shock. The authors used pooled cross section models to identify the impacts of the Hurricane Mitch by using interaction term between the age and year dummies. Dividing the children under 5 into two groups (younger and older than 2.5 years old in the two surveys) and estimating determinants of height-for-age Z-score and stunting in the pooled cross section models, they found results that are consistent with earlier studies which indicate that children aged 2 to 3 years old are vulnerable to economic shocks.

Using household panel data that include directly solicited information on economic shocks and employing household fixed-effects estimation, Carter and Maluccio (2003) explore how well households cope with shocks by examining the effects of shocks on child nutritional status. Unlike in the idealized village community, some households appear unable to insure against risk, particularly when others in their communities simultaneously suffer large losses. Households in communities with more social capital, however, seem better able to weather shocks.

The Ethiopian Case

Substantial efforts have been made to monitor the evolution of child malnutrition in Ethiopia (Central Statistics Authority's Rural Nutrition Survey (Addis Ababa, 1983, 1992); Health and Nutrition Survey (Addis Ababa, 1998); Welfare Monitoring Surveys (Addis Ababa, 1995–96, 1997, and 1999–2000)). The first striking observation is the sheer magnitude of child malnutrition in Ethiopia; the incidence of

underweight children has been consistently around 45%, much larger than the average incidence of 33% underweight children in sub-Saharan Africa in the nineties (Morrisson et al, 2000; World Bank, 2000; Christiaensen and Alderman, 2004). Similarly, surveys in Ethiopia have found more than half the children under 5 years old to be stunted, with stunting rates most often attaining more than 60% while the average prevalence of children stunted for 19 sub-Saharan African countries in the mid-nineties was 39% (Morrisson et al, 2000; Christiaensen and Alderman, 2004).

There are several possible explanations for the high rate of child malnutrition in Ethiopia. Household resources, parental education, and food prices are identified as key determinants of chronic child malnutrition in Ethiopia while maternal nutritional knowledge, and the community's diagnostic capability of growth faltering, also play an important role in the determination of child malnutrition (Christiaensen and Alderman, 2004).

Shocks are also found to negatively affect health status in Ethiopia. Making particular use of evidence from Ethiopia on the impact of droughts and other serious shocks Dercon and Hoddinott (2003) find that health status, as measured by height and body mass, is affected by these shocks. Similarly Yamano et al (2005) showed that income shocks, measured by crop damage, reduce child growth substantially, especially among children aged 6 to 24 months and suggested that the average value of food aid received in a community has indeed a large positive effect on early child growth.

Gilligan and Hoddinott (2007) studied the impact of food aid programs on household food security and welfare and, nutrition and found out that food aid programs such as general food distribution or food-for work have at most a small impact on food consumption or nutrition and often only a short-run effect on aggregate consumption while EGS programs and receiving free food raises growth in food consumption but negatively impacts food security; and suggest that food aid results in accumulated and persistent effects.

The studies cited hitherto unambiguously suggested that shocks can have a detrimental effect on child growth, but as long as there is some kind of social protection program effectively in place, the long term effects of shocks can be deterred. There is, however, a significant gap in the literature with regard to studies conducted in Ethiopia that relate children's nutritional achievements, the impact of economic shocks and the role played by social protection programs. This particular study intends to bridge this gap by investigating the effect of short and long-long-run effect of economic shocks on nutritional achievement of children amid with social assistance programs that existed more than a decade ago.

3. Method, data source and description of data

3.1. Econometric model

As indicator of child health production, child malnutrition (height for age and stunting) are analysed using an econometric model (described below) derived from a household's of utility maximisation subject to income and bilogicla health production constraints (Grossman, 1972a, b; Cropper, 1977; Rosenzweig and Schultz, 1983). The dependent variable is child's height-for-age (stunting). While the variables of interest are economic shocks that occurred before and after the birth of the child, various independent variables are used as controlling factors. Some of these variables are initial conditions such as height for age or stunting in round one, wealth index and household composition in round one. Lagged height-for-age is expected to help to capture lagged effects of health inputs and nutritional achievement. In order to make the model parsimonious, avoid the problem of endogeneity and have clear causal inferences, we used lagged variables (initial conditions) as explanatory variables for household wealth, education, and household compositions. Moreover, these variables are clearly exogenous variable in our setting as the dependent variable is nutritional achievement of five years old children who have not yet started to supply labour for the household that could influence household income. Shocks that hit the household before and after the birth of the child are included as these shocks affect health inputs and household income. Specifically the following three econometric models were examined with the objective of checking the robustness of results:

