Child Growth, Shocks, and Food Aid in Rural Ethiopia

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Abstract

Over the past decades child stunting in Ethiopia has persisted at alarming rates. While the country experienced several droughts during this period, it also received enormous amounts of food aid, leading some to question the effectiveness of food aid in reducing child malnutrition. Using nationally representative household surveys from 1995-96 and controlling for program placement, we find that children between 6 and 24 months experienced about 0.9 cm less growth over a six-month period in communities where half the crop area was damaged compared to those without crop damage. Food aid was also found to have a substantial effect on growth of children in this age group. Moreover, on average the total amount of food aid appeared to be sufficient to protect children against plot damage, an encouraging sign that food aid can act as an effective insurance mechanism, though its cost effectiveness needs further investigation.

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1. Introduction

Children that grow slowly experience poorer psychomotor development and interact less frequently in their environment (Grantham-McGregor et al., 1997). They 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. For example, Alderman et al. (2002) find that in Zimbabwe lowered stature as a pre-schooler 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.

Rural households in developing countries often live in risky environments, unable to protect their consumption against temporary income shocks such as droughts (Dercon, 2004). The available empirical evidence to date on the effect of such 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 (World Bank, 1993), further empirical investigation to quantify the magnitude of the effect of such shocks on early child growth is called for.

A common intervention to alleviate the effects of drought shocks is food aid, often motivated by explicit reference to its beneficial effect on child malnutrition. Ironically however, there is limited research on the effect of food aid on child growth (Barrett, 2002). The literature has so far mainly focused on food aid targeting, i.e. whether the poor are reached or not (von Braun, 1995; Sharp, 1997; Clay et al., 1999; Jayne et al., 2002), without examining the actual welfare effects of food aid for its beneficiaries. One notable exception is Quisumbing (2002) who finds positive effects of food aid programs on weight-for-height z-scores of children using panel data from Ethiopia.[1] Examining the effect of shocks and food aid on child growth is often complicated by the lack of sufficiently integrated data sets as well as the methodological difficulties in separating the causal effects of food aid on children's nutritional status from the reverse causality. Food aid programs are generally targeted to poorer areas and neglecting the endogeneity of program placement may lead to substantial underestimates of their effect (Rosenzweig and Wolpin, 1986; Pitt, Rosenzweig, and Gibbons, 1995).

This study addresses these challenges by integrating three different national surveys from Ethiopia conducted over the period 1995-96. To control for program placement effects, food aid allocations have been instrumented with past food aid needs assessments, long term rainfall patterns as captured by average rainfall and the coefficient of variation of rainfall, and rainfall shocks. Our empirical focus on Ethiopia is motivated by the alarmingly high pre-school child stunting rates which have persisted at around 60 percent since the early 1980s and are among the highest in the world (Christiaensen and Alderman, 2004). Yet, Ethiopia has received massive amounts of food aid over the past decades[2] often in response to severe droughts, which are a frequently recurring phenomenon. These facts have led some to question the effectiveness of food aid in reducing child malnutrition.

[1] Other related studies include Dercon and Krishnan (2003) who examine the extent to which food aid helps households smooth their consumption (as opposed to nutritional outcomes) in the face of negative income shocks while taking into account existing informal risk sharing arrangements. Their results, based on panel data from Ethiopia, indicate positive effects of food aid on consumption smoothing, though largely via intra-village risk sharing and not through direct targeting. Brown et al. (1994) and Webb and Kumar (1995) look at the relation between child malnutrition and participation in food for work programs. They find positive relationships but were unable to establish causality.

[2] About one fifth to a quarter of all food aid deliveries to Africa over the past decades has gone to Ethiopia, with food aid attaining up to 20 percent of domestic production in drought years (Jayne et al., 2002). According to World Food Programme estimates, Ethiopia has been the second largest recipient of food aid in the world for 1994-98 (after Bangladesh).

Our results indicate that crop damage has a large detrimental effect on early child growth (measured in height) with children aged 6 to 24 months experiencing about a 0.9 cm growth loss over a six month period compared to communities whose percentage of damaged crop area was 50 percentage points lower. We also find that food aid positively affects child growth, especially among the 6 to 24 months old who grew on average 1.6 cm faster in the food aid receiving communities than if no food aid would have been available. The empirical analysis further suggests that the total amount of food aid distributed is on average sufficient to offset the growth damage from the income shock. The paper proceeds by laying out the conceptual framework and our estimation strategy in section 2. Subsequently, the data are described in section 3. Determinants of food aid allocation are discussed in section 4, while section 5 examines the effect of food aid and income shocks on child growth, followed by our concluding remarks.

2. Conceptual Framework

As outlined in Foster (1995), Deolalikar (1996), and Dercon and Hoddinott (2004), by solving a general intertemporal household utility model defined over household consumption and child health including preference shifters (A) such as gender-based parental attitudes towards their children, and subject to an intertemporal budget constraint and a health production function, a child i's height at t+1 can be conceived as a function of its initial height, h_{it}, its household income, y_{it}, observed characteristics at the individual, household, and community level, X_{it}, as well as unobserved individual (e_{it}), household (u_{it}), and community (v_{jt}) characteristics:

$$h_{it+1} = f(h_{it}, y_{it}, X_{it}, e_{it}, u_{it}, v_{jt}, A). \qquad (1)$$

Household income, y_{it}, is determined by household characteristics including household assets, and community characteristics. Drought or insect related crop failure also affects income, especially among subsistence farmers who form the large majority in rural Ethiopia. Income can be defined as inclusive of transfers, including food aid. Unfortunately, we are not able to match our information on food aid and plot related shocks for each household with their children's growth. Instead, we use information on average amount of food aid received (F_{jt}) and average plot damage (S_{jt}) at the community level. Household income y_{it} can thus be written as:

$$y_{it} = y\,(S_{jt}, F_{jt}, X_{it}, u_{it}, v_{jt}). \qquad (2)$$

By substituting equation (2) into (1), a child i's height becomes:

$$h_{it+1} = f\,(h_{it}, S_{jt}, F_{jt}, X_{it}, e_{it}, u_{it}, v_{jt}). \qquad (3)$$

Plot damage is assumed to negatively affect household consumption, and thus child growth, especially when households are unable to insure their consumption from income shocks. Food aid is expected to have a positive effect on child growth by supplementing household income and increasing food consumption. Its effect on child growth will further depend on the intra-household allocation and thus age and gender preferences of the parents (A) regarding its children as well as the modality under which it is distributed—free distribution (FD) or food for work (FFW). When food aid is freely distributed, as is mostly the case in our sample, it also frees up time and energy for child care, another important input in child growth (Engle et al., 1999). This would suggest that free food aid may have a larger effect on child growth than an equivalent amount of food for work. In addition, depending on the degree of market integration, food aid may have an indirect positive effect on child growth by lowering food prices.

