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ARE DETERMINANTS OF RURAL AND URBAN FOOD SECURITY AND NUTRITIONAL STATUS DIFFERENT? SOME INSIGHTS FROM MOZAMBIQUE

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ABSTRACT

Undernutrition of children 0-60 months old in Mozambique is much higher in rural than in urban areas. Food security is about the same, although substantial regional differences exist. Given these outcomes, we hypothesized that the determinants of food security and nutritional status in rural and urban areas of Mozambique would differ as well. Yet we find that the determinants of food insecurity and malnutrition, and the magnitudes of their effects, are very nearly the same. The difference in observed outcomes appears primarily due to differences in the levels of critical determinants rather than in the nature of the determinants themselves.

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1. INTRODUCTION

National and municipal governments in developing countries have long struggled to conquer urban poverty, food insecurity, and malnutrition. In an increasingly urbanized world, that challenge will not go away soon. International aid agencies, whose programs have traditionally concentrated on rural areas, are now moving systematically to develop strategies to improve urban livelihoods.

As they detail their strategies for urban areas, governments and assistance organizations ask whether they can simply transfer their conceptual frameworks and programs from rural areas to the cities. A number of studies have looked at food security or nutritional status in rural and urban areas (Alderman 1990; Alderman and Higgins 1992; Blau, Guilkey, and Popkin 1996; Ricci and Becker 1996; Sahn 1994; Sahn 1988; Thomas, Strauss, and Henriques 1991; Thomas and Strauss 1992), but none have explored in depth the question of whether the factors that determine food and nutrition security are different between rural and urban areas, and what the implications of these differences are for the design and operation of food and nutrition programs.

The present study answers some of these questions using new data from a 1996-97 national household survey of living conditions in Mozambique. The paper concludes by highlighting implications of the findings for improving food and nutrition security in Mozambique and, more generally, for policy and program design in both rural and urban areas.

2. FOOD AND NUTRITION SECURITY IN MOZAMBIQUE

Mozambique faces severe challenges in eliminating poverty and food and nutrition insecurity. The country is only now emerging from decades of civil strife and is still coping with a transition to a more liberalized market economy. Despite Mozambique's largely rural population, urban food insecurity and malnutrition are significant problems. In Mozambique, 62 percent of the urban population is poor, and 18 percent of the total poor live in urban areas (MPF/UEM/IFPRI 1998). Given the United Nation's (1998) estimate of an urbanization level of 35 percent and a population of 15.7 million people (INE 1999), 2 million poor people now live in the cities and towns of Mozambique. This is more than the number of urban poor in highly urbanized Colombia and over half the number of urban poor in Indonesia, with a population more than 12 times that of Mozambique (Haddad, Ruel, and Garrett 1999).

Recent data also suggest that food insecurity is slightly higher in urban areas of Mozambique than in the countryside. Sixty-seven percent of the urban population is food insecure, compared to 64 percent of rural residents.[1] These aggregate figures, however,

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[1] In both this paper and the Mozambique poverty assessment report (MPF/UEM/IFPRI 1998), food security is defined as whether the household had enough calories available to meet caloric requirements of household members, using an adult equivalent unit measure. The number of “adult equivalents” in the household was determined by scaling the requirements of each individual in the household to those of a reference adult, based on age, sex, and an assumption of a moderate activity level. The 3,000 kilocalories per day requirement of the reference adult was based on the estimated requirements of an adult male, 18 to 30 years old, with moderate activity levels (FAO/WHO /UNU 1985). Expressing food security in these units makes it difficult to tell whether the difference between levels of food security in rural and urban areas is significant. Because the proportion of moderately active individuals may be higher in rural than in urban areas, adjustment for higher activity levels in rural areas could reduce the magnitude of the observed difference in levels of food security between urban and rural areas.

mask important regional differences. While levels of food insecurity in the rural areas of the central and southern regions, and in Maputo and other cities, are roughly similar, at about 65 to 75 percent, food insecurity is much lower in the northern region of Mozambique, which is the most productive agricultural area, at only 48 percent (MPF/UEM/IFPRI 1998).

