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**FOOD AID AND CHILD NUTRITION IN RURAL ETHIOPIA**

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### **Abstract**

This paper uses a unique panel data set from Ethiopia to examine the determinants of participation in and receipts of food aid through free distribution (FD) and food-for-work (FFW). Results show that aggregate rainfall and livestock shocks increase household participation in both FD and FFW. FFW also seems well-targeted to asset-poor households. The probability of receiving FD does not appear to be targeted based on household wealth, but FD receipts are lower for wealthier households. The effects of FD and FFW on child nutritional status differ depending on the modality of food aid and the gender of the child. Both FFW and FD have a positive direct impact on weight-for-height. Households invest proceeds from FD in girls' nutrition, while earnings from FFW are manifested in better nutrition for boys. The effects of the gender of the aid recipient are not conclusive.

**Keywords: food aid, child nutrition, Ethiopia**

**Contents**

Acknowledgments.....	v
1. Introduction.....	1
2. Conceptual Model.....	4
3. Data.....	7
4. Empirical Specification.....	12
Determinants of FFW and FD receipts.....	12
Determinants of Child Nutritional Status.....	14
5. Results.....	15
Determinants of Participation in and Receipts from Food-for-Work and Food Aid Programs.....	15
Impact of Food-for-Work and Food Aid on Child Nutritional Status.....	18
6. Conclusions and Policy Implications.....	23
References.....	26

## Tables

1	Characteristics of sample households, by survey round, Ethiopia Rural Household Survey.....	10
2	Trends in wasting and stunting, by survey round.....	11
3	Weight-for-height and height-for-age Z scores, by sex.....	11
4	Determinants of days worked and payments received, food-for-work program, Heckman maximum likelihood estimates.....	16
5	Determinants of food distribution receipts, Heckman maximum likelihood estimates.....	19
6	Effects of FD and FFW on child weight-for-height and height-for-age, low-asset households.....	20
7	Effects of FD and FFW on child weight-for-height and height-for-age, high-asset households.....	21

## Figure

1	Ethiopian Rural Household Survey (ERHS) sites.....	8
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## 1. Introduction

Food aid programs have become increasingly important for disaster relief in many developing countries. In Ethiopia, a drought-stricken economy with one of the lowest per capita incomes in the world, food aid has amounted to almost 10 million metric tons (mt) from 1984 to 1998, almost 10 percent of annual cereal production (Jayne et al. 2002). Because of the importance of food aid in Ethiopia, much effort has been devoted to evaluation of its effectiveness (Clay, Molla, and Habtewold 1999; Barrett and Clay 2001). Discussions have often focused on the appropriate modality of food aid, whether free distribution (FD) or food-for-work (FFW), the two historically important forms of food aid in Ethiopia (Webb, von Braun, and Yohannes 1992). Ethiopia's official food aid policy states that no able-bodied person should receive food aid without working on a community project in return, supplemented by targeted free food aid for those who cannot work. FD programs distribute cereals (wheat, maize, and sorghum) directly to households, while participants in FFW programs typically work in community development programs, such as roads, terraces, dams, and local infrastructure construction. The government of Ethiopia now devotes 80 percent of its food assistance resources to FFW programs, using the principle of self-targeting (Ethiopia 1996). While much of the literature on FFW has found that self-targeting employment schemes are effective in reaching the poor, recent evaluations in Ethiopia have found alternative explanations for the targeting of food aid—among which bureaucratic inertia or a history of past receipts of food aid is one of the most important determinants (Jayne et al. 2002).

Many evaluations of food aid have examined its impact on household calorie availability. This paper focuses on the effects of food aid on *individual* nutritional status, as measured by indicators of child nutrition. The few existing studies of the effects of food aid on individual nutritional status do not conclusively indicate whether participation in public works improved nutritional status nor measure its long-term impact. For example, Webb and Kumar (1995), using data from a public works program in Niger, found that children in high-participation households tended to be more

malnourished than those from low-participation households. However, this could be due to the successful targeting of FFW rather than its impact. Brown, Yohannes, and Webb (1994), using the same data, find that the female shares of public works receipts and days worked in FFW have greater positive impacts on child weight-for-age Z scores, controlling for the endogeneity of household calorie availability and days worked by males and females in FFW. However, since the data come from a single cross-section, analysis of the longer-term impact of FFW was not possible. Moreover, weight-for-age Z-scores capture both long- and short-term effects, making it difficult to infer causality from public works participation during the previous year to current nutritional status.

This paper takes a slightly different perspective from the above studies in evaluating the impact of food aid. First, it draws on a growing body of empirical literature that rejects the unitary model of the household in a variety of settings.<sup>1</sup> If, as this literature suggests, individuals within households have different preferences and do not pool their resources, the effect of public transfers such as food aid may differ, depending on who the recipient is. Indeed, recent human capital investment programs, such as the *Programa Nacional de Educacion, Salud y Alimentacion (PROGRESA)* in Mexico, have deliberately targeted cash transfers to women on the grounds that resources controlled by women are associated with better educational and nutritional outcomes of children (Skoufias 2003). Moreover, the World Food Programme (WFP)—through which one-quarter to one-third of global food aid has been channeled since the late 1980s and which is the major food aid donor in Ethiopia—has recently announced that it will require women to control the family entitlement in 80 percent of the operations it handles directly or subcontracts (Barrett 2002; World Food Programme 1996). Drawing from this literature, the paper examines whether the impact on nutritional status differs, depending on the gender of the aid recipient and the gender of the child.

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<sup>1</sup> For reviews, see Strauss and Thomas (1995), Behrman (1997), and Haddad, Hoddinott, and Alderman (1997).

Second, in line with debates on the appropriate modality of food aid, the paper investigates the determinants of participation in, and receipts of, food aid through FD or FFW, and whether the two modalities of food aid delivery represented by these programs matter for the impacts on nutritional status. The distinction is not between the form of the transfer (cash versus food), but the possibility that FD and FFW have different effects on the household's budget constraint, which, in turn, may affect the transfer's impact.<sup>2</sup> For example, in Ethiopia, Yamano (2000) finds that FD tends to increase farm labor supply of girls, while FFW decreases it. Lastly, this paper is able to take into account the possible endogeneity and codetermination of nutritional status and food aid by making use of a unique panel data set from rural Ethiopia that contains information on individual anthropometric outcomes and household food aid receipts for four survey rounds between 1994 and 1997.<sup>3</sup> Since there are multiple observations on individuals, the paper is also able to ascertain whether there are longer-term effects of food aid on nutritional status.