$$\Delta\left(\frac{H}{A}\right) = \beta_1 + \beta_2\left(\frac{H}{A}\right)_{t-1} + \beta_3 X_{t-1} + \beta_4 S_{t-4} + \beta_5 S_{t-8} + \varepsilon_t \qquad (3.1)$$

$$\Delta\left(Z\,score\,of\,\frac{H}{A}\right) = \beta_1 + \beta_2\left(Z\,scoer\,of\,\frac{H}{A}\right)_{t-1} + \beta_3 X_{t-1} + \beta_4 S_{t-4} + \beta_5 S_{t-8} + \varepsilon_t \qquad (3.2)$$

$$\Delta \ln H_t = \beta_2 + \beta_2 H_{t-1} + \beta_3 X_{t-1} + \beta_4 S_{t-4} + \beta_5 S_{t-8} + \varepsilon_t \qquad (3.3)$$

$$\left(\frac{H}{A}\right)_t = \beta_1 + \beta_2\left(\frac{H}{A}\right)_{t-1} + \beta_3 X_{t-1} + \beta_4 S_{t-4} + \beta_5 S_{t-8} + \varepsilon_t \qquad (3.4)$$

where H/A is height-for-age; H is height of the child in centimeters, H_{t-1} is lagged height of the child in centimeters; A stands for the age of the child in months; X_{t-1} lagged values of covariates other than those included in the regression; S_{t-4} is shocks at time t minus four years (shocks that occurred after the birth of the child) and S_{t-8} is shocks that occurred before the birth of the child (at most eight years before round two survey); β are parameters to be estimated, *t* is time, and ε is the error term. The shock variables (*S*) include drought, crop failure, breadwinners' illness, death of household members, theft, etc, while covariates (X_{t-1}) include household socio-economic characteristics such as household composition and household wealth. The

variables of interest are shocks that occurred before and after the birth of the child (i.e., S_{t-8} and S_{t-4}). In all regressions, we did not include age of the child as explanatory variable because the children considered in this paper are around the age same age (one year in round one and five years in round two) and hence there is little variation in age among the children. Moreover using the same set of independent variables, we run a probit model of probability of a child being stunted and severely stunted.

3.2. Data source and description of data sets

We used Young Lives data of the younger cohort combing data of round one and ro0und two. For the economic shock variables, we used data obtained from round one which are shocks that occurred before the child was born and those obtained during the second round survey which are shocks that occurred after the child was born. For the outcome variable, we used height for age, changes in height for age, changes on z score of height for age. As a robustness check we also run a probit model in which the dependent variables are stunting and sever stunting.

3.3. Description of variables

Wealth and asset indices. Table 3.1 presents levels and percentage changes of asset and wealth indices between two rounds. Wealth and asset indices were constructed using various assets and services households have access to. While wealth index are constructed from final wealth excluding assets used as inputs into production such as land, livestock and farm implements, asset index includes final wealth plus those assets used as inputs in production such as livestock, land, farm implements and other equipments used for non-farm activities. The two indices are constructed in such way to lie between 0 and 1 (see Appendix A for the detail of the construction of wealth and asset index). Both the wealth and asset indices have increased in round two compared to that of round one. The increments are statistically significant for both indices at less than one percent level although the magnitude of the change was higher for the wealth index than that of asset index. A comparison of the wealth and asset indices for urban and rural areas shows that there was a statistically significant increase in these indices in round 2 compared with round 1. Similar comparisons by region show that asset ownership as reflected by the asset index has increased in round 2 compared with round 1, but the result is not statistically significant for SNNP region in the older cohort sample. While a comparison of wealth index by region between the two rounds indicates a statistically significant increase for four of the five regions covered by the survey, a statistically significant decrease is observed for Tigray (Woldehanna et.al 2008), mainly due to a reduction in access in sanitation facilities and safe water, perhaps due to lack of maintenance of the services.

Table 3.1.Wealth and asset index by urban/rural and region

	Rural			Urban			Total		
	R1	R2	% change	R 1	R2	% change	R1	R2	% change
Wealth Index	0.08	0.13	60.39***	0.33	0.37	12.84***	0.18	0.23	25.42***
Asset Index	0.21	0.26	21.34***	0.12	0.16	26.93***	0.18	0.21	21.02***

% change refers to (R2-R1)/R1 times 100. Na=not available.