Prevalence of childhood malnutrition, on the other hand, is clearly worse in rural than in urban areas, regardless of region (MPF/UEM/IFPRI 1998), as is typical of most developing countries (Ruel et al. 1998). In Mozambique, 46 percent of rural preschoolers are stunted (height-for-age Z-scores < -2), compared to 26 percent in urban areas.[2] Despite its seemingly low prevalence in urban areas, stunting affects approximately 225,000 urban preschoolers. Considering the well-documented, long-term negative consequences of stunting on adult stature, body composition, work capacity, and women's reproductive performance (Martorell 1993), as well as new evidence of an association with increased risks of chronic disease and obesity (Barker 1994), these numbers are alarming.

As one of the poorest countries in the world, with an annual per capita expenditure of US$170 (MPF/UEM/IFPRI 1998), Mozambican policymakers must make hard choices

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[2] Although the level of wasting, or acute malnutrition, in Mozambique is indicative of poor country conditions (WHO 1995), it is low in Mozambique relative to stunting, or chronic malnutrition. Given the relatively low prevalence of acute malnutrition (6–7 percent in both urban and rural areas), this study chooses to focus only on the determinants of chronic malnutrition. Also, these estimates should be interpreted as a lower bound for malnutrition in Mozambique as approximately one-third of the anthropometric data collected for the survey was not usable. These unusable observations tended to be on children from rural areas and from poorer households (which tend to have higher prevalence of malnutrition), perhaps leading to an underestimate of actual prevalence of malnutrition (MPF/UEM/IFPRI 1998).

about how best to use their limited domestic resources. The above figures highlight the fact that they cannot focus their attention only on rural areas. Yet information on factors affecting food insecurity and malnutrition in urban areas is scarce and most programs are designed to alleviate poverty and food insecurity in rural areas. This paper provides insights into the factors that affect food and nutrition security in both areas, in ways that can assist policymakers and program administrators to act most effectively to reduce poverty and food and nutrition insecurity in rural and urban areas of Mozambique.

3. MODELS AND ESTIMATION PROCEDURES

Following well-known expositions (Behrman and Deolalikar 1988; Strauss and Thomas 1995), we use a standard household utility model to examine the determinants of food security[3] and nutritional status by specifying, respectively, a demand function for calories and a production function for child nutritional status. Conceiving of demand for calories as similar to demand for any other good, demand for calories will be influenced by income (Y_h), prices ($\boldsymbol{P}_h$), and demographic characteristics and other exogenous factors ($\boldsymbol{Z}_h$). The vector of prices includes not only food but also prices of other purchased and home-produced "goods," such as nutrition and health.

[3] Although calorie availability is a widely accepted indicator of food security, we recognize it measures only quantity of food. It does not incorporate other possible dimensions of food security, including nutritional adequacy, safety, or cultural acceptability (Oshaug 1994). Definitions of food security now reflect, according to Maxwell (1996), a "cornucopia of ideas." Consequently, this paper will, for the most part, use the term that more accurately reflects the focus of the study—calorie availability—rather than the potentially more confusing term "food security."

Maximizing utility subject to income constraints and the nutrition production function, we can derive a reduced-form household-level demand function for calories (K_h). A reduced-form equation includes only exogenous variables. We consider income to be endogenous, so in the reduced form assets (A_h), a predetermined variable, replaces income:

$$K_h = f\,(P_h, A_h, Z_h).$$

Nutrition for individual *i* can be conceived of as the output of a production function in which a specific technology translates inputs into nutritional outcomes, which are represented by some standardized anthropometric measure such as height-for-age. Guided by the underlying biological and economic determinants of nutritional status (UNICEF 1990), we can generalize to say that nutrition (N) is produced by a set of inputs, including caring behaviors directed toward the individual (C_i), health status and the household environment (H_i), and dietary intake (K_i), to which calorie availability at the household level, K_h, contributes:

$$N_i = N\,(C_i, H_i, K_i\,).$$

ECONOMETRIC CONSIDERATIONS

To estimate the independent effect of, say, income on calories or nutritional status, ordinary-least-squares (OLS) estimates will only be unbiased if we can rule out correlation between the error term and all explanatory variables. For income in the calorie availability regression or in the nutritional status regression, such a correlation is likely to exist. For instance, some unobserved influence, such as entrepreneurial talent, could influence both household calorie availability and household income, and so the explanatory variable (income) would be correlated with the error term.