The effect of food aid on child growth is of course contingent on the amount a household receives, i.e. the targeting rules of the food aid program. For example, if allocated in response to household income shocks ($F_{jt} = F(S_{jt})$), food aid may also mitigate the negative effect of income shocks. While the theoretical literature on targeting has devised optimal allocation rules given information constraints (Besley and Kanbur, 1988; Besley, 1997), the actual allocation of food aid is often the combined result of a host of factors including considerations of optimal targeting, but also spatial inertia in program operations due to fixed operational costs (Jayne et al., 2002), and the political economy of resource allocations at the national and regional level. Yet, different political economy theories predict quite different allocation rules. According to altruism theories of public transfers the least endowed ought to receive the highest transfer (Roberts, 1984), while pressure group theories predict that groups small in number and with considerable resources for lobbying take the highest share of public transfers (Becker, 1983). Thus, in practice, whether and how much food aid a household is likely to receive is mostly a context specific matter which needs to be empirically determined.

From equation (3), we derive an estimable growth equation:

$$h_{it+1} - h_{it} = \beta_h h_{it} + \beta_F F_{jt} + \beta_S S_{jt} + \beta_X X_{it} + e_{it} + u_{it} + v_{jt}. \quad (4)$$

However, food aid may be directed to those areas where child malnutrition is high, potentially leading us to underestimate its effect ($E(F_{jt}, v_{jt}) \neq 0$). To overcome the food aid program placement problem, we use the average food-aid-need assessments in 1984-88 (that is, up to 11 years before the period being studied), its squared term along with rainfall related variables capturing both chronic needs as well as actual shocks, as instruments to predict the quantity of food aid received. Given the inertia involved in the location of food aid programs as a result of high fixed start up costs, earlier needs assessments during the second half of the 1980s have been observed to be good predictors of future food aid in Ethiopia (Jayne et al., 2002). The selection of the instrumental variables is discussed in more detail in Section 5.

To examine the potential differential effect of free food aid distribution (FD) and food for work (FFW) the predicted amounts received of each kind are also separately included in the child growth regression ($\beta_F F_{jt} = \beta_{FD} F_{FDjt} + \beta_{FFW} F_{FFWjt}$). The presence of intra-household gender differentiation is explored through the inclusion of interaction terms of the sex of the child with the shock variables.

3. Child Growth, Food Aid and Crop Failure in Rural Ethiopia

Over the period 1995-96, a series of three nationally representative household surveys were conducted in Ethiopia as part of the Rural Integrated Household Survey Program. We integrate information from these surveys either at the household level or the enumeration area (EA)/community level. Anthropometric information on pre-school children is provided by the 1995/96 Welfare Monitoring Survey (WMS), which covered 12 randomly selected households in each EA/community. In this survey, 2,414 rural children under 5 years old were measured twice with a 6 months interval.[3] After excluding cases with more than 12-month age difference reported, negative height growth, more than 25 cm growth in six months, and a HAZ-score beyond the [–6, +6] range, 2,089 children remained spread over 469 EAs out of a total of 531 EAs.[4]

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[3] While 5,012 children under 54 months old were measured during the first round, only 2,414 were measured again during the second round. Because of a large number of children who were measured only once, we have tested for attrition biases, following Fitzgerald, Gottschalk, and Moffitt (1998) and Alderman et al. (2001). Since all children have an initial height we were able to test for the influence of unobservable differences in the sample in the base period. This test confirmed that the group with subsequent attrition is on the same nutrition production function as the rest of the sample. Further investigations indicated some reasons for attritions, such as a lower rate of follow up among children near the age cut off and miscoding child IDs across rounds. No large mortality rates among children or migration were reported during the few months between surveys. Therefore, it seems the reasons for attrition are not self-selection in nature and attrition bias is not a serious concern in our data.

[4] Those excluded are less likely to be in peri-urban areas, less likely to have an educated farther, less likely to come from a household that owns land, and more likely to be older. Other variables, including the EA-level food aid and crop damage variables, are not significantly correlated to the probability of being excluded due to unreasonable measurements.

The Food Security Survey (FSS) was conducted on a sub sample of the WMS (7 out of 12 households) and collected recall information on the amounts of food aid received by each household. The 1995/96 Annual Agricultural Sample Survey (ASS) covered a larger set of households in each community (25 in total, including those covered in the WMS) and collected information on crop damage on each plot during the 1995 Meher (main) season. As the plot size of each plot was physically measured, we could calculate the proportion of plot area damaged for each household. In the absence of appropriate common household identifiers, we merged the ASS and FSS with the WMS at the EA level. In particular, we proxied per capita household food aid availability and the proportion of plots damaged per household by their respective community averages.

About one in five communities (116 out of 531 communities) received food aid between June 1995 and January 1996 (Table 1). Of those communities receiving food aid, 53 percent reported using this aid exclusively for FD, 21 percent only for FFW and 27 percent had both types of distribution. Communities that received food aid in this period were assessed to be more in need of food aid during the 1984-88 needs assessments, compared to those that didn't. They experienced lower rainfall on average as well as higher variation in their rainfall patterns as captured by the coefficient of variation. These findings suggest that food aid allocations are somewhat targeted to chronically poor communities although the allocations may also suffer from inertia. Finally, communities that received food aid were also observed to be poorer in 1995/96 as reflected by their lower average household expenditure per capita.

Food aid programs appear also targeted to communities that experienced crop damage in the 1995/96 Meher season. The average percentage of damaged crop areas was about 30 percent in communities with food aid, while it was only 16.7 percent in communities without food aid. Most of the damage was caused by rainfall shocks (mostly droughts), though a non-negligible proportion (about 1/3) of the damage was related to insect attacks and crop diseases. Comparing shock incidence in communities with and without food aid, it appears that food aid was especially responsive to droughts (and flooding) though not to (idiosyncratic) insect attacks or crop diseases. The 1995 rainfall shock (registered at the Woreda[5] level and measured as the deviation from its long-run mean) appears not to differ between communities with and without food aid.

To explore the relationship between child growth and food aid, we plot child growth (in cm) over the six-month interval against child age at the first measurement (Figure 1), both for all children (426) in the food aid receiving communities as well as for those (1,663 in total) in the non-food aid receiving communities. The observed pattern reflects normal growth curves, i.e. growth velocity declining by age. More strikingly, we also find that, in general, children in food aid receiving communities grow faster than children in communities without food aid, especially those below two years old. Consistent with Figure 1, we find that 6 to 24 months old children grew about 0.41 cm faster in communities with food aid compared to those without, although the difference is not statistically significant (t-stat = 1.28). We do not find any difference in growth among children aged 25 to 60 months old children (Table 2).

Following common child growth specifications (Deolalikar, 1996; Hoddinott and Kinsey, 2001), other variables in our regressions include the individual child, household and community characteristics. The descriptive statistics are reported in Table 3. We control for individual child characteristics by including initial height, gender of the child, and child age. We use the community level expenditure (net of food aid) as a proxy to control for chronic poverty/income at the community level.

[5] A Woreda is the second lowest administrative unit in Ethiopia and corresponds to what is commonly known as a district in other countries. There are about 560 Woredas in the country.