Results show that aggregate rainfall and livestock shocks increase household participation in both FD and FFW. FFW also seems well-targeted to asset-poor households, but the probability of receiving FD does not appear to be affected by household wealth. Conditional on being included in FD, however, FD receipts decline for wealthier households. The effects of FD and FFW on child nutritional status differ depending on the modality of food aid and the gender of the child. Both FFW and FD have a positive direct impact on weight-for-height, which responds more quickly to short-run interventions than does height-for-age. Households seem to invest proceeds from FD (which can be interpreted as an increase in unearned income) in girls' nutrition, while earnings from FFW are manifested in better nutrition for boys. The effects of the gender of the aid recipient are inconclusive.

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<sup>2</sup> There is a separate literature on the desirability of cash versus food in income transfer programs. See, for example, Barrett (2002) and Rogers (1988).

<sup>3</sup> The data set is described more fully in Dercon and Krishnan (2000a, 2000b) and Fafchamps and Quisumbing (2002).



The rest of the paper is organized as follows. Section 2 presents a brief conceptual model of child nutrition. Section 3 describes the survey and presents descriptive statistics. Section 4 discusses the empirical specification, while Section 5 presents the results on the determinants of FD and FFW and their impact on child nutritional status. Section 6 concludes and discusses policy implications from the research.

## 2. Conceptual Model

A simple model can be used to illustrate the differential effects of FD and FFW on child nutrition. Suppose that the household utility function can be characterized as:

$$U = U(X_p, X_h, L), \quad (1)$$

where  $X_p$  refers to market-purchased goods,  $X_h$  refers to home-produced goods, such as child health and nutrition, and  $L$  is leisure. At this point the assumption is that the household has a single utility function, although this assumption is later relaxed. The simplifying assumption is made that home-produced goods depend only on household labor supply,  $t_h$ .<sup>4</sup> That is,

$$X_h = f(t_h). \quad (2)$$

Suppose the household derives income from agricultural production, wage labor, and participation in FFW activities. Suppose also that the household may be eligible to receive food aid through free distribution. Since free distribution does not require work, it is treated as unearned income.<sup>5</sup>

The household income constraint can then be written as

$$p_a \cdot Q_a(A, t_a) + w \cdot t_w + w_f \cdot t_f + N = pX_p, \quad (3)$$

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<sup>4</sup> This is similar to the exposition in Strauss and Thomas (1995).

<sup>5</sup> This abstracts from the time costs of obtaining food aid through free distribution.

where  $p_a \cdot Q_a$  is the value of agricultural output, which is a function of land and other agricultural assets  $A$  and of time allocated to agricultural production  $t_a$ .  $w \cdot t_w$  is income from wage labor, where  $w$  is the market wage rate, and  $t_w$  is time spent in the labor market.  $w_f$  is the wage rate offered in FFW, which may be lower than the market wage rate for self-targeting purposes. Finally,  $N$  is unearned income, which may include transfers such as those from FD. Household income is spent on purchases of the market-produced good,  $X_p$ .

The time of individuals in the household is allocated to time in own agricultural production, time spent in the wage labor market, time on FFW activities, time producing home goods, and leisure. Thus, the household time constraint is as follows:

$$T = t_a + t_w + t_f + t_h + L. \quad (4)$$

Incorporating the household time constraint into the income constraint, the full income constraint can be written as

$$pX_p + w \cdot L = wT + (p_a \cdot Q_a - w t_a) + (p_h X_h - w t_h) + N. \quad (5)$$

That is, total consumption, including the value of time spent in leisure, cannot exceed full income. Full income is the value of time available to all household members, returns from agricultural production, “profits” from home production, and nonlabor income  $N$ . Maximizing equation (1) subject to the full income constraint yields reduced form demand functions for goods  $\mathbf{x}$  and leisure  $L$ , which can be written as a function of prices, the vector of wages  $\mathbf{w}$  (which includes both market wages and wages in FFW), and unearned income  $N$ , given the household’s asset levels:

$$\mathbf{x} = \mathbf{x}(\mathbf{p}, \mathbf{w}, N; A), \quad (6)$$

$$L = l(\mathbf{p}, \mathbf{w}, N; A). \quad (7)$$

Suppose, however, that the household is composed of two individuals,  $m$  and  $f$  (male and female), who do not have the same preferences, nor pool their incomes. A

collective model of the household would then be more appropriate, and the demand functions would be<sup>6</sup>

$$x_i = x_i(\mathbf{p}, \mathbf{w}, N_m, N_f, A_m, A_f, \alpha_m, \alpha_f); \quad i = 0, m, f. \quad (8)$$

$$L_i = L_i(\mathbf{p}, \mathbf{w}, N_m, N_f, A_m, A_f, \alpha_m, \alpha_f); \quad i = m, f. \quad (9)$$

In addition to wages and prices, the demand functions are conditioned on individual assets  $A_m$  and  $A_f$  and extrahousehold environmental parameters (EEPs)  $\alpha_m$  and  $\alpha_f$ . The EEPs affect the relative desirability of being outside the household (e.g., being single) and may include access to common property resources and divorce laws. Gender-specific targeting practiced in many FFW programs could also be viewed as an EEP that increases women's options outside marriage. Moreover, if spouses do not pool incomes, lump sum transfers such as free food distribution could have different effects, depending on whether the husband or the wife were the recipient. It is possible that FFW wages, if lower than the market wage for self-targeting purposes, may not necessarily improve women's outside options. However, opportunities for women to participate in the labor market are rare in rural Ethiopia. The earmarking of 80 percent of WFP's FFW operations to women, for example, would almost certainly improve their outside options.<sup>7</sup>

Time allocation to various activities, including farm production, home goods production, and FFW, could then be expressed as a function of the above right-hand-side variables. This paper investigates the impact of one form of unearned income, FD and FFW (which can be interpreted both as a change in the EEP as well as the wage vector) on child nutritional status, defined using the indicators weight-for-height and height-for-age.

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<sup>6</sup> See Haddad, Hoddinott, and Alderman (1997) for a review. For a more detailed exposition and derivation of the reduced form demand functions, see Thomas (1990).

<sup>7</sup> In practice, where wages are determined by communities, they have not been set below the market wage. Instead, days are rationed to provide employment opportunities for more households (Sharp 1997).