Use of OLS in the presence of such endogeneity gives biased and inconsistent estimates. In principle, use of instrumental-variables (IV) estimation can resolve this problem. For IV estimation to eliminate the correlation between the explanatory variable suspected of endogeneity and the error term, the instrumental variable must be contemporaneously uncorrelated with the error *and* correlated with the potentially endogenous variable it is instrumenting. However, if the correlation between the instrumental variable and its corresponding endogenous variable is weak, the variance-covariance matrix of the IV estimator will increase. Consequently, the IV estimator may not be very precise, and, using a criterion of mean-squared error, we might prefer the OLS estimator (Kennedy 1992).

Additionally, if even a weak relationship exists between the instrumental variable and the error in the equation with the potentially endogenous variable, IV estimates may themselves be inconsistent. In finite samples (even large ones) if this association exists, IV estimates will be biased in the same direction as OLS estimates, and the magnitude of the bias will approach that of OLS as the F-statistic on the excluded instruments in the first-stage regression goes to zero (Bound, Jaeger, and Baker 1995).

CONCEPTUAL AND EMPIRICAL MODELS

Conceptual models and empirical evidence can help place this theoretical discussion in context and suggest which variables belong in the estimated equations and what estimating procedures are appropriate.

Calorie Availability

The access that a household has to food depends on whether the household has enough income to purchase food at prevailing prices or has sufficient land and other resources to grow its own food. It can also receive assistance from formal programs or informal networks to compensate for any shortfall. Factors other than income and prices can also affect household calorie availability, mostly by influencing preferences. These factors include household demographic structure (such as the presence of small children or the elderly and gender of the household head), educational levels of household members, and location (including differences among regions as well as between urban and rural areas). Household income and the kinds of food available can also vary by season. Of special interest in Mozambique is whether those displaced during the war have unique characteristics that affect their food security. The calorie availability model includes variables to reflect the influence of each of these factors.

Nutritional Status

In addition to factors that affect the household's access to food, which can affect an individual's own dietary intake, a child's nutritional status will also be affected by the hygienic condition of the household, ease of access to and quality of health care, and mothers' caregiving practices.

Because the survey was designed primarily to collect expenditure and demographic information, it did not collect detailed information on the proximal determinants of nutritional status, such as individual dietary intake, nor on genetic or biological factors that determine growth such as mother's height. As a result, in some cases we use household-level variables to represent the effects of these potential determinants at the individual level, while understanding that intrahousehold mechanisms mediate the effect of these factors on child nutrition.

Factors affecting the household's access to food, which may also affect the child's access to food, are detailed above in the discussion of the calorie availability model. Maternal educational attainment is used as a proxy for caring practices.[4] Use of prenatal care is included as a proxy for preventive health care use, and availability of a latrine, source of water, and in-house crowding (denoted by number of rooms per capita) are used to capture the environmental conditions of the household. Because Mozambique is home to over 40 different tribal languages, the mother's ability to speak Portuguese, the nation's

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[4] Maternal education and adult female education were highly correlated. Logically maternal education is the more appropriate variable to include in the nutritional status models, and so adult female education was omitted.

lingua franca, is included as a potential indicator of the mother's ability to access or understand health or nutrition education messages. As local clinics may, in fact, use local languages, maternal ability to speak Portuguese may also capture further enrichment of a mother's own human capital or a wealth effect not otherwise captured in the model.

Because the determinants of malnutrition may differ according to the age of the child, as suggested by others (Grosse 1996; Sahn and Alderman 1997),[5] we separated the sample into two subsamples of observations on children less than 24 months of age and those 24-60 months old and ran age-specific models.

General

In the calorie availability and the nutritional status models, instead of reported income, we use the value of total household consumption (also referred to by many, including us, as household consumption expenditure). Expenditures are a better representation than income of total resources available to the household because households typically try to smooth consumption over time in the face of fluctuations in income. Consumption expenditure includes values for all current consumption, imputing values where necessary for items such as rent or home-grown food.