Household characteristics included in the model are mother's age, educational information on household members, gender of the household head, the composition of the household, household assets, and the source of drinking water. We proxy the educational status of the household by using the highest grade attained by the most educated male and female adult in the household, as opposed to education of the parents, to capture potential intra-household externalities from education. These are especially important when education levels are low (Basu and Foster, 1998; Gibson, 2001). While the highest grade attained by the most educated male adult in the household is twice as large as the highest grade attained by the most educated female adult, at an average of 2.3 grades for the most educated male adult per household educational attainments in Ethiopia are extremely low.

Nearly all households report owning land, and about 60 percent possessed a plough. Yet, less than 20 percent of the households possess a radio, a sign of widespread poverty; and only one in five households reports ownership of animals. About 15 percent of the households have access to a tap for drinking water. Dummy variables for peri-urban areas, availability of a tarmac road in the zone[6] as well as elevation, a proxy for malaria infestation[7], capture some important location characteristics for child growth. About 17 percent of the children in our sample live in peri-urban areas and slightly more than half of the children live in zones with a tarmac road. Finally, we include 9 Killil dummies to control for other spatially correlated characteristics such as food prices, the presence of development programs, and quality of service delivery.

[6] There are about 55 Zones in Ethiopia which is the administrative unit between the Woreda (district) and the Killil (the largest administrative unit).

[7] Malaria is virtually absent in most of the Ethiopian highlands.

From the descriptive discussion (Table 2) it appears that our key variables of interest, shocks and food aid, may have differential effect according to child age. Consequently, we estimate separate child growth regressions both for children younger and older than two years old. We begin however by examining the determinants of food aid reception.

4. Food Aid Allocation in Rural Ethiopia

Our main interest here is in determining the responsiveness of food aid allocations to income shocks, which combined with the effect of food aid on child growth (discussed in the section below), permits us to analyze how effective food aid is in mitigating the effect of shocks on child growth. A more detailed discussion of the food aid allocation rules in rural Ethiopia has been provided by Jayne et al. (2002) and Dercon and Krishnan (2003).[8] The dependent variable is the community's total per capita value of food aid received (whether used for FD or FFW) between the first and the second survey round, which comprises up to eight months. Because only one fifth of the sampled communities received food aid, we use Tobit models.

The results in Column A, Table 4, indicate that the EA-level per capita expenditure (excluding food aid) is negatively correlated with food aid. But the results also indicate that, even after controlling for the current expenditure level, proxies of inertia/chronic poverty (Z) are important determinants of food aid distribution. In particular, the food aid needs assessments during 1984-88, which encompasses the major 1984/85 famine, have a significant positive effect on the amount of food aid received by communities. This may indicate that communities that were considered vulnerable in 1984-88 are still vulnerable and in need of food aid in 1996.

[8] To examine the food aid allocation rules we augmented the data set used by Jayne et al. with more disaggregated rainfall data covering a much longer time period than used in the earlier study.

Alternatively, this may also reflect inertia in food aid programs due to high fixed costs related to program establishment leading to a high degree of spatial continuity in food aid allocations with the current spatial pattern of food allocations still reflecting the geographical allocation set up in response to the 1984/85 famine. The empirical evidence presented by Jayne et al. (2002) favors the latter interpretation. We return to this in the empirical analysis below.

An important proxy of chronic poverty is the coefficient of variation for rainfall, especially in rural Ethiopia which largely depends on rain-fed agriculture. Not only may high rainfall variability instigate farmers to adopt low risk, low return production technologies, trapping them into chronic poverty, but rainfall variability is also negatively correlated to long run average rainfall.[9] In other words, the depressing effects of low average rainfall on living standards are exacerbated by increased uncertainty. The larger the coefficient of variation, the larger the amount of food aid received in the eight-month period. Since the coefficient of variation is distinct from the current shock, the significance of this variable should be interpreted in terms of long run conditions in the communities.

We also find that food aid programs are responsive to crop damage, represented by the ratio of damaged plots in the community. We do not observe an additional response to rainfall shocks, represented by the 1995 rainfall shock.[10] However, the amount of food aid delivered in response to shocks seems small compared with the amount of food aid determined by the inertia/chronic poverty measurements. When decomposing the average predicted value of total food aid per capita (5.92 Ethiopian Birr over eight-months) into food aid allocated in response to

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[9] Pearson correlation coefficient = -0.4 and statistically significant at the 1% level.

[10] If we exclude crop damage and re-estimate the food aid regression, the 1995 rainfall shock remains insignificant, though when combined with the interaction term with the needs assessment in 1984-88 they are jointly significant at the 10 percent level.

inertia and chronic poverty and food aid allocated in response to shocks[11], we find that the lion's share of all food aid (87 percent =(5.17/5.92)*100) has been allocated in response to inertia and chronic poverty (as well as the other community characteristics), and that only a small part (13 percent = (0.75/5.92)*100) has been allocated in response to shocks. While these results may partly follow from the fact that only 20 % of the crop area was damaged,[12] they are in keeping with Dercon and Krishnan (2003) who also report a limited response of food aid to shocks in their purposively selected sample of 15 villages in Ethiopia surveyed three times between 1994 and 1995. Nonetheless, to judge how effective food aid is in mitigating the effect of shocks on child growth, we also need to know how food aid reception and plot damage affect child growth. We revisit this issue in section 5, which discusses the empirical results on the effect of the different child growth determinants on child growth.

When looking at the determinants of free food aid and food for work allocations separately[13] (Table 4 columns B and C respectively), we find that while free food aid has been allocated both in response to the current expenditure level, chronic needs, shocks, food for work allocations seem solely determined by the chronic needs criteria, especially the coefficient of variation for rainfall. This would suggest that in practice food for work programs have been

[11] The amount of food aid determined by inertia and chronic poverty has been estimated by setting all shock variables (S) and interaction terms with the shock variables (S x P) equal to zero. The amount of food aid responding to the shocks has been predicted based on the shock variables and its interaction terms. The latter were included to examine if the responsiveness of the food aid distribution system to shocks depends on the inertia of the system, which was not supported by the data.

[12] Doubling the plot damage ratio to 40 percent, increases the percentage food aid allocated in response to shocks to 24.4 percent.

[13] The sum of the number of EAs that received food aid in both regressions exceeds the total number of EAs with food aid in our sample because some EAs used food aid both for free food distribution and food for work. In these EAs, we calculated the average per capita value of each type of food aid.

largely set up to address chronic food insecurity, while free food aid may serve a limited insurance function. Yet, further investigation is needed, as experience in the sample studied by Dercon and Krishnan (2003) seems to suggest the opposite.

When we estimate the effects of food aid on child growth, we use some variables in Table 4 as instrumental variables. Those variables include all of the inertia/chronic poverty measurements (Z), the 1995 rainfall shock, and its interaction term with the needs assessment in 1984-88. We assume that these variables are correlated with the amount of food aid, but that they are not direct determinants of child growth. We present supportive evidence below.