### 3. Data

This paper uses all four rounds of the Ethiopian Rural Household Survey (ERHS). The 1997 round was undertaken by the Department of Economics of Addis Ababa University (AAU), in collaboration with the International Food Policy Research Institute (IFPRI) and the Center for the Study of African Economies (CSAE) of Oxford University. The first three rounds were conducted in 1994/95 by AAU and CSAE, building on an earlier IFPRI survey conducted in 1989. The ERHS covered approximately 1,500 households in 15 villages across Ethiopia. While sample households within villages were randomly selected, the villages themselves were chosen to ensure that the major farming systems are represented.<sup>8</sup> Thus, although the 15 villages included in the sample are not statistically representative of rural Ethiopia as a whole, they are quite diverse and include all major agroecological, ethnic, and religious groups.<sup>9</sup>

The questionnaires for the first four rounds consist of a series of core modules on various issues such as consumption expenditures, wealth, income, and health, as well as a module on anthropometric measurements for all household members. The questionnaire used in the 1997 round includes the original core modules, supplemented with new modules specifically designed to address intrahousehold allocation issues. These modules were designed not only to be consistent with information gathered in the core modules, but also to complement individual-specific information.<sup>10</sup> Because assets at marriage may determine spouses' bargaining power within marriage (Quisumbing and Maluccio 2000; Frankenberg and Thomas 2001), a variety of assets brought to the

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<sup>8</sup> About 400 households in six sites were initially surveyed by IFPRI in 1989; these were selected from drought-prone areas for the study by Webb, von Braun, and Yohannes (1992). Three more sites were added in 1994–1995 to include areas north of Debre Berhan, which could not be surveyed in 1989 due to military conflict. Six other sites were also added to cover the main agroclimatic zones and farming systems of the richer parts of the country. The selection of new sites is described in Bereket Kebede (1994).

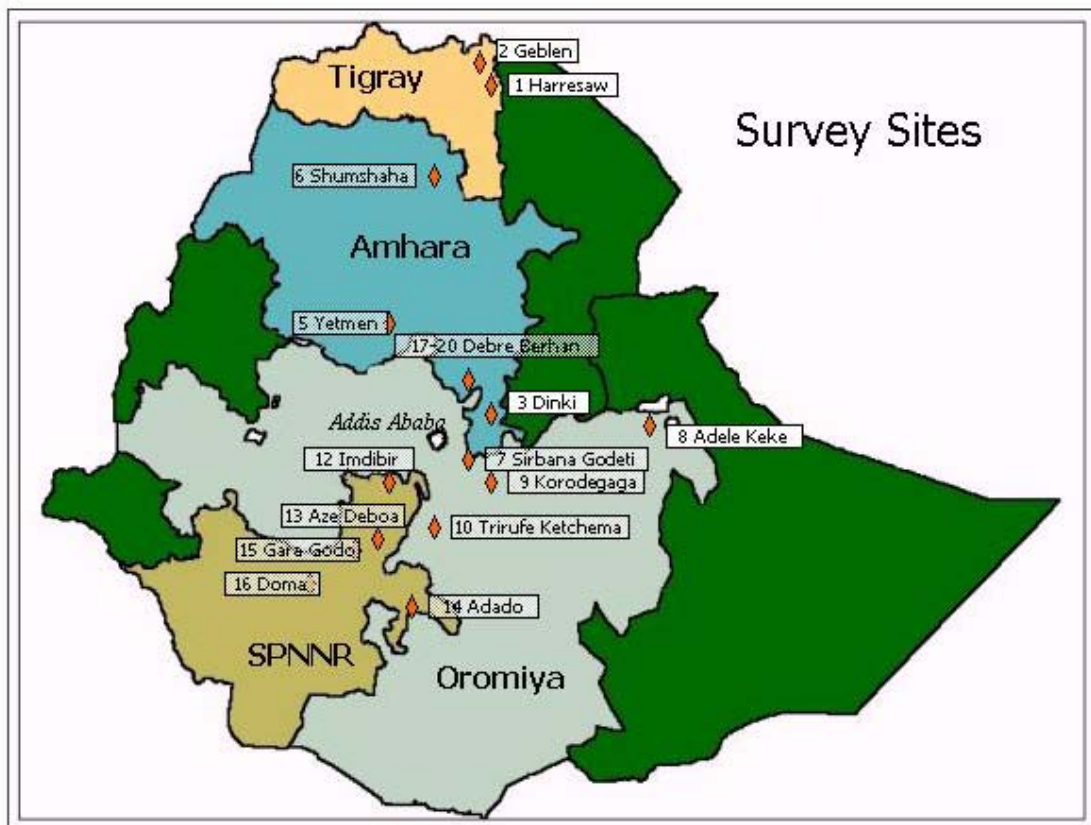
<sup>9</sup> See Fafchamps and Quisumbing (2002) for a discussion of the representativeness of the sample.

<sup>10</sup> These are described in more detail in Fafchamps and Quisumbing (2002).

marriage were recorded, as were all transfers made at the time of marriage. Values of assets at marriage were converted to 1997 birr, using the consumer price index.<sup>11</sup>

The location of the surveyed villages is depicted in Figure 1. Most surveyed villages are placed along a north-south axis. This ensures a good coverage of the various agroclimatic zones that characterize the Ethiopian highlands, where the bulk of the population lives. Arid lowlands and other regions that are particularly hard to reach, such as the western part of the country along the Sudanese border, were excluded from the sample for cost reasons. This may limit the policy conclusions on targeting that can be drawn.

**Figure 1—Ethiopian Rural Household Survey (ERHS) sites**



**Source:** UNDP-EUE 1998.

Note: All borders and survey site locations are approximate.

<sup>11</sup> See Fafchamps and Quisumbing (2002) for details.

Each survey round obtained information on income earned from various activities in the past four months, including FFW. For each activity, information was collected on the number of days worked, whether the payment was in cash or in kind, the value of cash payments, the quantity and unit of in-kind payments, and the identity of the income recipient. Respondents were also asked whether the household received food aid through free distribution, and which person in the household received it.<sup>12</sup> Most participants in both FD and FFW received their payments in kind, typically in wheat, maize, sorghum, and cooking oil; all in-kind receipts were converted to cash equivalents using the village-level price.

Table 1 presents descriptive statistics of the sample households, by survey round. About a quarter of the households participated in FFW over the four survey rounds. The proportion that benefited from FD was more variable, ranging from 11 percent in the 1995 round to 37 percent in the second 1994 round. There is also greater variation in FD compared to FFW receipts. FD payments were highest in the second round.<sup>13</sup> FD and FFW contributed 2 to 7 percent of household monthly consumption across survey rounds.

Table 1 also presents information on individual rainfall and livestock disease shocks. All data on shocks are self-reported, based on recall of events in the last cropping season and the relevant harvest, and are used to construct indices of adverse occurrences affecting crop and livestock production.<sup>14</sup> The broad categories of shocks are rainfall shocks, nonrain shocks (mostly common problems related to pests, flooding,

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<sup>12</sup> Ideally we would have interviewed husbands and wives separately, but this was difficult in practice, since husbands did not want their wives to speak to male interviewers. Thus, with the exception of female heads of households, the respondent was the husband. If a woman wanted to conceal her food aid receipts from her husband, respondent reports would understate the true value of receipts. We did administer a module on indicators of bargaining power separately to husbands and wives, but only after the interviewers had resided in the village for a longer period.

<sup>13</sup> The descriptive statistics pertain to the sample used in the estimation, and will be slightly different from those reported by Dercon and Krishnan (2000a). The estimation sample is slightly smaller than the full sample because it includes households present in all rounds and for which there is information on assets at marriage.