Because the variables for calories/AEU and consumption expenditure share a basis of calculation (the quantities of food consumed), any unobserved factor that affects

[5] Additional tests for our sample, not reported here, support the hypothesis of differences in determinants of the nutritional status of children 0-23 and 24-60 months old.

quantities of food consumed will affect them both and create a source of endogeneity. Two-stage least squares (2SLS) procedures were used to control for this endogeneity, with an index of household assets (the total number of different household items and vehicles possessed by the household) as the identifying instrument in combination with the other (exogenous) variables in the first-stage equation.[6] STATA 5.0, which provides corrected standard errors in 2SLS estimation, was used to estimate the regression equations.

Factors specific to each community, such as prices, could also affect calorie availability and nutritional status. Unfortunately, the community survey was not carried out in both urban and rural areas, so comparable data are not available for these factors in both areas. To control for unobserved community-level heterogeneity, we employed a community fixed-effects model using a dummy variable for each of the communities in the sample (an administratively-defined neighborhood in an urban area and a locality in a rural area).[7]

Some variables had a number of missing observations (adult and mother's education, mother's ability to speak Portuguese, land possession, use of prenatal care, and latrine

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[6] The asset index comprised mainly household items and appliances, like radios and sewing machines, and vehicles. Although these assets seem more appropriate to urban than rural areas, this index performed better than other asset indexes composed of other, more rural-based assets, including livestock and other animals, even for this highly rural sample.

[7] In some cases, observations were not available within a particular community or inclusion of the dummy variable for community caused problems of perfect collinearity. The total number of community dummy variables for each model is 264 for the calorie availability model, and 268 and 252 for the 0-23 month age group and the 24-60 month age group, respectively, for the nutritional status models.

availability), although this was generally less than 10 percent of the observations. These variables were recoded so that a missing or 0 value was represented by 0. A separate dummy variable, coded 1 when the value for the corresponding variable was missing and 0 when it was not, was also included in the equation. This method allows us to retain other nonmissing observations from the household for which the information is missing in the sample, but it removes the influence of the missing value in estimating the parameter for where the household has no observation (Ward 1982). The coefficient on each of these variables is conditional on the observation being present. Tests for levels of significance of the variable that denotes a missing observation indicate whether or not those households with missing observations differ in some way from those with observations. Tables 1, 2, and 3 indicate the number of observations that were available for each variable.

We test for equality of coefficients in urban and rural areas using a dummy variable technique. Although an alternative method would be to estimate and test coefficients from similar models using separate urban and rural samples, the dummy variable approach allows for easier manipulation of the variables and permits information from both samples to be used when there is no significant difference between them (Kennedy 1992). For our models, we first interacted all variables (except regional and community-level dummies) with an urban-rural dummy and tested the significance of the interaction terms. Interactions that were insignificant at the 0.1 level or higher were dropped from the model. The results for each model, then, are based on only one equation using a combined sample.

4. DATA

The data are from a national cross-sectional household demographic and expenditure survey carried out by the Government of Mozambique from February 1996 to March 1997. Data from 8,274 households were collected to be representative at the level of each of the 10 provinces and the capital, Maputo. Although nonfood expenditures made monthly or quarterly were collected in the principal questionnaire, food expenditures were collected from a daily consumption module that covered a 7-day recall period. Household-level calorie availability was calculated from this daily consumption module. After excluding extraordinarily unreasonable values of calorie availability per Adult Equivalent Unit (< 800 calories/AEU and > 7,000 calories/AEU), the sample used for estimation included 6,463 households.

Anthropometric measures of height, along with age in months, were also collected for all children 60 months old and younger in the household. Z-scores were derived using the WHO/CDC reference values (WHO 1979). When outlying values of / 5 Z-scores for height-for-age were excluded, a total of 1,474 observations remained on children < 24 months old and 1,835 for those ≥ 24 and ≤ 60 months of age. When households with values for calories/AEU outside the acceptable range were then omitted, 1,201 and 1,514 observations, respectively, remained.

5. RESULTS

DESCRIPTIVE ANALYSES

The descriptive data suggest some striking differences between rural and urban areas as well as some interesting similarities. Table 1 uses data from the calorie availability sample and shows that, with a higher cost of living in the cities, the total mean consumption expenditure/day/capita is more than twice as high in urban than in rural areas. Reflecting higher food prices in the cities, the average value of food consumption/day/capita is also higher in urban than in rural areas, 4,655 Mts. versus 2,840 Mts. (MPF/UEM/IFPRI 1998). Despite substantially higher expenditures, the mean calories/day/AEU is slightly lower in urban than in rural areas, although, as with the comparison of levels of food security, the number must be treated with some caution.