In our definition household with less than 0.2 wealth index are considered as extremely poor. The percentage of children living in households, in the young cohort, with wealth index below 0.2 decreased from 42.0 to 32.4 which represent an improvement over time by about 23 percent. This difference is statistically significant at less than 1 percent level. The differences are similar for the percentage of children living in households with asset index less than 0.2 with the change over time being slightly larger (about 29 percent) but still statistically significant at the 1 percent level (Table 3.1). A comparison of the percentage of children living in households below a wealth index of 0.2 by region also shows similar results except for Tigray where the difference was not statistically significant. The improvement is the largest for Addis Ababa (92.31%) compared with other regions and it is larger for urban areas (44.29%) compared with rural areas (16.21%). A similar comparison of asset index by location shows, however, that there was no statistically significant change for urban areas. Moreover, the percentage of children living in households with asset index below 0.2 has decreased for four of the five regions, the exception being SNNP for which the difference was not statistically significant (see Woldehanna et. Al., 2008 for details).

Malnutrition. We calculated the main statistics that is used in the literature to measure malnutrition among children, namely, height for age and stunting for the younger cohort (1 and 5 years old children). In order to measure nutritional achievements such as stunting, severe wasting and Z-scores of nutritional achievements of the one and five years old children, we used the recently developed table by WHO in 2007 (WHO, 2007; WHO Multicentre Growth Reference Study Group, 2006) based on Brazil, Ghana, India, Norway, Oman and USA as a reference population. We categorized children's' nutritional achievements into three based on the z-score values. Children with z-score greater than or equal to minus two are considered as normal child, that is, children not stunted, while children with z-score less than minus two reflect stunted and z-score less than minus three reflect severely stunted.

As can be seen in Table 3.2, stunting declined significantly, both in terms of magnitude and in the statistical sense as indicated by the t-tests. According to the statistics, the severe form of height for age has declined substantially. This is an impressive accomplishment in the span of time period elapsing between the two data collection periods, which can be attributed to improvement in wealth level of households and increased access to health services. One should, however, take note of the fact that these measures were quite high in round 1. Thus, what we observe could easily be one of recovery of child nutrition status.

When we observe, the split in terms of rural-urban residence of households, we see relatively larger percentage points of improvement for children living in rural

areas. However, caution should be taken in interpreting this result as well, since children living in rural areas started with a relatively higher incidence of malnutrition in round one. Moreover, the percentages for incidence of malnutrition are still higher in rural areas. Consequently, much needs to be done for rural children to catch up with their urban compatriots.

Table 3.2. Malnutrition among one and five years old children

	Total			Rural			Urban		
	R1	R2	% change	R1	R2	% change	R1	R2	% change
Stunted	34.84	31.33	-10.0**	41.34	36.41	-11.92**	25.03	23.65	-5.51
severely stunted	15.46	8.22	-46.80***	19.2	10.63	-44.64***	9.83	4.6	-53.19***

*R1=Round 1; R2=round 2; % change= ((R1-R1)/R1))*100;* *Significant 10, ** significant at 5%, and *** significant at 1%;

Except for female stunting (height for age z-score less than minus 2) showed an improvement for both genders that are more or less equal in magnitude (Table 3.3). The changes between the two rounds have also been statistically significant. Thus, the improvements in the nutritional status of children, whenever they occurred were not gender biased.

Table 3.3: Younger cohort: Changes in the proportion of children malnourished by gender of child

	male			Female		
	Round 1	Round 2	% change	Round 1	Round 2	% change
Stunted	0.39	0.33	-16.4***	0.3	0.29	-0.6
Severely stunted	0.18	0.08	-54.4***	0.12	0.08	-33.7***

*Significant at 10%, ** Significant at 5% and *** Significant at 1%

Table 3.4 reports the results for malnutrition outcomes by wealth index quartile among the younger cohort of the Young Lives data. Change in stunting showed insignificant changes between the two rounds) For the other outcome variables, the poorest 50% of the sample have attained improvements in the children's malnutrition status as indicated by the reductions in the percentages of children below the cut-off point of -2 and -3 z-scores. It is also important to note that in almost all the cases, except for the case of stunting to be precise, the percentage in the difference is larger for the poorest two quartiles (the poorest 50%).

Changes in malnutrition indicators between the two rounds for younger cohort of Young Lives children categorised by education level of household head are provided in Table 3.5. It may seem surprising to see that there is little, if any, change for these indicators where the household head has post-secondary education. On the other hand, children that were under the severe malnutrition category have shown statistically significant changes, in the improvement direction, for all household heads with lower than post secondary education including the illiterate ones. One should, however, take into account the fact that for households with heads having post-secondary education, the incidence of severe malnutrition was relatively smaller than the others in Round 1. Moreover, the proportion of this category in the whole sample was also small. All the forms of malnutrition (except for female stunting -- height for age z-score less than -2) showed an improvement for both genders that are more or

less equal in magnitude (Woldehanna et al. 2008). The changes between the two rounds have also been statistically significant. Thus, the improvements in the nutritional status of children, whenever they occurred were not gender biased.