<sup>14</sup> This description is taken mostly from Dercon and Krishnan (2000b); for comparability, this study used a very similar methodology for creating the shock index.

**Table 1—Characteristics of sample households, by survey round, Ethiopia Rural Household Survey**

	Survey round			
	1994a	1994b	1995	1997
Dummy for participant in food-for-work	0.27	0.26	0.26	0.24
Days worked in past four months (participants only)	36.40	40.90	35.82	36.55
Value of food-for-work payments received in past four months (participants only), in 1997 birr	113.66	121.73	125.82	131.66
Dummy for recipient of free distribution	0.12	0.37	0.11	0.18
Value of free distribution received in past four months (recipients only), in 1997 birr	115.45	237.14	65.76	58.97
Monthly consumption expenditure, net of free distribution and food-for-work, in 1997 birr	460.68	768.10	545.75	674.87
Monthly equivalent food-for-work receipts, whole sample	29.17	7.13	8.00	8.29
Monthly equivalent free distribution receipts, whole sample	3.60	19.03	1.38	2.00
Total monthly consumption, including free distribution and food-for-work, in 1997 birr	493.45	794.26	555.13	685.16
Contribution of food-for-work and free distribution to monthly consumption, percent	0.07	0.03	0.02	0.02
Rainfall index (1 is best)	0.51	0.48	0.62	0.52
Livestock disease index (1 is best)	0.74	0.89	0.89	0.98

insects, and animal trampling or weed damage), and livestock shocks. This paper focuses only on rainfall shocks and livestock disease shocks, since these tend to be common within villages and thus could be a proxy for aggregate shocks. The individual rainfall index was constructed to measure the farm-specific experience related to rainfall in the preceding season, based on such questions as whether plowing occurred too early or too late for the rain, whether it rained when harvesting, etc. Responses to each of the questions (either yes or no) were coded as favorable or unfavorable rainfall outcomes, and averaged over the number of questions asked so that the best outcome would be equal to 1 and the worst, zero. According to Dercon and Krishnan (2000b), the village-level variance accounted for 77 percent of total variance in the rainfall index. Similar questions were also asked regarding livestock; among the sub-indices referring to problems with livestock, this study focused on livestock disease, because contagion enables individual shocks to be easily shared within the community. Relatively speaking, livestock disease was quite important in the first round of data collection, particularly in the south.

Ethiopia's history of wars, droughts, and famines has taken its toll on the nutritional status of children (Table 2). Close to half of children between 0 and 9 years of age are stunted, an indicator of long-term nutritional deprivation.<sup>15</sup> Wasting, an indicator of acute energy deficiency, ranges from 9 to 22 percent for children between 0 and 3 years of age. Boys' and girls' anthropometric indicators do not significantly differ between 0 and 3 years of age, but stunting becomes more prevalent for boys between ages 3 and 5 and remains so in the 5–9 age group; wasting is more prevalent among boys from ages 5 to 9 (Table 3).

**Table 2—Trends in wasting and stunting, by survey round**

	Survey round			
	1994a	1994b	1995	1997
Children 0 to 3 years				
Wasted	0.11	0.09	0.15	0.22
Stunted	0.51	0.5	0.52	0.66
Children 3 to 5 years				
Wasted	0.08	0.09	0.11	0.15
Stunted	0.53	0.53	0.52	0.57
Children 5 to 9 years				
Wasted	0.07	0.08	0.11	0.13
Stunted	0.46	0.48	0.43	0.52

Note: Wasting is defined as weight-for-height Z-score less than -2; stunting is defined as a height-for-age Z-score of less than -2.

**Table 3—Weight-for-height and height-for-age Z-scores, by sex**

	Weight-for-height Z-scores									
	Age 0–3			Age 3–5			Age 5–9			
	Number of observations	Mean	Standard Deviation	Number of observations	Mean	Standard Deviation	Number of observations	Mean	Standard Deviation	
Males	610	0.14	2.52	571	-0.33	1.56	1,050	-0.42	1.52	
Females	536	0.26	2.68	529	-0.29	1.62	1,172	-0.06	2.07	
t-test of difference		-0.76			-0.46			-4.59		
p-value		0.45			0.65			<b>0.00</b>		
	Height-for-age Z-scores									
Males	619	-2.61	2.22	573	-2.49	2.02	1,056	-2.22	1.82	
Females	543	-2.56	2.15	533	-2.27	2.06	1,177	-1.89	1.81	
t-test of difference		-0.38			-1.83			-4.35		
p-value		0.70			<b>0.07</b>			<b>0.00</b>		

<sup>15</sup> Stunting is defined as having a height-for-age Z-score below -2 standard deviations from the NCHS standard; wasting is defined as a weight-for-height Z-score below -2.



#### 4. Empirical Specification

The empirical portion of this paper consists of two parts. The first part examines the determinants of participation in FFW and FFW receipts, as well as the determinants of the probability of receiving FD and FD receipts.<sup>16</sup> In addition to individual and family characteristics, the study includes household- and village-level rainfall and livestock disease shocks to investigate the extent to which households and individuals use food aid to mitigate the effects of these shocks. In the second part, the paper models current child nutritional status as a function of past nutritional status, receipts of FFW or FD, consumption net of food aid, and aggregate rainfall and livestock disease shocks.

##### Determinants of FFW and FD Receipts

Food aid is targeted using three methods: administrative targeting, using such indicators as asset or livestock ownership, age and gender, nutritional status, access to resources such as land and family labor; self-targeting, typically implemented using wages below the market wage rate and “inferior” goods; and community-based targeting, based on community decisions about the eligibility of households to participate in food aid programs (Clay, Molla, and Habtewold 1999). Thus, food aid receipts are not random and will depend on individual, household, and community characteristics. To take into account the endogeneity of participation in FFW and receipt of FD, this paper uses the Heckman procedure to correct for selectivity (Heckman 1979). The study assumes that the determinants of food aid receipts operate on two levels. First, the community decides which households are eligible for which type of program, based on program eligibility

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<sup>16</sup> Since the data are not nationally representative, this study does not examine the determinants of program placement, unlike Jayne et al. (2000), who examine *wereda*- (small regional unit) and household-level determinants of participation in food aid programs. This analysis is at a lower level of disaggregation—the household and the individual.

criteria; second, the individual within the eligible household decides to participate in the program.<sup>17</sup> That is, the study attempts to estimate

$$F_j = X_j\beta + u_{1j}, \quad (10)$$

where  $F_j$  is the receipt of food aid, estimated separately for FFW and FD.  $F_j$  is observed only if

$$z_{j\gamma} + u_{2j} > 0, \quad (11)$$

where  $u_1 \sim N(0, \sigma)$ ,  $u_2 \sim N(0, 1)$ , and  $\text{corr}(u_1, u_2) = \rho$ .