5. Estimated Effects of Shocks and Food Aid on Pre-School Child Growth

The results on child growth in Table 5 show that children aged 6 to 24 months old are quite vulnerable to shocks, consistent with findings by Hoddinott and Kinsey. A 10 percentage-point increase in the proportion of damaged plot areas within a community corresponds to a reduction in child growth by 0.12 cm over a six months period (column A). Because the average growth rate among this age group is 6.68 cm, a 0.12 cm decline represents a 1.8 percent reduction in growth.

When we add food aid variables to the growth models, columns B-C,[14] the coefficient on plot damage increases (from –1.213 to –1.763) as does the precision of the estimate. This suggests that food aid mitigates the negative effect of plot damage on child growth. When the food aid variable is excluded (column A), the estimated coefficient on plot damage not only picks up the (negative) effect of plot damage but also the (positive) effect of food aid on child

[14] While we also control for food aid in model D, the latter model is applied to a restricted sample, i.e. excluding those communities that distribute food aid both through FD and FFW. As a result, the coefficient on damaged plot areas is not strictly comparable with those in models B and C, even though the size, sign and statistical significance are very similar.

growth because areas with plot damage are more likely to receive food aid, as indicated in Table 4. Thus, by controlling for food aid programs in columns B-C, we are able to isolate the full effect of plot damage.

Food aid has a positive effect on the growth of children between 6 and 24 months old and the positive effect of food aid on child growth more than doubles (coefficient increases from 0.028 to 0.070), when we control for program placement effects through use of instrumental variables (column C). As discussed previously, the instrumental variables are Woreda-level variables on the inertia/chronic poverty measurements (Z), the 1995 rainfall shock, and its interaction term with the needs assessment in 1984-88. These variables are merged with the other variables in the child growth model at the community level and included in the instrumental variables model as instruments. Recall that we include community average per capita expenditures (excluding food aid) thereby controlling for chronic poverty at the community level. The F-tests on the instruments in the first stage regression presented at the bottom of Table 5 clearly show high predictive power. The instruments also pass the over-identification test (Wooldridge, 2002) for each IV model providing additional confidence in the validity of our identifying variables.[15]

Two key messages emerge from these results. First, the substantial change in the size of the coefficient on food aid—the coefficient increases by 150 percent—when instrumenting the food aid allocations, underscores the importance of controlling for program placement in examining the effect of food aid on individual welfare. This is consistent with our expectations since food aid programs appeared to be located in communities with poor child nutrition and

[15] The chi-square statistics are 10.8 for children aged 6 to 24 months and 8.6 for children aged 25 to 60 months. Both are below the 5 percent critical value in the chi-square distribution with the degree of freedom of six.

growth (Table 1). It is also in line with Pitt, Rosenzweig, and Gibbons (1995), who reported increases of up to 100 % in the estimated effect of public programs on human development outcomes when accounting for program placement. Second, the effect of food aid on child growth among 6 to 24 months old children in our sample is considerable. Children in communities who received food aid grew on average 1.6 cm (0.070 times 22.5 Ethiopian Birr) faster in a six-month period than if no food aid would have been available.[16]

We further investigate if the effects of food aid programs differ by the modality of food aid utilization (Table 5, column D). To do so, we predict both types of food aid separately with the same set of instrumental variables (proxies for inertia and chronic poverty measurements (Z), the 1995 rainfall shock, and its interaction term with the needs assessment in 1984-88) using the instrumental variable procedure. We also restrict the sample to communities that do not have dual use. Given that our food aid variables are matched with individual child growth at the community level, inclusion of communities that use food aid for both purposes may confound the estimation of the differential effect of FD and FFW. Application of model C to the restricted sample yields very similar results as those obtained from the full sample, apart from the coefficient on total food aid,[17] permitting us to use the restricted sample for examining the differential effect of both uses of food aid.

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[16] Recall from Table 1 that the average value of food aid received among the food aid receiving communities was 22.5 Ethiopian Birr.

[17] The coefficient on the value of food aid received in the restricted sample (=0.100) is larger than in the full sample (=0.070), as presented in Appendix Table A1. However, when separately predicting the value of FD and FFW received using the restricted sample (column D), the weighted average of both coefficients corresponds to the coefficient on the value of total food aid with the restricted sample, providing confidence that we can use the restricted sample for exploring the differential effect on child growth of both types of food aid.

The results indicate that both uses have positive effects on child growth, though the effect of free distribution is smaller and more precisely identified[18] than the effect of food for work. While one might expect the opposite—FFW having a smaller effect on child growth given its demands on the participants' time and energy—the result may suggest better targeting of FFW to the needy households compared to FD. Both Jayne et al. (2002) and Dercon and Krishnan (2003) indicate that food for work in Ethiopia is better targeted to poorer Woredas and villages compared to free food, but within the Woreda and the villages, free food seems better targeted than food for work. While our results suggest that the combined effect ultimately results in better targeting of food for work to the needy compared to free distribution, more in depth analysis of the differential effect of both types of food aid on child growth is needed.

Inclusion of an interaction term between the ratio of damaged plot area and the gender of the child (boy=1), indicates that on average intra-household dynamics tend to favor girls in protecting children under two from income shocks. The coefficients on the interaction term (-2.06) and the damage variable (-0.81) are jointly significant (F-test=4.38) and clearly suggest that the growth of very young boys suffers much more from income shocks than the growth of very young girls. This result—which is also borne out by other evidence from Ethiopia (Christiaensen and Alderman, 2003) —is in keeping with Svedberg (1990) who finds that boys are more malnourished in Sub Saharan Africa. Other noteworthy results include the importance of female formal education for child growth; each completed grade of the most educated female adult in the household yields an additional 0.16 cm growth. In addition, the coefficient on initial

[18] The poorer identification of the effect of food for work may be related to the weaker correlation between the instruments and the value received from food for work. The F-statistic on the instruments for the value received from food for work is 4.38, while the F-statistics on the instruments on the value received from free distribution, 18.3.

height (-0.25) suggests only limited catch up growth. However, the latter result must be interpreted with caution as initial height may be endogenous, an issue to which we return below.

The results on the child growth of children aged 25 and 60 months old are similar to the results on children aged 6 to 24 months, but less precisely estimated (Table 6). The coefficient on the plot damage variable has a negative sign and its size increases as we control and instrument for food aid—as in the case of younger children—though in none of the models (A-D) is it statistically significant. The size of the estimated coefficient is also much smaller. This is consistent with other studies (Martorell, 1999; Jensen, 2000; Hoddinott and Kinsey, 2001) that find children between 12 and 24 months to be especially vulnerable in the face of income shocks. Similarly, the estimated coefficient of the food aid variable has a positive sign when food aid is instrumented, though, again, it is not statistically significant. The point estimate of the coefficient (0.045) is also smaller than the one found among younger children (0.070).

We check the robustness of our findings regarding the effects of food aid and shocks on child growth in two ways (Table 7). First, thus far, we have considered the initial height of children as exogenous, though it could be correlated with unobserved child characteristics, which may contaminate our estimated coefficients of interest as well as the others. As it is very difficult to find plausible instruments that are correlated with initial height (a state variable) but not with child growth, we examine the robustness of the estimated coefficient of food aid by excluding the initial height (columns A and B in Table 7). Our estimated coefficients of interest are similar to the ones reported in Tables 5 and 6. We also find these coefficients to be robust when instrumenting children's initial height by their initial weight (results not reported), which corrects for measurement error though not for endogeneity.