Table 3.4 Changes in the proportion of stunted children between round 1 and round 2 by round 1 wealth quartile

	Quartile	Round 1	Round 2	% change
Height for age z-score < than – 2: (stunted)	1	0.43	0.43	0
	2	0.44	0.36	-18.2***
	3	0.32	0.29	-9.4
	4	0.2	0.17	-15
Height for age z-score < than -3: (severely stunted)	1	0.21	0.16	-23.8**
	2	0.2	0.09	-55***
	3	0.13	0.06	-53.8***
	4	0.08	0.02	-75***

*Significant at 10%, ** Significant at 5% and *** Significant at 1%

Table 3.5: Younger cohort: Changes in the proportion of children malnourished by education of household head (test changes for significance)

	Illiterate			Grade 1-4		
	R1	R2	% Δ	R1	R2	% Δ
Stunted	0.39	0.35	-8.4	0.38	0.33	-14.8
Severely stunted	0.17	0.10	-43.7***	0.16	0.09	-40.9**

*Significant at 10%, ** Significant at 5% and *** Significant at 1%; Δ= change

Economic shocks. Young lives survey has observed various economic shocks that affect household wellbeing during both round one and round two surveys. Those asked during round one survey are shocks that affect households five years before round one survey and hence these shocks are shocks that occurred before the index child was born. Shocks asked during round two surveys are those occurred after the child was born, but before round two surveys.

Table 3.6 and 3.7 presents the incidence of shocks that affect households before and after the child was born, respectively. The highest incidence of shock observed before the child was born was for decrease in food availability followed by crop failure and for urban areas job lose. Among those shocks that occurred after the child was born are drought, crop failure, pests and diseases.

In general the most serious shocks reported by the respondents that occurred before the child was born are (1) decrease in food availability; (2) crops failure; (3) death of livestock death, (4) severe illness or injury; (5) job loss/source of income/family enterprise; (6) birth of new household member, (7) death of household members. Although they have very little perceived impact on child welfare, crime, divorce or separation of family members, paying for child's education, and migrated of family members were also reported shocks that occurred before the index child was born. The shocks that occurred after the index child was borne are (1) illness and death of household members, (2) drought, (3) crop failure, (4) pests and diseases, (5) place employment shutdown or job loss, (6) natural disaster such as drought and flooding (7) divorce or separation of family, (8) death of livestock, (9) increased input prices, (10) decreased output prices, (11) theft and robbery, (12) having to pay for education, and (13) birth or addition of new household member.

Table 3.8 presents descriptive statistics of household composition for round one and round two surveys. The family size was 5.2 in 2002 during the round survey.

After 4 years the family size increased to 6.7. Table 3.9 and 3.10 present descriptive statistics of variables used in the regressions.

4. Results and discussion

We have estimated several versions of model specified in section 3.2 above to explain child nutritional achievement measured in terms of height for age, Z-score of height for age, stunting and sever stunting (see equation 3.1 to 3.4. above). In the estimation of the models, we used data of 1860 children of 4.5 to 5.5 years old of which 1119 are living in rural areas while 741 are living urban areas. Estimated results of equations 3.1, 3.2, 3.3 and 3.4 as well as probit regressions of stunting and severe stunting are presented in Table 4.1 to 4.6. As a robustness check the dependent variables are specified differently in these regressions. In equation 3.1, the dependent variable is change in height for age, while it is change in z-score of height for age in equation 3.2. In equation 3.3, we used change in natural logarithm of height. To check the results in levels, the dependent variables in equation 3.4 is specified as height for age in round two. In all regressions, we included initial height for age in the list of explanatory variables. To further check the robustness of our result, we run two probit regressions of stunting and sever stunting on the same set of explanatory variables as well as on initial stunting and sever stunting, respectively. The independent variables in all regression in equation 3.1 to 3.4 as well as in the probit equations include initial height for age (stunting or sever stunting), initial household level wealth index and initial household compositions (number of male and female household members separately for less than seven and above 65 years old, between 7 and 17 years old, between 17 and 65 years old, members). As a focus of the paper, we include events occurred before and after the child was born that were reported to have affected the household welfare negatively. The types of shocks occurred before the child was born which are included in the regression are (1) decrease in food availability; (2) crops failure; (3) death of livestock death, (4) severe illness or injury; (5) job loss/source of income/family enterprise; (6) birth of new household member, (7) death of household members and (8) divorce or separation of family members. Shocks that have very little perceived impact on household welfare such as crime, paying for child's education, and migrated of family members were not included in the regressions. The included shocks that occurred after the index child was borne are (1) illness and death of household members, (2) drought, (3) crop failure, (4) pests and diseases, (5) place employment shutdown or job loss, (6) natural disaster such as drought and flooding (7) divorce or separation of family, (8) death of livestock, (9) increased input prices, (10) decreased output prices, (11) theft and robbery, (12) having to pay for education, and (13) birth or new household member. We also included interaction of these shocks with the initial wealth index, however, non-of the interaction were found to have significant influence on the child nutritional achievements. The interaction variables increased the level of multicollinearity among the regressors measured by