From the poverty assessment report, we know that city-dwellers purchase 83 percent of this food, while those who live in rural areas purchase only 30 percent of it, either growing or gathering the rest or receiving it as transfers from social assistance programs or other households.

Educational levels are much higher in urban areas. No male adult is literate or has any education in 71 percent of rural households, while at least one adult male in 73 percent of urban households is literate or has some education. In an astounding 91 percent of rural households, no female adult is literate or has any education, while this is true of 54 percent of urban households. Although almost all rural households in the sample have land, only 42 percent of urban households do.

Demographic structure and household size are about the same in rural and urban areas. On average, about half the household members are younger than 18 years old, and the average household has about 5 members. Women head about 20 percent of households in both areas.

In summary, expenditure levels are higher in urban areas but calorie availability is not, which, in addition to greater expenditure on nonfood needs, may also reflect higher prices and lower energy requirements due to lower physical activity. Education, which is assumed to affect income levels, is higher for both men and women in urban areas, though women still lag far behind.

Tables 2 and 3 describe the data used in the nutritional status models. The mean height-for-age Z-score is much lower in rural than in urban areas. For children 0-23 months, the mean Z-score is –1.35 in rural areas versus –0.72 in urban areas. Corresponding figures for the 24–60 month age group are –1.91 and –1.19. Although not reported in the tables, prevalence of stunting among children 0–23 months is 39 percent in rural areas and 23 percent in urban areas, and 51 percent and 28 percent in rural and urban areas, respectively, for children 24–60 months old.

Educational levels of adults in households with preschoolers are much lower in rural than in urban areas, mirroring the levels in the general population, as shown by comparison with Table 1. Whereas 80 percent of mothers with preschoolers in urban areas speak Portuguese, only about 30 percent of rural mothers do. Well over 90 percent of urban mothers, but only 62 percent of rural mothers, receive some prenatal care.

Urban households have greater access to improved sanitation and piped water or public taps. About 70 percent of urban households with preschoolers have latrines and 50–60 percent have piped water or get water from public taps. Only 35 percent of rural households have latrines. Over one-third of rural households get water from rivers and lakes, compared to fewer than 5 percent of urban-dwellers. Almost half of rural households get water from public or private wells.

In-house crowding is similar in rural and urban areas, with about two household members per room. While about 10 percent of these households with preschoolers are headed by women in rural and urban areas, half that of the general population as shown in Table 1, means of other variables are about the same. Neither are any substantial differences apparent between Tables 2 and 3.

In summary, preschoolers in urban areas seem to have higher levels of the inputs required for good child nutrition: higher levels of expenditure and maternal and adult male education as well as better access to sanitation and safe water.

MULTIVARIATE ANALYSES

Table 4 summarizes the results of our tests exploring the potential endogeneity of the household expenditure variable in the calorie availability and the nutritional status models. The Durbin-Wu-Hausman test determined whether OLS and 2SLS give significantly different coefficients on household expenditure. If the two procedures provide significantly different results, and we have a reasonably good prediction of household expenditure in the first-stage regression, then we can be reasonably confident that we should use the 2SLS estimates. For the calorie availability model and the nutritional status model for 24-60 month old children, the Durbin-Wu-Hausman statistic rejects the hypothesis that the OLS and 2SLS estimates are identical. This hypothesis cannot be rejected for the nutritional status model for 0-23 month old children.

Following the suggestion of Bound, Jaeger, and Baker (1995), the F-statistic on the identifying instruments in the first-stage estimation of each model is reported as an indicator of its quality. Table 4 shows that the instrumental variables perform well, and are highly significant in the first-stage regressions of all three models. The results in Table 4 suggest that the 2SLS estimates are preferred for the calorie availability model and the nutritional status model for 24-60 month olds. OLS is preferred for the nutritional status model for 0-23 month olds.