Second, we apply instrumental variables on the damaged plot areas. Because the plot damage information is based on farmers' subjective measurements and because some plot damages might be mitigated in a manner that is also correlated with a farmer's managerial ability and overall access to information, communities with a large proportion of their total plot area damaged might also be communities with poor health management. That is, the damaged plot areas might be correlated with unobserved community characteristics that also affect nutrition. This may cause bias in the estimated effect of food aid and shocks. To examine the robustness of our findings, we treat the damaged plot areas as an endogenous variable by applying the same set of instrumental variables used on the food aid variable. The results are in Table 7, columns C and D. The point estimate on plot damage remains similar to that reported in table 5, though the t-statistic declines. The coefficients of the food aid variable are stable.

Given this stability, we can use the results in Table 5, column C, to examine how effective food aid is in protecting child growth from plot damage shocks. The marginal response to plot damage in Table 4 shows that each percentage point of plot damage would result in 0.38 Ethiopian Birr food aid per capita, which in turn augments child growth by 0.38*0.070 (Table 5, Column C) = 0.027 cm. Given that one percent of plot damage is associated with –0.018 cm less growth, the total amount of food aid available is on average more than sufficient to fully mitigate the plot damage.

6. Summary and concluding remarks

Using three nationally representative surveys conducted during 1995-96, we 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 about 0.9 cm growth over a six-month interval when half of their crop area is damaged. 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.

Food aid has often been procured in response to shocks and has been motivated by its beneficial effect on child malnutrition. This depends, of course, critically on the allocation rules and the marginal effects of food aid on child growth. Our empirical results indicate that the average value of food aid received in a community has indeed a large positive effect on early child growth. The results further underscore the critical importance of controlling for program placement effects to properly estimate the effect of food aid on child growth.

In addition, based on the empirical targeting rules derived from the data, the total amount of food aid appears on average sufficient to offset the negative effects of plot damage on child growth. This result is encouraging as it indicates that overall food aid can indeed be used as an effective mechanism for protecting early child growth from droughts and other income shocks. Yet, at the same time child stunting has persisted at alarming levels over the past decades, despite massive amounts of food aid, and despite its apparent responsiveness to shocks, pointing to the endemic nature of poverty in Ethiopia. Also, further analysis is necessary to determine how cost effective food aid is compared to other insurance programs such as for example rainfall based insurance.

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Figure 1. Child Growth in Height (cm) in a Six-Month Period and Food Aid

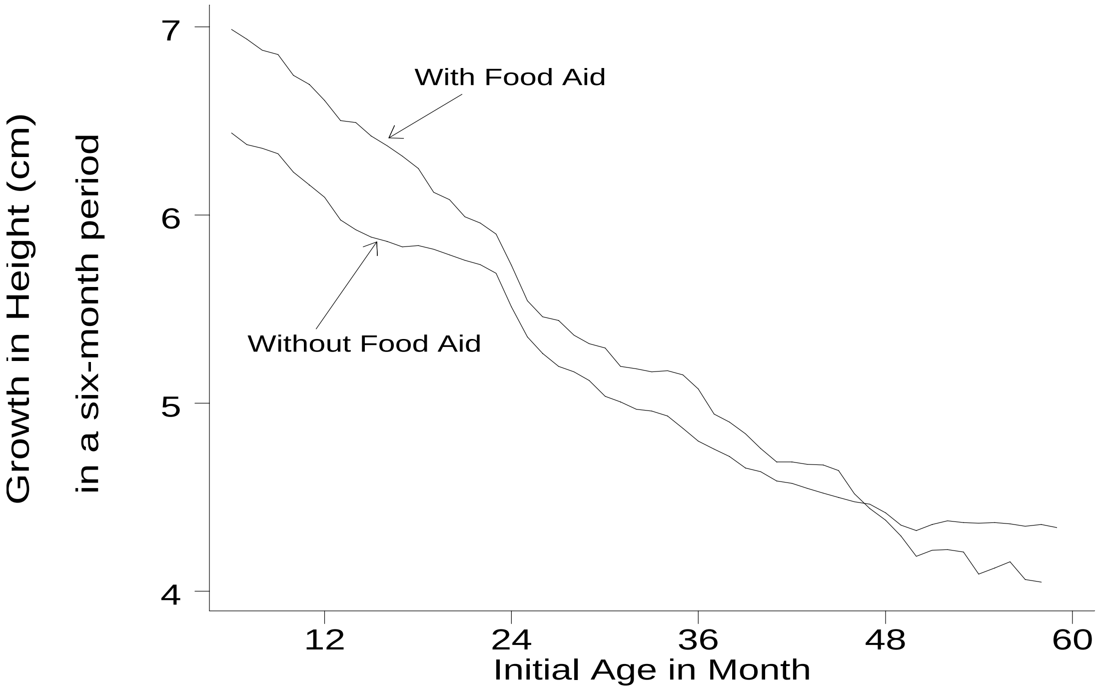

Table 1: Food Aid Distribution and Plot Damage at EA Level(A)

	EA with Food Aid	EA without food aid	Total
Number of EAs	116	415	531
Annual Expenditures Per Capita(Birr)	852	1,111*	1,054
	(513.3)	(1,172)	(1,069)
Per Capita Food Aid Received in Birr (June 1995–January 1996)	22.5	0.0**	4.97
	(32.7)	(0.0)	(18.0)
Inertia/Chronic Poverty Measures (A)			
Needs assessments in 1984-88	0.288	0.089**	0.133
	(0.248)	(0.160)	(0.200)
Long-run Average Rainfall (in mm) (1967-2001)	866.3	1017**	984.1
	(271.4)	(262.4)	(271.4)
Coefficient of variation of rainfall (1967-2001)	0.324	0.267**	0.280
	(0.126)	(0.108)	(0.114)
Shocks			
Ratio of damaged plot area within EA	0.302	0.167**	0.197
	(0.266)	(0.175)	(0.206)
Break down by causes of damage			
Too little rain	0.164	0.061**	0.084
	(0.262)	(0.130)	(0.173)
Too much rain	0.072	0.036**	0.044
	(0.12)	(0.072)	(0.087)
Crop disease/insect problem	0.087	0.079	0.081
	(0.116)	(0.116)	(0.112)
1995 Rainfall Shock (mm) (=1995 Rainfall – Long-run average)	0.207	-3.656	-2.812
	(18.4)	(22.6)	(21.8)

Note: Numbers in parentheses are standard deviations. In 1996 1US$ equals about 6.5 Ethiopian Birr.
* and ** indicate a statistically significant difference at the 5 and 1 percent level respectively on a particular attribute between communities with and without food aid.
(*A*) Long-run average rainfall, coefficient of variation of rainfall, and 1995 rainfall shock are measured at the Woreda level.