Equation (10) pertains to the determinants of individual receipts, while equation (11) is the (unobserved) selection process driven mostly by household characteristics. In the food aid receipts equation, the vector  $X_j$  contains individual characteristics such as the gender of the FFW participant or FD recipient, age, age squared, height, highest grade attained, household size and household composition variables, the value of assets at marriage (in 1997 birr) and the share of assets controlled by women, household rainfall and livestock disease indices, and village and round dummies. The household composition variables are the proportions in each age-sex demographic category, relative to males 15 to 65 years of age (the excluded category). In the selection equation, the vector  $z_j$  consists of a dummy for a female-headed household, household size and household composition variables, both asset-at-marriage variables, community-level rainfall and livestock disease indices, and round dummies. The community-level indices for each household were constructed by taking the average over all other households (i.e., excluding the particular household).<sup>18</sup> The asset-at-marriage variables are used instead of current asset measures, since the latter are arguably endogenous to labor force and asset

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<sup>17</sup> Selection of households eligible for FD or FFW is done by local-level committee or by the community, although actual practice may differ across sites. Some individuals are predetermined to be eligible for FD—e.g., the old, sick, or disabled; lactating and pregnant women; persons who are required to care constantly for young children; or incapacitated adults. For details, see Sharp (1997, 22).

<sup>18</sup> Although it would have been ideal to use actual rainfall data instead of self-reported rainfall data, data for all sites for the last survey round were not available.

accumulation decisions; using this set of variables also permits a specification consistent with a collective model of household decisionmaking.

### **Determinants of Child Nutritional Status**

Child nutritional status is a cumulative measure that depends on inputs in past periods and possibly on past nutritional status as well (Strauss and Thomas 1995). A general child health and nutrition production function can be written as

$$H_t = f(H_{t-1}, X_i, X_h, X_c, u), \quad (12)$$

where subscript  $i$  denotes a child-level,  $h$ , a household-level, and  $c$ , a community-level covariate, and  $u$  represents unobserved heterogeneity. The input vector may include inputs of past periods as well as health, lagged several periods.

More specifically, child nutritional status can be written as a dynamic panel data model,

$$h_{it} = \sum h_{it-j} \alpha_j + \mathbf{x}_{it}\beta_1 + \mathbf{w}_{it}\beta_2 + v_i + \varepsilon_{it}, \quad (13)$$

where  $h_{it}$  is the nutritional status of child  $i$  in period  $t$ ,  $h_{it-j}$  is nutritional status in the  $t$ - $j$ th period,  $\mathbf{x}_{it}$  is a vector of exogenous covariates,  $\mathbf{w}_{it}$  is a vector of predetermined covariates,  $v_i$  are random effects that are independently and identically distributed over the individuals with variance  $\sigma_v^2$  and  $\varepsilon_{it}$  is identically and independently distributed over the whole sample with variance  $\sigma_\varepsilon^2$ . The dependent variables are weight-for-height and weight-for-age. The exogenous variables are household- and community-level rainfall and livestock disease shocks, while the predetermined variables, lagged one time period, are monthly consumption net of food aid, FA receipts (estimated separately for FFW and FD and also for the sum of both), the gender of the child interacted with the amount of

the receipt, and the gender of the child interacted with the gender of the aid recipient.<sup>19</sup> The interaction terms indicate whether food aid has differential effects on children depending on their gender, and whether aid recipients have different preferences toward children based on gender. This model is estimated using the Arellano-Bond GMM estimator (Arellano and Bond 1991).

## 5. Results

### **Determinants of Participation in and Receipts from Food-for-Work and Food Aid Programs**

Maximum likelihood estimates of the determinants of participation in FFW, days worked, and total FFW receipts are presented in Table 4. FFW participation appears to be self-targeted, with wealthier households less likely to participate. The share of assets held by women does not appear to affect the probability of participation, owing to the low share of women's assets for the majority of households (the median value of women's assets at marriage is zero). Larger households have a higher probability of participating in FFW. Households with a higher proportion of females between 15 and 65 years old are more likely to participate in FFW, but households with more females under 15 years of age are less likely to participate.<sup>20</sup> Participation in FFW responds as expected to

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<sup>19</sup> Although mother's height is an important determinant of child nutritional status, it is not an explanatory variable in the regressions. The Arellano and Bond (1991) dynamic panel data estimator addresses the problem of correlation of the lagged dependent variable with the error term by first differencing to remove the individual-specific random effects, and then using lagged levels of the dependent variable and predetermined variables and differences of the strictly exogenous variables as instruments. Individual-specific variables such as mothers' height that do not vary through time would drop out. However, if this study were to estimate this equation in levels, mother's height would be included. For example, Hoddinott and Kinsey (2002) include mother's height in least-squares regressions of growth in height of children, measured in centimeters per year, but mother's height drops out in the maternal fixed-effects estimates. While it is possible that the genetic potential for height can be fully expressed in the height-for-age Z-score of a newborn, it is more likely that the Z-score of the child of a tall mother will increase more in childhood relative to that of an average or short mother.

<sup>20</sup> This study disaggregated age groups further into children under 6 and children 6–15, but the results do not change. The aggregated results are presented here.

**Table 4—Determinants of days worked and payments received, food-for-work program, Heckman maximum likelihood estimates****(Robust standard errors corrected for clustering on households.)**