For reported results for all models, when rural and urban coefficients are the same, the interaction term was insignificant and was dropped before the final model was estimated. Therefore, there is just one coefficient (the same in both areas) to report. Where rural and urban coefficients differ, the interaction term was significant and parameters were calculated separately. The coefficient in the table represents the main effect of the variable in either the rural or the urban area, as noted.

Calorie Availability Model

Table 5 presents the OLS and 2SLS estimates for the calorie availability model. We focus on the 2SLS estimates for reasons given above.

Only household expenditure, household size, household composition, seasonality, and location have any significant effect on calorie availability. Of these, only household expenditure and household size have a different effect on calorie availability in urban and rural areas.

The expenditure elasticity for calorie availability is slightly higher in urban than in rural areas (.14 compared to .12),[8] which suggests that a city-dweller is more likely to spend an increase in income on food than a rural-dweller. Although low, the estimates of the expenditure-calorie elasticity are consistent with other 2SLS findings (Behrman and Deolalikar 1987; Bouis and Haddad 1992). On the other hand, this contrasts with analysts who have found that expenditure-calorie elasticities are typically higher for poor families and those living in rural areas (Alderman and Higgins 1992; Alderman 1986; Sahn 1988).[9]

Greater household size has a large negative impact on calorie availability, with the effect initially greater in rural than in urban areas. The quadratic term is significant and positive, indicating that the negative impact is increasing at a declining rate. This

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[8] Because the data used in the regression were not weighted, elasticities are calculated using the unweighted mean of 2,950 calories/AEU/day for the sample.

[9] In Mozambique mean consumption expenditure per capita in rural areas is only about half that of urban areas (4,797 Mts. versus 10,476 Mts., respectively). On the other hand, average daily calories/AEU are about 10 percent lower in urban areas (2,835 versus 3,033), so the elasticity may be reflecting a logical greater marginal propensity to spend on food.

relationship reflects the ability of larger households to begin to mitigate the negative effects of an additional household member through exploiting economies of scale in consumption. The negative effect is larger in rural areas than in urban areas at small household sizes, although larger household size begins to have a positive effect at 10 members in rural areas and 13 in urban areas. The reason for this differential relationship is an important topic for future research. Perhaps additional members in rural areas have limited opportunities to improve household income and food availability but stronger social networks in rural areas eventually begin to compensate for this effect.[10] In any case, fewer than 10 percent of households are composed of more than 10 individuals, so the negative effect of household size on calorie availability holds for almost all households in the sample.

The positive effect on calorie availability of having higher percentages of children or of elderly people in the household probably reflects the construction of the dependent variable: when household size is the same, households with larger percentages of children or the elderly will, because these individuals have lower calorie requirements, have a lower number of "adult equivalents" than those with young adults. The same per capita sums, then, could be used to provide more food for a smaller number of "adult equivalents," creating a positive relationship.

Surprisingly, seasonality does not have a differential effect between urban and rural areas. Rather, calorie availability declines substantially in both urban and rural areas

[10] See MPF/UEM/IFPRI (1998) for a more complete discussion of social networks in Mozambique.

during the period of early rains and the harvest season, as compared to the rainy season (the omitted dummy variable). Calorie availability in the post-harvest period does not differ significantly from the rainy season. This result is difficult to interpret. Although calorie availability might understandably decrease during the early rains (a postharvest period of intense agricultural activity), it is unclear why calorie availability would increase in the rainy season only to decline again during the harvest period. Correlation of these seasons with a determinant of calorie availability could help explain this result, but such a correlation is not readily apparent.

Although only individually the parameter on "other urban areas" (smaller urban areas outside Maputo and the secondary cities) is significant, the parameters on the regional variables as a whole are highly significant (Pr > .0001) and, in many cases, are quite large. Residence in smaller urban centers has a substantial negative effect on calories/AEU/day and residence in rural areas of the northern provinces has a substantial positive effect. The high significance level of the dummy variables included for each community, when considered as a group, confirm that community-level factors, such as prices, also exert strong influences on household-level calorie availability.

Just as interesting as what is significant, is what is not. Level of education (as represented by the highest level of education attained by an adult member of the household) did not affect household calorie availability—at least beyond the effect of income, which is already included in the model. In fact, to test whether the income effect was working through education (and therefore reducing the significance of the education variable), we dropped the expenditure variable and re-estimated the model. Education remained insignificant.