Table 2. Child Growth in Height by Food Aid in Rural Ethiopia

	Children Aged 6 to 24 months	Children Aged 25 to 60 months
	(A)	(B)
Number of Children		
All	1,083	1,006
No Food Aid (F=0)[A]	862	801
Food Aid (F=1)[A]	221	205
Growth in Height (cm)		
All	6.68	5.48
	(4.27)	(4.04)
No Food Aid (F=0)[A]	6.78	5.49
	(4.25)	(4.15)
Food Aid (F=1)[A]	7.19	5.44
	(4.33)	(3.57)
Difference (Yes-No)	+0.41	-0.05
[t-statistics]	[1.28]	[0.16]

Note: Numbers in parentheses are standard deviations, and numbers in brackets are absolute t-values.

(A) *No Food Aid* includes children who live in enumeration areas (EAs) where no food aid program was available in June 1995 to January 1996 (a period between the first and second surveys). *Food Aid* includes children who live in EAs where at least one food aid program (free distribution, food for work, or both) was available June 1995 to January 1996.

Table 3. Socio-Economic Determinants of Child Growth in Rural Ethiopia

	Children aged 6-24 months		Children aged 25-60 months	
	Mean	S.D.	Mean	S.D.
Child Growth				
Growth in height in six months (cm)	6.68	4.27	5.48	4.04
EA Level Food Aid				
Per capita food aid received (birr)	3.7	11.5	3.1	10.3
PC food aid from Free Distribution	2.8	10.4	2.2	9.3
PC food aid from Food for Work	0.9	4.0	0.9	3.7
EA Level Variables				
Damaged Plot Areas (ratio)	0.21	0.20	0.21	0.20
Per capita expenditure (net of food aid)	1,104	1,159	1,081	1,034
ln(Per capita expenditure)	6.79	0.57	6.80	0.53
Child Characteristics				
Initial Height	67.2	7.7	85.2	7.6
Gender (boy=1)	0.47	0.50	0.54	0.5
Age in Months	13.5	6.6	38.7	8.9
Household Characteristics				
Mom's Age in years	28.60	6.94	30.68	7.28
No Mother Info (No info=1)	0.03	0.17	0.05	0.22
Max Male Education (Years)	2.16	3.48	2.45	3.75
Max Female Education (Years)	1.13	2.68	1.24	2.95
Female headed households	0.11	0.31	0.11	0.32
Number of Men	1.24	0.76	1.32	0.82
Number of Women	1.30	0.61	1.32	0.62
Number of Children age 6-14	1.52	1.32	1.71	1.33
Ownership: land	0.93	0.25	0.91	0.28
Ownership: Plough	0.60	0.49	0.59	0.49
Ownership: Animals	0.19	0.40	0.22	0.41
Ownership: Radio	0.17	0.37	0.20	0.40
Water source: Protected Well	0.05	0.22	0.06	0.24
Water source: Tap	0.15	0.36	0.16	0.37
Community Characteristics				
Elevation	1989	467	1987	449
Peri-Urban	0.17	0.38	0.18	0.39
Tarmac Road Available in Zone (=1)	0.52	0.50	0.54	0.50
Number of children	1,083		1,006	

Table 4. EA-level Food Aid Received (Per Capita) in Birr (EA-level Analysis: Tobit)

	Total Food Aid	Free Distribution	Food For Work
	Tobit	Tobit	Tobit
	(A)	(B)	(C)
Inertia/Chronic Poverty Measures (Z)			
Needs assessment in 1984-88 (*P*)	310.4	367.9	8.523
	(3.08)**	(3.08)**	(0.16)
Needs assessment squared (P^2)	-223.7	-220.5	-52.77
	(2.89)**	(2.42)*	(1.27)
Assessment (*P*) x Long-run Rainfall	-0.867	-1.622	0.633
	(1.02)	(1.62)	(1.37)
Long-run Average Rainfall 1967-2001	0.096	0.201	-0.122
	(0.68)	(1.21)	(1.38)
C.V. of Rainfall 1967-2001	58.36	35.44	31.68
	(2.07)*	(1.05)	(2.05)*
Shocks (S)			
Damaged Plot Areas (ratio)	37.95	46.38	6.658
	(2.29)*	(2.33)*	(0.75)
Rainfall (positive) Shock in 1995	0.044	0.047	0.052
	(0.26)	(0.23)	(0.54)
Shocks (S) x Needs assessment (P)			
Damaged Plot Areas x Assessment (*P*)	-55.99	-71.31	3.344
	(1.17)	(1.28)	(0.12)
Rainfall (positive) Shock x Assessment (*P*)	-1.212	-1.576	-0.175
	(1.60)	(1.72)	(0.44)
EA Level Variables (X)			
ln(EA-level per capita expenditure)	-19.12	-20.11	-1.074
	(3.46)**	(3.05)**	(0.38)
Elevation	9.044	7.768	6.416
	(1.52)	(1.10)	(1.97)*
Peri-Urban	-65.49	-80.70	-24.88
	(3.46)**	(2.85)**	(2.36)*
Good Road Available (=1)	-5.889	-6.004	-2.226
	(0.91)	(0.76)	(0.66)
Constant	36.64	35.06	-28.69
	(0.81)	(0.65)	(1.16)
Joint Significance tests			
On Inertia/Chronic Poverty Measures (*Z*)	8.30 [0.00]**	5.36 [0.00]**	3.47 [0.00]**
On Shocks (*S*) and *S x P*	2.39 [0.05]*	2.52 [0.04]*	0.42 [0.79]
Predictions			
Predicted: total food aid	5.92	4.87	1.00
Predicted: permanent transfer	5.17	4.22	0.78
Predicted: response to shocks	0.75	0.65	0.22
Number of EAs with food aid	116	92	55
Number of EAs	531	531	531

Note: Nine Killil dummies are also included but not reported. Numbers in parentheses are absolute t-values calculated on heteroskedasticity-robust standard errors with cluster (EA) effects. * indicates 5 % significance level; and ** indicates 1 % significance.