	Days worked		Probability of participation		Payment received		Probability of participation	
	Coefficient	Z-score	Coefficient	Z-score	Coefficient	Z-score	Coefficient	Z-score
Female-headed household			-0.01	-0.03			0.01	0.03
Sex (1 = female)	0.60	0.20			-22.98	-1.19		
Age	-0.80	<b>-1.75</b>			3.78	1.02		
Age squared	0.01	<b>1.82</b>			-0.04	-0.88		
Height	0.15	1.11			-1.28	<b>-1.66</b>		
Highest grade	-0.68	-0.89			4.10	0.65		
Log household size	-0.40	-0.13	0.50	<b>4.95</b>	-21.29	-1.12	0.50	<b>4.96</b>
Males < 15	9.67	1.16	-0.23	-0.73	107.73	<b>1.69</b>	-0.23	-0.73
Females < 15	23.77	<b>2.95</b>	-0.80	<b>-2.44</b>	148.03	<b>3.27</b>	-0.80	<b>-2.45</b>
Females 15–65	18.18	<b>2.24</b>	0.89	<b>2.48</b>	9.18	0.19	0.89	<b>2.48</b>
Males 65+	136.11	<b>3.65</b>	-0.63	-0.94	876.48	<b>2.24</b>	-0.63	-0.94
Females 65+	-9.07	-0.26	-0.76	-0.92	103.04	0.71	-0.76	-0.92
Total assets at marriage	0.00	1.35	-0.00	<b>-3.16</b>	0.01	1.27	-0.00	<b>-3.16</b>
Share of women's assets	-1.32	-0.22	0.14	0.56	0.79	0.03	0.13	0.52
Rainfall index	-6.70	<b>-2.47</b>			-2.60	-0.15		
Livestock disease index	-0.38	-0.16			-5.47	-0.29		
Community rainfall index			-1.35	<b>-8.00</b>			-1.35	<b>-7.99</b>
Community livestock disease index			-1.29	<b>-4.35</b>			-1.30	<b>-4.38</b>
Geblen	6.65	1.47			-57.10	-1.28		
Dinki	-16.13	<b>-3.85</b>			-48.45	-1.17		
Shumshaha	36.53	1.28			284.62	1.13		
Adele Keke	4.39	0.64			-9.41	-0.16		
Trirufe Kechema	-13.44	<b>-3.80</b>			-65.25	-1.27		
Imdibir	-0.04	-0.01			-12.49	-0.32		
Gara Godo	27.04	<b>6.57</b>			43.10	0.96		
Doma	-15.12	<b>-4.63</b>			-43.37	-1.04		
Round 2 dummy	0.17	0.10	0.10	<b>1.85</b>	-6.34	-0.50	0.10	<b>1.85</b>
Round 3 dummy	-3.60	<b>-2.06</b>	-0.09	-1.52	-5.17	-0.49	-0.09	-1.51
Round 4 dummy	-4.57	<b>-2.34</b>	-0.11	-1.02	-11.81	-0.82	-0.10	-1.01
Constant	16.73	0.78	0.58	<b>1.96</b>	239.46	<b>2.02</b>	0.58	<b>1.95</b>
Log likelihood	-4,007.80		-5,231.75					
Test of independent equations:								
Chi-square (p-value)	1.24	(0.26)						
Number of observations	2,753							
Censored	2,139							
Uncensored	614							

Note: Z-statistics in bold are significant at 10 percent or better.

community rainfall and livestock disease shocks. Since the rainfall and disease indices are constructed so that more favorable outcomes are closer to unity, a higher value of the index is a positive shock, and thus the negative signs on the coefficients indicate that households are less likely to participate if they receive positive shocks. Contrary to the

findings of Clay, Molla, and Habtewold, this study does not find that female-headed households are more likely to participate in FFW (Clay, Molla, and Habtewold 1999). The test of independent equations (fourth line from bottom of Table 4) indicates that the receipts and days-worked equations can, in fact, be estimated independently of the selection equation.

Days worked in FFW are negatively related to schooling attainment of the FFW participant, but this coefficient is insignificant.<sup>21</sup> Participants in households with a higher proportion of working-age females, as well as older males, tend to work more. The latter finding is consistent with that of Clay, Molla, and Habtewold (1999), who find that households with older male household heads tend to be disproportionately targeted in food aid interventions. Conditional on participation, household rainfall outcomes also affect days worked—individuals in households that experienced negative rainfall shocks worked more. FFW programs do not seem to discriminate against female participants, whose earnings are not significantly less than male FFW participants. Interestingly, FFW payments appear to be weakly negatively correlated with height. This may be due to an institutional feature of FFW in Ethiopia. In many cases, the desire to spread the benefits of FFW thinly has led communities to share individual rations among a large number of households (Sharp 1997). If quotas are small, for example, the local committee may cut the number of workplaces or rations given to each household rather than reduce the number of families assisted, so payments would no longer be directly linked to work effort. In some areas, FFW is also organized on a part-time basis so that participants can continue with farming or other work. Able-bodied participants who are still farming could therefore devote less time to FFW and thus would earn less than those without outside activities.

Payments are also higher if the participant belongs to a household with a higher proportion of males and females under 15, and with a larger ratio of males over 65 years

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<sup>21</sup> The coefficient on schooling was negative and significant in the specification that did not include height. Schooling and height may thus represent alternative forms of human capital stocks.

of age, conditional on participation. If these demographic groups are more vulnerable to shocks, then payments do seem to provide some protection to them. While larger households have a higher probability of participating in FFW, household size does not significantly affect actual receipts, probably due to de jure rules whereby only one member of the household is allowed to work (Jayne et al. 2002).

In contrast to FFW, FD participation, which is determined by the community, does not appear to be targeted on the basis of household wealth (Table 5). Larger households surprisingly have a lower probability of receiving FD.<sup>22</sup> However, households with a larger proportion of young members, both male and female, also have a higher probability of receiving FD. Lastly, the probability of receiving FD responds to aggregate community rainfall and livestock disease shocks: better rainfall and livestock health outcomes reduce the probability of participation. Turning to FD receipts, the only significant determinant of receipts is household assets: individuals from wealthier households receive less FD. Individual FD receipts do not appear to be affected by individual shocks, suggesting that FD is probably targeted at the community level. Unlike the results shown in Table 4, the test of independent equations confirms that the FD receipt equation (fourth line from bottom of Table 5) cannot be estimated independently of the selection equation.

### **Impact of Food-for-Work and Food Aid on Child Nutritional Status**

To assess whether food aid has an impact on child nutritional status, this study runs regressions on weight-for-age Z-scores and height-for-age Z-scores separately on children from 0 to 5 years old and from 5 to 9 years old, for low-asset and high-asset households. Results for low-asset households are presented in Table 6, and for high-asset households in Table 7. Regressors include the lagged change in the anthropometric

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<sup>22</sup> Jayne et al. (2002) also find a negative relationship between per capita food aid receipts and household size. The negative relationship turns positive when household FFW receipts rather than per capita receipts are used as the dependent variable.

**Table 5—Determinants of food distribution receipts, Heckman maximum likelihood estimates**

(Robust standard errors corrected for clustering on households.)

	FD receipts		Probability of receiving FD	
	Coefficient	Z-score	Coefficient	Z-score
Female-headed household			-0.17	-1.21
Sex (1=female)	-24.73	-0.43		
Age	4.30	0.41		
Age squared	-0.01	-0.07		
Height	-2.73	-0.94		
Highest grade	8.42	1.27		
Log household size	1.56	0.02	-0.27	-3.32
Males < 15	225.18	0.86	0.61	2.52
Females < 15	-274.98	-1.05	0.55	2.08
Females 15–65	48.52	0.19	-0.10	-0.38
Males 65+	78.61	0.14	0.33	0.65
Females 65+	-215.31	-0.66	-0.16	-0.22
Total assets at marriage	-0.01	-2.10	0.00	1.31
Share of women's assets	-11.36	-0.15	0.20	1.17
Rainfall index	35.85	0.73		
Livestock disease index	69.31	1.36		
Community rainfall index			-2.48	-14.57
Community livestock disease index			-1.45	-9.54
Geblen	-38.61	-0.14		
Dinki	15.76	0.06		
Shumshaha	298.46	1.04		
Sirbana Godeti	139.00	0.46		
Adele Keke	285.00	1.00		
Korodegaga	190.67	0.68		
Trirufe Kechemma	8.49	0.03		
Imdibir	170.76	0.62		
Aze Deboa	431.58	1.45		
Gara Godo	240.03	0.85		
Doma	-94.02	-0.34		
Debre Berhan	137.97	0.44		
Round 2 dummy	324.85	2.33	1.10	11.49
Round 3 dummy	27.16	0.41	-0.17	-1.97
Round 4 dummy	-75.16	-1.98	-0.00	-0.07
Constant	181.87	0.49	1.66	9.23
Log likelihood	-4,523.48			
Test of independent equations:				
Chi-square (p-value)	10.46	(0.00)		
Number of observations	2,818			
Censored	2,360			
Uncensored	458			