Finally, we might expect to find some association between calorie availability and variables such as land availability per capita, the gender of the head of the household, and whether the household had members who had migrated during the war. The results show that these characteristics do not affect calorie availability independently, once we control for other factors.

In general the results from this estimation conform to expectations: income and prices (as represented by the community dummy variables) matter to household-level calorie availability. Demographic structure and regional location of the household are also important, and probably affect availability through their influence on food consumption patterns. Only household size and household expenditure levels have a small differential effect on calorie availability in urban and rural areas.

Nutritional Status, 0-23 months of age

Table 6 presents the preferred OLS estimates of the factors affecting nutritional status of children 0-23 months old. There are no significant differences in the determinants of nutritional status of children 0-23 months of age in urban and rural areas with the exception of households surveyed in the post-harvest period, where there is a negative impact on child stunting relative to the rainy season. This difference is most likely due to the fact that no households in urban areas outside Maputo City were surveyed during the postharvest period. This variable is therefore acting, in part, as a dummy variable representing Maputo, where child stunting is lower than in other areas. Effectively, then, there is no difference between urban and rural areas in the relative effects of the determinants of nutritional status of children 0-23 months old.

Statistically significant determinants of child height-for-age Z-scores in both urban and rural areas in this sample include child characteristics (sex and age), maternal characteristics (education level) and household characteristics (expenditure per capita and percentage of household less than 5 years of age).

Girls' nutritional status is better than boys' by 0.36 Z-scores. This reflects the documented, yet not well-understood, greater vulnerability of boys at this age (Svedberg 1990). Nutritional status deteriorates rapidly with age, at the rate of 0.13 Z-scores per month, reflecting deterioration in the rapid growth that typically occurs in young children.

Mother's education has a significant effect on children's nutritional status at this age. Even just being literate or having some education improves the child's nutritional status by more than one-third of a z-score.[11] Because the model controls for income (through the expenditure variable), the effect of maternal education documented here is independent of income and probably reflects better maternal caring practices such as child feeding, use of health services and hygiene. The highest level of education attained by an adult male in the household is not significant.

[11] In the nutritional status models, mother's education has only two categories: none/illiterate and literate or at least some formal education. Insufficient numbers of women in the sample for the nutritional status models had completed primary level or higher to create a third and separate category.

In contrast to findings by Sahn and Alderman in Mozambique (1997), we find that expenditure matters even for this young age group, with 10 percent rise in expenditure contributing to a 2.4 percent improvement in Z-score. Still, for the effect of income to equal that of maternal literacy or only some maternal schooling, income would have to more than double.

To investigate whether the effect of maternal education varied by income level, we added an interaction term of expenditure and maternal education to the model. We do not present the results here, but a positive sign on the interaction term, which was significant, indicated that education enhances the positive effect of increases in expenditure. Other researchers have documented similar results showing that maternal schooling is associated with improved child nutrition only among households that have access to a minimum level of resources without being among the wealthiest group (Bairagi 1980; Reed, Habicht, and Niamego 1996).

Although household size does not affect nutritional status, larger percentages of children less than 5 years old in the household negatively affect height-for-age, with a 10 percent increase in this percentage causing a 3.7 percent deterioration in height-for-age Z-score. This could reflect the increased demands on maternal time that a larger number of small children exert; the shorter periods between births, which can result in lower birth weights and poorer postnatal growth; or, in light of the previous finding that households with small children have higher levels of calorie availability, resource allocation patterns within the households that do not favor younger children. With more than half of these households reporting more than one child under 5, further research into the causes of the decline would be well-justified.

Access to land and gender-based characteristics, such as gender of the head of the household or the mother's ability to speak Portuguese, do not affect nutritional status. Variables that reflect physical environment, including source of water, are not significant, nor is whether the mother received prenatal care. If regional effects exist, they appear to be captured by other variables in the model. Due to the low level of significance of regional variables (Pr > .62), they were dropped from the final model. On the other hand, the dummy variables for the communities were jointly significant, indicating the importance of local-level variation in determining nutritional status.