condition index (Belsely et al., 1980) and variable inflating factor (VIF) following Gujarati (2003). Initially, we also included boys' dummy (to account for the gender of the child) as one of the explanatory variable, but we dropped later because the coefficients for boys' dummy was not statistically significant at any reasonable level of significance in any of the regression equations we estimated.

Since the types of shocks that affect households are potentially different for rural and urban areas, we did not intend to run the same model for rural and urban areas. However estimating separate equations for rural and urban areas will be inefficient if the pooled regression works well. Hence we had to conduct chow test before we estimate separately for rural and urban areas. According to the Chow test we conducted, we reject the null hypothesis that coefficient for rural and urban area the same at one per cent level of significant suggesting that we have to estimated the models separately for rural and urban areas[1].

Estimates of equation 3.1 to 3.4 are provided in Table 4.1 to 4.6 separately for rural and urban areas. For both rural and urban areas, the data fits quite well in the all OLS and probit regressions: about 99% of the variations in changes in height for age are explained by the explanatory variables in the model specified in equation 3.1. For equations 3.2 and 3.3 more than 50% of the variations are explained by the model. In the probit regressions, the Psedu R^2 is 11% and 14% for rural and urban areas, respectively. We have checked for multicollinearity, and heteroscedasticity, and omitted variable biased. After we tested for multicollinearity, we decided to drop the interaction variables, because it makes the condition index to be above 30 and the coefficients to be highly insignificant. After we dropped the interaction variables, we found condition index is 15.3 which according to Greene (2003) is tolerable. The variable inflation factor was 4.5 when interaction of shocks and wealth index variables are included in the regression. When we exclude these interaction variables, the variable inflation factor reduced to 2.2. In order account for hereosacedasticty, we estimated robust standard errors using site dummies as cluster variable. Using *stata* built-in command called Ramsey RESET test that regresses the squared residuals on powers of the fitted values of the dependent variable, we could not reject the null hypothesis that the model has no omitted variables indicating that the models we estimated do not suffer from omitted variable biases. As we can see in Table 4.1 to 4.6, for all models, we estimated two versions where version one includes all explanatory variables except the interaction terms and version two includes explanatory variables whose t-values are above or equal to one[2]. The interpretation of the results presented in this paper is based on version two estimates.

Although the focus of this paper is on economic shocks and children's nutritional achievement, it worth mentioning the other factors that affect childhood nutritional status such as initial nutritional status (height for age, stunting and severe

[1] For example for equation 3.1, the test statistics χ^2 is given by 67.2 which greater than the critical value with 29 degree of freedom at 1 % level. This indicates rejection of the null hypothesis that the coefficient for rural and urban area are the same.

[2] When explanatory variables with T-values below one are deleted, , it increases the adjusted R^2 and improve the model.

stunting), household wealth and household compositions. As expected height for age at the age of one year (initial nutritional achievement) has positive and statistically significant effect on height for age at the age of five years and negative and significant effect on the growth of height for age at the age of five implying that the effect of the early (initial) nutritional status increases late childhood nutritional status, but the increment declined over time and hence makes the effect transitory. The positive results of the effect of height for age at the age of one year on nutritional achievement of five years old children are supported by the result obtained from the stunting and sever stunting regressions. Stunting and sever stunting at the age of one year has positive and statistically significant effect on the stunting and sever stunting of children at the age of five years. These effects are substantial in magnitude and are consistent and similar for rural and urban children. The results in general imply that efforts to achieve better nutritional status of children should start early stage of child development perhaps at pregnancy and birth of the child.