Note: Z-statistics in bold are significant at 10 percent or better.

measure, first differences in the following variables: the child's age and age squared, household consumption expenditure net of food aid and food for work, community livestock and rainfall shocks, and the interactions of the shock variables with child sex,



round dummies, and first differences and lagged differences in food for work, free distribution, the value of the aid receipt times a dummy for a female child, and the interaction of a dummy variable for a female aid recipient with a dummy variable for a female child. Only the coefficients of the aid variables are presented here. The explanatory variables are expressed either in lags or in first differences, eliminating variables that do not vary across time. Since the sample consists of children for whom

**Table 6—Effects of FD and FFW on child weight-for-height and height-for-age, low-asset households**

	Weight-for-height				Height-for-age			
	Children 0–4.9		Children 5–8.9		Children 0–4.9		Children 5–8.9	
	Coefficient	Z-score	Coefficient	Z-score	Coefficient	Z-score	Coefficient	Z-score
Number of observations	306		415		311		420	
Low-asset households (assets less than or equal to median assets)								
Value of FFW								
First difference	0.05	<b>1.93</b>	0.01	1.30	–0.04	<b>–1.73</b>	0.00	0.85
Lagged difference	–0.02	–0.47	0.01	1.04	0.02	0.60	0.00	0.37
Girl x FFW receipt								
First difference	–0.09	<b>–1.78</b>	–0.01	–0.44	0.02	0.38	–0.00	–0.05
Lagged difference	–0.02	–0.29	0.00	0.03	–0.05	–0.64	–0.08	<b>–1.99</b>
Girl x female participant								
First difference	–3.81	–0.29	0.05	0.02	–4.51	–0.33	0.23	0.07
Lagged difference	–3.13	–0.25	0.02	0.03	–5.85	–0.44	–0.58	–0.47
Value of FD								
First difference	–0.00	–0.65	0.00	0.10	–0.00	–0.58	0.00	0.18
Lagged difference	0.00	0.30	0.00	1.42	–0.00	–0.86	0.00	0.09
Girl x FD receipt								
First difference	0.00	0.56	0.00	0.29	–0.01	–1.19	–0.00	–0.39
Lagged difference	0.01	1.19	–0.00	–0.71	–0.01	–1.34	–0.00	–0.00
Girl x female recipient								
First difference	1.58	0.43	4.26	1.22	–3.58	–0.92	–0.11	–0.04
Lagged difference	–1.62	–0.87	–3.98	<b>–2.93</b>	1.45	0.80	–0.06	–0.05
Value of FFW and FD								
First difference	0.01	1.35	0.00	0.52	–0.01	–1.38	–0.00	–0.38
Lagged difference	0.00	0.63	0.00	<b>2.61</b>	–0.00	–1.00	–0.00	–0.15
Girl x total value of receipts								
First difference	–0.06	–0.66	–0.00	–0.31	–0.01	–1.31	0.00	0.50
Lagged difference	0.01	1.02	–0.00	–0.88	–0.02	<b>–2.94</b>	0.00	0.17
Girl x female FFW participant								
First difference	2.92	0.37	–9.08	–1.21	–0.73	–0.11	6.91	1.07
Lagged difference	2.28	0.29	1.37	0.56	–2.52	–0.40	0.05	0.04
Girl x female FD recipient								
First difference	1.16	0.30	4.54	<b>1.65</b>	0.84	0.31	–3.72	–1.41
Lagged difference	–0.64	–0.32	–3.68	<b>–2.47</b>	2.62	<b>1.87</b>	–0.09	–0.09

Notes: Regressors include lagged change in weight-for-height Z-scores, and first differences in net expenditure, age, age squared, community livestock and rainfall shocks, and interactions of the shock variables with child sex, and round dummies. Z-values in bold are significant at 10 percent or better.

**Table 7—Effects of free distribution (FD) and food-for-work (FFW) on child weight-for-height and height-for-age, high-asset households**

	Weight-for-height				Height-for-age			
	Children 0–4.9		Children 5–8.9		Children 0–4.9		Children 5–8.9	
	Coefficient	Z-score	Coefficient	Z-score	Coefficient	Z-score	Coefficient	Z-score
High-asset households (assets greater than median assets)								
Number of observations	319		431		328		438	
Value of FFW								
First difference	-0.01	-0.93	-0.01	-0.46	0.00	0.10	-0.01	-0.54
Lagged difference	-0.02	-0.76	-0.06	-0.76	0.01	0.29	-0.01	-0.19
Girl x FFW receipt								
First difference	-0.01	-0.32	0.01	0.31	0.12	0.95	0.00	0.17
Lagged difference	-0.31	<b>-2.25</b>	0.07	0.97	0.19	0.95	0.00	0.11
Girl x female participant								
First difference	4.43	0.75	-1.58	-0.47	-6.87	-0.86	-2.46	-1.27
Lagged difference	-1.00	-0.43	0.51	0.16	0.58	0.20	-2.02	-0.81
Value of FD								
First difference	-0.01	-0.91	-0.00	-0.04	0.00	0.78	0.00	0.06
Lagged difference	0.00	<b>2.25</b>	0.00	<b>1.93</b>	0.00	0.82	-0.00	<b>-3.86</b>
Girl x FD receipt								
First difference	-0.00	-0.25	-0.00	-0.16	0.01	1.26	0.00	0.15
Lagged difference	0.01	<b>2.06</b>	0.00	<b>1.86</b>	0.00	0.79	0.00	0.12
Girl x female recipient								
First difference	3.01	1.53	3.63	<b>2.24</b>	0.01	0.00	-1.11	-0.68
Lagged difference	-2.16	-1.53	-2.65	<b>-2.17</b>	-0.67	-0.62	0.81	1.26
Value of FFW and FD								
First difference	-0.00	-0.47	-0.00	-0.03	-0.00	-0.34	-0.00	-0.44
Lagged difference	0.00	<b>2.45</b>	0.00	<b>1.84</b>	0.00	1.04	-0.00	<b>-4.01</b>
Girl x total value of receipts								
First difference	-0.00	-0.35	0.00	0.12	0.00	1.36	-0.00	-0.02
Lagged difference	0.00	0.65	0.00	<b>1.83</b>	0.00	0.39	-0.00	-0.37
Girl x female FFW participant								
First difference	15.34	1.23	-3.57	-1.42	-10.25	-0.83	-1.81	-0.95
Lagged difference	3.45	0.99	-0.93	-0.67	-1.56	-0.60	-1.55	-1.24
Girl x female FD recipient								
First difference	4.51	1.59	2.77	<b>1.73</b>	-0.07	-0.04	-0.01	-0.01
Lagged difference	-1.40	-0.50	-2.60	<b>-2.16</b>	0.26	0.26	1.43	1.60