Table 5. Child Growth in Height (cm): Children aged 6 to 24 months

	Age 6 to 24 months			
	OLS (A)	OLS (B)	IV (C)	IV (D)
EA Level Food Aid				
Per capita food aid received (birr) [A]		0.028	0.070	
		(2.24)*	(2.23)*	
PC food aid from Free Distribution (FD) [A]				0.085
				(1.97)*
PC food aid from Food for Work (FFW) [A]				0.257
				(1.13)
EA Level Variables				
Damaged Plot Areas (ratio)	-1.213	-1.433	-1.763	-2.032
	(1.84)	(2.16)*	(2.50)*	(2.52)*
ln(EA-level per capita expenditure)	-0.316	-0.232	-0.107	-0.285
	(1.18)	(0.86)	(0.37)	(0.97)
Child Characteristics				
Initial Height	-0.261	-0.255	-0.248	-0.250
	(9.11)**	(8.92)**	(8.47)**	(8.31)**
Gender (boy=1)	0.201	0.194	0.184	0.160
	(0.77)	(0.75)	(0.71)	(0.59)
Age in Month	0.259	0.254	0.245	0.269
	(2.59)**	(2.54)*	(2.44)*	(2.56)*
Age squared	-0.003	-0.003	-0.003	-0.003
	(0.90)	(0.91)	(0.90)	(1.01)
Household Characteristics				
Mom’s Age in years	0.003	0.006	0.012	0.025
	(0.12)	(0.28)	(0.50)	(1.05)
No Mother Info (No info=1)	0.662	0.706	0.771	0.490
	(0.88)	(0.94)	(1.02)	(0.60)
Max Male Education (Years)	-0.021	-0.024	-0.030	-0.035
	(0.40)	(0.48)	(0.58)	(0.64)
Max Female Education (Years)	0.166	0.164	0.161	0.171
	(2.36)*	(2.34)*	(2.29)*	(2.35)*
Female headed households	-0.122	-0.091	-0.046	-0.094
	(0.26)	(0.20)	(0.10)	(0.19)
Number of Men	-0.041	-0.034	-0.023	-0.074
	(0.21)	(0.17)	(0.12)	(0.37)
Number of Women	-0.286	-0.298	-0.315	-0.428
	(1.24)	(1.29)	(1.36)	(1.75)
Number of Children age 6-14	0.029	0.019	0.005	-0.016
	(0.25)	(0.17)	(0.04)	(0.13)
Ownership: land	0.867	0.847	0.816	0.917
	(1.48)	(1.45)	(1.39)	(1.53)
Ownership: Plough	-0.091	-0.090	-0.088	0.089
	(0.29)	(0.28)	(0.27)	(0.27)
Ownership: Animals	0.020	0.012	-0.000	-0.004
	(0.06)	(0.03)	(0.00)	(0.01)
Ownership: Radio	-0.103	-0.090	-0.071	0.006
	(0.24)	(0.21)	(0.17)	(0.01)
Water source: Protected Well	-0.900	-0.895	-0.887	-0.944
	(1.52)	(1.52)	(1.49)	(1.54)
Water source: Tap	-0.115	-0.149	-0.199	-0.239
	(0.23)	(0.30)	(0.40)	(0.46)
Elevation	-0.128	-0.173	-0.239	-0.176
	(0.40)	(0.54)	(0.74)	(0.51)
Peri-Urban	0.338	0.407	0.510	0.860
	(0.60)	(0.72)	(0.89)	(1.49)

Good Road Available (=1)	0.208	0.238	0.281	0.239
	(0.70)	(0.80)	(0.94)	(0.78)
Constant	23.16	21.84	19.88	20.51
	(8.71)**	(8.04)**	(6.53)**	(6.64)**
Joint significant tests on instruments				
F-stat on IVs on total food aid			19.1	
F-stat on IVs on FD / FFW				18.3 / 4.38
R-squared	0.10	0.10	0.09	0.08
Number of children	1,083	1,083	1,083	1,005

Note: Killil dummies (n=9), asset ownership variables (land, plough, radio), and two water source dummies are also included but not reported. None of the asset ownership variables and water source variables has a significant coefficient. Numbers in parentheses are absolute t-values calculated on heteroskedasticity-robust standard errors. * indicates 5 % significance level; and ** indicates 1 % significance. (*A*) Endogenous variables.

Table 6. Child Growth in Height (cm): Children aged 25 to 60 months

	Age 25 to 60 months			
	OLS	OLS	IV	IV
	(A)	(B)	(C)	(D)
EA Level Food Aid				
Per capita food aid received (birr) [A]		-0.010	0.045	
		(0.74)	(0.96)	
PC food aid from Free Distribution (FD) [A]				0.041
				(0.64)
PC food aid from Food For Work (FFW) [A]				0.281
				(1.62)
EA Level Variables				
Damaged Plot Areas (ratio)	-0.199	-0.110	-0.616	-1.294
	(0.30)	(0.16)	(0.77)	(1.40)
ln(EA-level per capita expenditure)	-0.124	-0.141	-0.045	-0.023
	(0.46)	(0.52)	(0.16)	(0.07)
Child Characteristics				
Initial Height	-0.205	-0.205	-0.201	-0.204
	(9.86)**	(9.89)**	(9.44)**	(9.22)**
Gender (boy=1)	0.223	0.221	0.234	0.177
	(0.92)	(0.91)	(0.95)	(0.67)
Age in Month	0.196	0.202	0.171	0.144
	(1.53)	(1.57)	(1.30)	(1.01)
Age squared	-0.002	-0.002	-0.002	-0.001
	(1.17)	(1.20)	(0.99)	(0.70)
Household Characteristics				
Mom's Age in years	0.039	0.038	0.040	0.047
	(1.97)*	(1.95)	(2.03)*	(2.25)*
No Mother Info (No info=1)	0.440	0.441	0.436	0.445
	(0.79)	(0.79)	(0.78)	(0.74)
Max Male Education (Years)	0.022	0.023	0.016	0.039
	(0.49)	(0.51)	(0.36)	(0.81)
Max Female Education (Years)	0.041	0.039	0.047	0.034
	(0.66)	(0.64)	(0.75)	(0.52)
Female headed households	-0.161	-0.170	-0.122	-0.175
	(0.38)	(0.39)	(0.28)	(0.38)
Number of Men	-0.088	-0.089	-0.083	-0.105
	(0.50)	(0.50)	(0.46)	(0.55)
Number of Women	0.266	0.266	0.265	0.330
	(1.23)	(1.23)	(1.22)	(1.41)
Number of Children age 6-14	-0.123	-0.125	-0.111	-0.090
	(1.21)	(1.23)	(1.07)	(0.83)
Ownership: land	-0.489	-0.492	-0.475	-0.492
	(0.95)	(0.96)	(0.92)	(0.90)
Ownership: Plough	0.259	0.261	0.252	0.388
	(0.87)	(0.87)	(0.83)	(1.20)
Ownership: Animals	0.393	0.386	0.428	0.289
	(1.24)	(1.21)	(1.33)	(0.85)
Ownership: Radio	0.193	0.196	0.178	0.077
	(0.51)	(0.52)	(0.47)	(0.19)
Water source: Protected Well	-0.901	-0.915	-0.835	-0.745
	(1.71)	(1.74)	(1.56)	(1.30)
Water source: Tap	0.144	0.153	0.104	0.186
	(0.29)	(0.31)	(0.21)	(0.34)
Elevation	0.163	0.171	0.127	0.107
	(0.53)	(0.55)	(0.40)	(0.32)
Peri-Urban	-0.633	-0.654	-0.535	-0.511
	(1.08)	(1.11)	(0.89)	(0.82)

Good Road Available (=1)	-0.029	-0.025	-0.047	-0.152
	(0.10)	(0.09)	(0.16)	(0.49)
Constant	16.41	16.57	15.68	16.22
	(4.83)**	(4.86)**	(4.46)**	(4.18)**
Joint significance tests on instruments				
F-stat on IVs on total food aid			9.89	
F-stat on IVs on FD / FFW				8.35 / 6.07
R-squared	0.14	0.14	0.12	0.10
Number of children	1,006	1,006	1,006	940

Note: Killil dummies (n=9), asset ownership variables (land, plough, radio), and two water source dummies are also included but not reported. None of the asset ownership variables and water source variables has a significant coefficient. Numbers in parentheses are absolute t-values calculated on heteroskedasticity-robust standard errors. * indicates 5 % significance level; and ** indicates 1 % significance. (*A*) Endogenous variables.