The other factors found to affect nutritional achievements at the age of five years is initial household wealth (measured by wealth index). Consistent with many finding and previous Young Lives result (Alemu et al., 2005), for both rural and urban children, we found initial household wealth index have statistically significant and positive effect on height for age and change in height for age at the age of five years. The squared wealth index is found to have statistically significant negative effect on height for age and change in height for age at the age of five years indicating the effect of household wealth on nutritional achievement of children is non-linear. Consistent with this results are that wealth index negatively affects stunting and sever stunting at the age of five years for both rural and urban children. These effects are statistically significant at one per cent level for all children living in both rural and urban areas. However the square of wealth index was not found statistically significant for both stunting and sever stunting and for both rural and urban children. To check the robustness of the result, we replaced wealth index by asset index and the result is the same in that household asset index in round positively affect height for age and change in height for age and negatively affect stunting and sever stunting at the age of five years, while the effect of squared asset index is the opposite sign indicating again a non-liner effect.

We have included four kinds of household composition variables namely (1) number of people below the age of seven and above the age 65, (2) number of people between 7 and 17 years old, (3) number of male members between 17 and 65 years old and (4) number of female members between 17 and 65 years old. Among these four kinds of household composition variables, we found number of people between 7 and 17 years old have statistically significant and negative effect on height for age, change in height for age and stunting of children for rural children only. This signifies the fact that households with more number of dependents in the household will face significant resource constraints to feed children and improve the health of child. We did not find this variable to have statistically significant effect in urban areas although the sign of the effect is negative. The number of female family members between 17 and 65 years old are found to have positive and significant effect on height for age

and change in height for age of the five years old children in urban areas only. In rural areas this variable does not have significant and positive effects. The rest of the household composition variables were not found to have statistical significant effect on both heights for age and change in heights for age. Especially in sever stunting regression; none of the household composition variables are found to have any significant effect.

Coming to main focus of the paper, let us discuss the result in relation to economic shocks and children's nutritional achievements. Controlling for early (initial) nutritional achievements of children, and initial household wealth and compositions, we found that height for age, change in height for age are affected negatively (and stunting and sever stunting affected positively) by shocks that affects household before and after the birth of the five years old children (which are under consideration in this paper).

Economic shocks occurred after the birth of the five years old children. When we look at rural children, among those shocks that occurred after the child was born, natural disaster including drought, crop failure and pest and diseases have significant and negative effect on the height for age and the changes in height for age and positive effect on stunting of the five years old children. The effect of this shock on sever stunting is not statistically significant although the sign of the effect is positive. Unexpectedly, decrease in output price affected nutritional achievements of children positively and stunting and sever stunting negatively which are all statistically significant. Given many of the rural households in young Lives sites are poor and are perhaps net buyers of food, a decrease in output price may be a positive shock to many households instead of being negative economic shocks and as result had affected children's nutritional achievement positively.

In urban areas, we found only one economic shock namely dummy for divorce or separation of family to have a negative effect on height for age and change in height for age of five years old children. When we see stunting of the five years old children, it is affected by dummy for death of livestock, while sever stunting of the five years old children is not affected by any of the economic shocks that affect the household after the birth of the child.

Economic shocks occurred before the child (five years old children) was born. Relatively speaking, shocks that hit the household before the child was born are found more damaging to children than the shocks that affected the households after the child was born in both rural and urban areas. In rural areas, decrease in food availability, death of household members, divorce or separation of family affected height for age and change in height for age (including changes in z-score) negatively which are statistically significant. For stunting we found only decrease in food availability and divorce or separation of family that affected household before the child was born have negative and significant effect on the probability of a five years old being stunted, while we found the only shock that hit households before the birth of the five years old children that has a significant and negative effect on sever stunting of five years old child is divorce or separation of family. These results in general imply that the idiosyncratic shocks have long-term consequences on child

welfare due to the fact that the idiosyncratic shocks are not covered by any of the government and no-government social assistance programs. If the idiosyncratic shocks are not going to be covered by social assistance program, the current crisis such as unemployment and inflation will have consequence on the nutritional achievements and hence mental development of our future children and generations. Therefore, government and donors need to revise their assistance program to make idiosyncratic shocks be included in the assistance programs.

In urban areas, it is only crop failure that hit the household before the child was born that affect height for age and change in height for age of the child negatively, which is statistically significant. Unexpectedly, divorce or separation of families that hits the household before the birth of the five years old child affects child height for age and change in height for age positively, which is statistically significant, but requires further investigation. In general the results in this study suggest that rural children are more vulnerable to economic shocks than urban children. Therefore, government social assistance program designed to reduce household vulnerability to various shocks should focus mainly in rural areas. Perhaps the type of economic shock included in the survey questionnaire is mainly focused on rural areas and those shocks that affect urban households (such as inflation from which many Ethiopian urban households are suffering from general increase in cost of living since 2003) were not included. Therefore, further study on shocks in urban areas has to be conducted in order to examine the effects on nutritional achievement effect of other shocks which are not included in Young Lives questionnaire.