Notes: Regressors include lagged change in weight-for-height Z-scores, and first differences in net expenditure, age, age squared, community livestock and rainfall shocks, and interactions of the shock variables with child sex, and round dummies. Z-values in bold are significant at 10 percent or better.

we have observations on all four rounds within each age group, and because the differencing procedure reduces the number of observations used in estimation, the sample size used for estimation is much smaller than the original sample size of children.<sup>23</sup>

Regression results for low-asset households (Table 6) show that both FFW and FD have gender-differentiated impacts. FFW has a positive direct impact on weight-for-height for children ages 0 to 5 in low-asset households, although there is weak evidence that FFW has improves boys' weight-for-height more than it does girls'. This effect does not depend on the gender of the aid recipient. In contrast, among older children, if FD is received by a woman, it results in an improvement of boys' weight-for-height relative to that of girls. The lagged difference of total aid receipts has a positive impact on weight-for-height of older children. The effects of the interaction of child sex and a female recipient in the combined aid regression do not show a consistent pattern of gender preference.

Since height-for-age is a measure of long-term nutritional status, it is not as responsive to food aid interventions in the short run as is weight-for-height. This study finds that FFW has a weak negative impact on height-for-age of younger children. Similar to the effects on weight-for-height, total food aid receipts seem to improve boys' height-for-age more it does girls'. If a woman is the FD recipient, however, this weakly favors younger girls. Height-for-age of older children is less responsive to food aid partly because height growth slows down for older children. The only significant food aid variable (the lagged difference in FFW receipts interacted with the female child dummy) suggests that FFW receipts tend to improve boys' long-run nutritional status relative to girls.

Do these effects differ for high-asset households? Among younger children, FFW receipts improve boys' weight-for-height relative to girls. In contrast, FD has both a

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<sup>23</sup> Attrition bias may arise because children who remain in the sample for all four rounds may be better nourished than those who leave the sample (as in child death due to undernutrition). However, in this analysis, the reduction in sample size arose mainly because of the differencing procedure and the age criterion used to define the sample for estimation.

positive direct effect on weight-for-height for both older and younger children, and tends to benefit girls. Total food aid receipts, regardless of modality, improve weight-for-height, and weakly favor girls. The effects of the gender of the FD recipient on girls are not consistent, with the first difference showing a positive effect, and the lagged difference a negative one. Consistent with the relative insensitivity of height-for-age to short-run interventions, the aid variables have a negligible impact on height-for-age. Although not reported in the tables, the strongest determinant of height-for-age is the lagged change in height-for-age. There is an indication, however, that FD receipts have a lagged negative effect on height-for-age of older children, although the coefficients are very small in magnitude.

To summarize, FFW has a positive direct impact on the weight-for-height of younger children in low asset households, while FD has a similar positive impact on children of both age groups in high-asset households. The effect of FFW on low-asset households probably reflects its self-targeting features. Does food aid have a differential effect on child gender, depending on its modality? In both low- and high-asset households, FFW receipts appear to be invested in improving boys' nutritional status relative to girls, while in high-asset households, girls' nutritional status improves with FD. The effects of a female recipient of food aid are inconsistent. To interpret these results, we return to the collective model of the household. FD receipts, which are not conditional on work effort, can be considered a form of unearned income. FFW opportunities, on the other hand, reflect a change in the wage rate as well as improvements in women's outside options. Increases in the households' unearned income from FD are invested in girls, but changes in the wage rate and in women's outside options from FFW translate into better outcomes for boys.

## **6. Conclusions and Policy Implications**

This paper has examined the effects of food aid on child nutritional status through two complementary analyses: one of the determinants of participation in, and receipts

from, two types of food aid programs, and investigation of the effects of food aid on child nutritional status. The analysis of both FD and FFW receipts shows that these increase with negative rainfall and livestock shocks, thus performing an important consumption-smoothing function. Participation in FFW also seems to be well-targeted to poorer households. While participation in FD seems to be motivated more by household characteristics such as the presence of young children rather than household wealth, FD receipts do decline with wealth. Thus, both programs are also reaching poorer and more vulnerable households in their communities. The analysis at the first level, however, does not reveal who in the household benefits from aid received. The analysis of child nutritional status shows that the effects of food aid on individuals within the household differ, depending on the modality of food aid and the gender of the child. Both FFW and FD have a positive direct impact on weight-for-height, which is expected to respond more to these interventions in the short run. Households seem to invest proceeds from FD, which can be interpreted as an increase in unearned income, in girls' nutrition, while earnings from FFW are manifested in better nutrition in boys. The effects of the gender of the aid recipient are not conclusive.

Why would different forms of transfer income be invested differentially depending on the gender of the child? First, parents may want to use some forms of aid to redress imbalances among children. Nutritional status indicators, while poor for both boys and girls, become progressively worse for boys (see Table 3). Second, it may be due to returns that parents expect to reap from children in their old age. In related work using the same data set, Quisumbing and Maluccio (2000) find that daughters of mothers who bring more resources to the union have inferior educational outcomes than do their brothers. If boys are important sources of old-age security, mothers may choose to invest preferentially in boys. If FFW is increasingly targeted to women, mothers may use their increased bargaining power to preferentially invest in boys. A general increase in household wealth, however, operating through FD receipts, may result in better outcomes for girls.

These findings suggest that stopping at the household level to assess the impact of food aid may not reveal how the modality of food aid affects investments in the next generation. The effects of food aid are not limited to its effects on unearned income and women's outside options. Children's time allocation may also change, depending on the modality of food aid (Yamano 2000). Participation in FFW may also affect time allocation and nutritional status of participants. While participation in demanding physical labor such as FFW may improve children's nutritional outcomes, it may lead to a deterioration in the participants' own nutritional status as well as a reallocation of time away from the production of home goods, again with implications for child health and nutrition.<sup>24</sup>

Program designers need to examine the impact of food aid on individual outcomes, both for adults and for the next generation, to better assess food aid's long-term impact.

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<sup>24</sup> Evidence that increased physical labor is detrimental to nutritional status can be found in Higgins and Alderman (1997).

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