Table 7. Child Growth in Height (cm): Robustness checks

	Excluding Initial Height		**IVs on Damaged Plot Areas**	
	6-24 months	25-60 months	6-24 months	25-60 months
	IV	IV	IV	IV
	(A)	(B)	(C)	(D)
EA Level Food Aid				
Per capita food aid received (birr) [A]	0.082	0.017	0.070	0.089
	(2.55)*	(0.34)	(1.99)*	(1.01)
EA Level Variables				
Damaged Plot Areas (ratio) [B]	-1.794	-0.065	-1.839	-3.037
	(2.46)*	(0.08)	(0.84)	(0.71)
ln(EA-level per capita expenditure)	-0.051	-0.111	-0.108	0.030
	(0.17)	(0.37)	(0.37)	(0.09)
Child Characteristics				
Initial Height	-- Excluded --	-- Excluded --	-0.248	-0.201
			(8.44)**	(9.17)**
Gender (boy=1)	-0.254	0.179	0.180	0.265
	(0.96)	(0.70)	(0.69)	(1.00)
Age in Month	-0.106	-0.052	0.245	0.137
	(1.11)	(0.39)	(2.43)*	(0.91)
Age squared	0.001	-0.000	-0.003	-0.001
	(0.37)	(0.05)	(0.90)	(0.64)
Household Characteristics				
Mom's Age in years	0.010	0.036	0.012	0.042
	(0.43)	(1.73)	(0.49)	(2.05)*
No Mother Info (No info=1)	0.651	0.204	0.771	0.334
	(0.83)	(0.35)	(1.02)	(0.56)
Max Male Education (Years)	-0.039	0.011	-0.030	0.010
	(0.72)	(0.23)	(0.59)	(0.21)
Max Female Education (Years)	0.095	-0.008	0.160	0.040
	(1.31)	(0.12)	(2.23)*	(0.62)
Female headed households	-0.004	-0.149	-0.047	-0.012
	(0.01)	(0.33)	(0.10)	(0.02)
Number of Men	-0.004	-0.093	-0.024	-0.090
	(0.02)	(0.50)	(0.12)	(0.49)
Number of Women	-0.245	0.325	-0.313	0.241
	(1.02)	(1.44)	(1.35)	(1.07)
Number of Children age 6-14	-0.026	-0.151	0.006	-0.105
	(0.21)	(1.40)	(0.05)	(0.98)
Ownership: land	0.805	-0.557	0.817	-0.542
	(1.32)	(1.03)	(1.38)	(1.01)
Ownership: Plough	-0.190	0.128	-0.092	0.231
	(0.57)	(0.41)	(0.29)	(0.74)
Ownership: Animals	-0.116	0.373	0.000	0.460
	(0.33)	(1.11)	(0.00)	(1.37)
Ownership: Radio	0.007	-0.025	-0.065	0.298
	(0.02)	(0.06)	(0.15)	(0.70)
Water source: Protected Well	-0.793	-0.951	-0.885	-0.730
	(1.29)	(1.71)	(1.48)	(1.27)
Water source: Tap	-0.051	0.168	-0.193	0.151
	(0.10)	(0.32)	(0.39)	(0.29)
Elevation	-0.226	0.076	-0.240	0.028
	(0.67)	(0.23)	(0.73)	(0.08)
Peri-Urban	0.358	-0.722	0.515	-0.490
	(0.61)	(1.15)	(0.90)	(0.78)
Good Road Available (=1)	0.240	0.065	0.279	-0.155
	(0.78)	(0.21)	(0.92)	(0.44)

Constant	6.997	6.206	19.89	16.17
	(2.66)**	(1.79)	(6.46)**	(4.36)**
R-squared	0.02	0.05	0.09	0.08
Number of children	1,083	1006	1,083	1,006

Note: Killil dummies (n=9), asset ownership variables (land, plough, radio), and two water source dummies are also included but not reported. None of the asset ownership variables and water source variables has a significant coefficient. Numbers in parentheses are absolute t-values calculated on heteroskedasticity-robust standard errors. * indicates 5 % significance level; and ** indicates 1 % significance. (*A*) Endogenous variables. (*B*) Endogenous variables in columns C and D.

Appendix Table A1. Child Growth in Height (cm) in Six Months - Excluding Areas that receive both FD and FFW

	6-24 months	25-59 months
	IV	IV
	(A)	(B)
EA Level Food Aid [A]		
Per capita food aid received (birr)	0.100	0.082
	(2.67)**	(1.56)
EA Level Variables		
Damaged Plot Areas (ratio)	-1.749	-0.686
	(2.51)*	(0.89)
ln(EA-level per capita expenditure)	-0.283	-0.025
	(0.96)	(0.08)
Child Characteristics		
Initial Height	-0.251	-0.203
	(8.37)**	(9.26)**
Gender (boy=1)	0.129	0.194
	(0.48)	(0.74)
Age in Month	0.265	0.179
	(2.53)*	(1.30)
Age squared	-0.003	-0.002
	(0.98)	(1.00)
Household Characteristics		
Mom's Age in years	0.026	0.049
	(1.07)	(2.38)*
No Mother Info (No info=1)	0.685	0.563
	(0.90)	(0.95)
Max Male Education (Years)	-0.024	0.038
	(0.46)	(0.80)
Max Female Education (Years)	0.161	0.034
	(2.25)*	(0.52)
Female headed households	-0.017	-0.093
	(0.04)	(0.20)
Number of Men	-0.055	-0.096
	(0.28)	(0.51)
Number of Women	-0.383	0.356
	(1.63)	(1.55)
Number of Children age 6-14	-0.030	-0.104
	(0.24)	(0.96)
Ownership: land	0.961	-0.440
	(1.62)	(0.81)
Ownership: Plough	0.059	0.344
	(0.18)	(1.08)
Ownership: Animals	0.010	0.313
	(0.03)	(0.92)
Ownership: Radio	-0.018	0.064
	(0.04)	(0.16)
Water source: Protected Well	-1.019	-0.746
	(1.69)	(1.31)
Water source: Tap	-0.231	0.164
	(0.45)	(0.31)
Elevation	-0.227	0.101
	(0.67)	(0.30)
Peri-Urban	0.853	-0.499
	(1.48)	(0.80)
Good Road Available (=1)	0.242	-0.123
	(0.79)	(0.40)
Constant	20.48	15.08

	(6.64)**	(4.04)**
R-squared	0.09	0.11
Number of children	1,003	937

Note: Killil dummies (n=9) are also included but not reported. Numbers in parentheses are absolute t-values calculated on heteroskedasticity-robust standard errors with cluster (EA) effects. * indicates 5 % significance level; and ** indicates 1 % significance. (*A*) Endogenous variables.