Given such result, the next questions is "what are the policy options that help improve the nutritional achievements of children or reduce malnutrition of children in rural Ethiopia?" As malnutrition is a question of household poverty or wealth and the highest effect on stunting is observed for household wealth, the first and most important policy option is increasing the wealth status of household substantially so as to reduce the incidence of stunting among children. Moreover, improving household wealth (income) will reduce households' vulnerability to various economic shocks which have short-term and long-term consequences on nutritional achievements of children. However, given the frequency of shocks especially area-wide shocks that hits rural and urban Ethiopia, it is unlikely that increasing income is the only option to reduce malnutrition in Ethiopia. In many cases household wealth itself is highly vulnerable to area-wide and idiosyncratic economic shocks. Over the last 15 years Ethiopia experiences area-wide economics shocks every four or five years. Not only poor, but also richer households are vulnerable to the area-wide economic shocks such as drought, insect and pests. Every year households are hit by various idiosyncratic economic shocks such as illness of household members, breadwinners and caregivers, as well as separation of family members or divorce. Surprisingly, substantial number of household (more than 50%) are vulnerable to these idiosyncratic economic shocks. Therefore, intensifying the social assistance program to effectively reduce households' vulnerability to both area-wide and idiosyncratic economic shocks seems the second option to reduce malnutrition of children in Ethiopia. To assess this latter option, we conducted a simulation exercise on the

effectiveness of reducing household vulnerability to area-wide only and to both area-wide and idiosyncratic economic shocks via intensification of social assistance programs in Ethiopia.

The first simulation exercise comes from the fact that government and non-governmental organizations can intensify the social assistance program to effectively reduce household vulnerability to area-wide shocks such as drought, insect, pests and diseases through increasing the resources to social assistance program such emergency relief, productive safety net and other food security programs such as resettlement and household food security package programs. Currently, about 63% of the Young Lives rural households are vulnerable to natural disaster such as drought, insect, pests and diseases. At national level, about 12% % of the households are vulnerable to drought (Woldehanna et al. 2008). If the effectiveness of social assistance program in rural areas increase, say, from the present 63% to 10%, the change in height for age among the five years old rural children will increase by 94% % of the initial (at the age of one year) height for age score and stunting of five years old rural children will be reduced from the present 36.4 % to 33.4 % while sever stunting will decline from 10.6 % to 8.7%. If, on the other hand, the social assistance become inclusive of idiosyncratic shocks such as illness of household member so as to reduce vulnerability of households from the present level of 7% to 5 % and unavailability of food from the present 50% to 10% through prop-poor health care financing, the change in height for age will increase by 99 percent and stunting of five years old children will change from the present 36.4 % to be 29.2 per cent, while sever stunting will decline from 10.6 % to 2.5%. This implies that although area-wide economic shocks such as drought are very important on which government need to focus more, the idiosyncratic shocks have considerable contribution to the improvement of children's height for age and consequently to the reduction of stunting and sever stunting in Ethiopia. Therefore, it is still worth if government assistance programs are inclusive of idiosyncratic shocks such as death and illness of household members (bread winners and caregivers) and separation of family or divorce.

5. Summary and conclusions

Using longitudinal Young Lives younger cohort data, we examine the effect of economic shocks on nutritional achievement of index children (five-year old children). The economic shocks considered are those occurred before and after the child was born. The data set used include round one and two survey data collected in the third quarter of 2002 and 2006, respectively. The most serious shocks reported by the respondents that occurred before the child was born are (1) decrease in food availability; (2) crops failure; (3) death of livestock death, (4) severe illness or injury; (5) job loss/source of income/family enterprise; (6) birth of new household member, (7) death of household members. Although they have very little perceived impact on

child welfare, crime, divorce or separation of family members, paying for child's education, and migrated of family members were also reported shocks that occurred before the index child was born. The shocks that occurred after the index child was borne are (1) illness and death of household members, (2) drought, (3) crop failure, (4) pests and diseases, (5) place employment shutdown or job loss, (6) natural disaster such as drought and flooding (7) divorce or separation of family, (8) death of livestock, (9) increased input prices, (10) decreased output prices, (11) theft and robbery, (12) having to pay for education, and (13) birth or new household member.

We control for initial nutritional achievements (at the age of one year), household wealth and household compositions when we analyzed the effect of shocks on nutritional achievement. We found that shocks that occurred before the child born have significant effects on the five year old children's nutritional achievements. In rural areas increased in output prices has positively associated with nutritional achievement of children and while reduction in household food availability, household head death, and divorce occurred before the child was born reduced children's growth. Natural disaster including drought that hit the households after the birth of the child reduced children's growth (nutritional achievement). In urban areas, only crop failure and job lose that occurred before the child was born and natural disaster including drought that occurred after the child was born reduced children's growth (nutritional achievements), while separation of mother and fathers and increase in input prices positively affect children's nutritional achievements. The same effect was found when we assess the effect of these shocks on stunting explaining the robustness of the result. The results in this study also suggest that rural children are more vulnerable to economic shocks than urban children and hence government social assistance program designed to reduce household vulnerability to various shocks should focus mainly in rural areas.

Simulation exercise indicate that dealing with the effectiveness of social assistance programs on recuing vulnerability of household to area-wide economic shocks such as drought are far more important, providing more additional focus on idiosyncratic shocks will also help reducing malnutrition of children in Ethiopia. Therefore, in order to improve children's' nutritional achievements, government and non-governmental organizations should intensity the provision of social assistance program such as emergency relief, productive safety net, household food security packages, and resettlement programs as well as provision of free health care faculties for the poor via the heath care financing strategy.

The fact that idiosyncratic shocks have long-term impact on child nutritional achievement tells that social assistance program should include not only area-wide shocks, but also individual idiosyncratic shocks if one wants to protect the future children from being affected by shocks. Therefore, government and non-governmental organizations in Ethiopia should revise their social assistance program to make it inclusive of idiosyncratic shocks that affect households frequently and consequently children.

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Appendix A. Wealth and asset indices

***D*efinition of wealth index**

An important variable in YL data is the wealth index, which attempts to measure the relative poverty status of households. The wealth index was constructed based on the following variables:

The number of rooms per person as a continuous variable;

1. A set of eleven consumer durable dummy variables, each equal to one if a household member owned a radio, fridge, bicycle, TV, motorbike/scooter, motor vehicle, mobile phone, landline phone, modern bed, table or chair, and sofa;
2. A set of three dummy variables equal to one if the house had electricity, brick or plastered wall, or a sturdy roof (such as corrugated iron, tiles or concrete);
3. A dummy variable equal to one if the dwelling floor was made of a finished material (such as cement, tile or a laminated material);
4. A dummy variable equal to one if the household's source of drinking water was piped into the dwelling or yard;
5. A dummy variable equal to one if the household had a flush toilet or pit latrine; and
6. A dummy variable equal to one if the household used electricity, gas or kerosene.

The wealth index captures variables that are broader than production assets, such as home ownership and the durability of that home, plus access to infrastructure such as water and sanitation. The construction of the wealth index is summarized in the following table.

Table Construction of the wealth index

Components of index and score	Contributing variables
H = Housing quality (/4)	Rooms/person, wall, roof, floor durability.
CD = Consumer Durables (/11)	Radio, fridge, bicycle, TV, motorbike/scooter, motor vehicle, mobile phone, landline phone, modern bed, table or chair and sofa.
S = Services (/4)	Electricity, water, sanitation, cooking fuel.
Wealth Index = (H+CD+S)/3	Range = 0.0 – 1.0

Method used to construct asset index:

The asset index is constructed in such a way that the possible values of the index are between 0 and 1, possibly inclusive. It is calculated so that the asset index for round 1 is comparable to that for round 2. The asset index is calculated as a simple average of the following five separate indices (each of which are between 0 and 1): livestock, land held, house owned, consumer durables owned and productive assets. These five indices are in turn calculated as follows.

1. Livestock owned: the livestock are classified into the following four groups, with the weights (tropical livestock units, TLUs) attached to each group indicated in parentheses: draught animals (1); cattle (0.7); sheep, goat and pig (0.15); and rabbit and poultry (0.05). For each of these four groups of livestock, the maximum number of livestock owned by a household in each cohort (and for both rounds) is also taken into account in the computation.
2. Land held: this index is calculated as the ratio of land owned by the household to the maximum land size owned by a household in each cohort (and for both rounds).
3. House owned: This is a dummy variable which is 1 if the household owned the house it lived in and 0 if it did not.
4. Consumer durables: This is calculated the same way it is calculated for the computation of wealth index. Thus, dummy variables for ownership of eleven items were assigned and the simple average of this variable is calculated.
5. Productive assets: There were two productive assets on which data exists about ownership in the two rounds. These are pump and sewing machine. We used dummy variables to identify those who owned the item (with a value of 1) from those who do not (with a value of 0). We also used the average prices reported for these items in the surveys as weights to calculate a weighted average.