In summary, our results concur with those of other researchers who find that in young children (those 0–23 months old), the primary determinants of nutritional status are child biological characteristics (sex, age), and maternal schooling which probably acts through good child-care feeding, health and hygiene practices (Ricci and Becker 1996; Ruel et al. 1999). Household income is also a determinant of child nutritional status in our sample, a finding that contrasts with other studies in urban Mozambique (Sahn and Alderman 1997) and in Accra (Ruel et al. 1999).

The R^2 is similar to those found in other estimations of nutritional status (Alderman and Garcia 1994; Sahn 1994), but its relatively low value indicates that the explanatory power of the model remains to be improved, perhaps by including more specific descriptions of the more proximal determinants of nutritional status.

Nutritional Status, 24-60 Months of Age

Table 7 shows that the determinants of nutritional status in urban and rural areas only begin to differentiate once children are older.

Among the older age group, the effects of land holdings per capita, source of water, and seasonality differ between urban and rural areas. In urban areas, nutritional status declines if the household has land. The reason for this negative effect may be that, in urban areas, landholding is associated with poor environmental conditions and poor access to health care.[12] For example, urban households with land tend to live in cities outside Maputo where public services are less available and nutritional status is lower (MPF/UEM/IFPRI 1998). Landholdings by urban households may, then, in some sense be capturing regional effects. Households with land may also be raising animals in close proximity to the house, which in a crowded area may lead to a poorer quality environment inside and outside the house. Little work has been done on the impacts of urban agriculture and urban land holdings on child nutritional status (Maxwell, Levin, Csete 1998); additional research is needed to shed light on the nature of the association found here.

The importance of the physical environment for this age group is also highlighted by the negative effect of using well water in urban areas, as compared to piped water or

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[12] Although in this sample urban households with land do tend to be poorer than those without land, and may be using land as a coping strategy (Maxwell 1995), it is less likely that this negative association with land holding and nutritional status is associated with low incomes. Including expenditures in the model should have controlled for this effect. This conclusion is strengthened by noting that land holding did not show up as a key determinant in the calorie availability model.

public taps. Using well water in urban areas is associated with decline of 0.73 in height-for-age Z-score. This probably reflects contamination or lack of access to sufficient water.[13] Surprisingly, the source of water does not affect the nutritional status of children in rural areas.

The period of early rains has a significant negative effect on children in rural areas, relative to the other seasons of the year. The reasons for this decline are uncertain and should be explored further, but it could reflect a slowing of growth in a season where morbidity may be increasing along with moisture and temperatures, where calorie availability is falling, and demand for agricultural labor is increasing, perhaps drawing attention away from child care.

Household expenditure, household size, and the number of rooms per capita were the only other factors that affected the nutritional status of children 24–60 months old. The effects of these determinants did not differ between urban and rural areas. At this age, the more biological influences of age and sex of the child are no longer significant. Surprisingly, maternal education did not have any effect on children's height-for-age Z-scores at this age. Still, this concurs with findings by Sahn and Alderman (1997) for the same age group in Maputo. As with the model for 0–23 month old children, we tested an

[13] The benefits of using piped water to the nutritional status of children is well-known, but quantity as well as quality of water are important to reducing morbidity and improving child nutrition (Burger and Esrey 1995). The data do not permit further exploration of which is the key factor in urban areas of Mozambique.

interaction term of expenditure and maternal education to see if the effect of education varied with income level. The interaction term was not significant.

The impact of expenditure on nutritional status is stronger among the group of older children as compared to the 0–24 months old group. Although still provoking less than a one-to-one response, the expenditure elasticity for nutritional status of 0.43 is almost twice that of the younger age group and is fairly high. As distinct from its negative effect on household calorie availability, larger household size has a positive effect on older children's nutritional status. This may reflect some economies of scale in providing for the needs, in addition to food, of older children. The positive influence of less in-house crowding further argues for the importance of the physical environment for this age group. Each additional room per person in the household improves height-for-age Z-scores by 0.35.

As in the model for children 0-23 months old, once other factors are controlled for, the potential determinants of gender of head of household, use of prenatal care, existence of a latrine, or maternal ability to speak Portuguese do not exert independent influences on nutritional status. The significance of the community dummy variables support the analysis that community-level factors are also important to nutritional status. As with the model for children 0-23 months of age, better measurement of more proximal determinants of nutritional status would probably go far to improving the explanatory power of the model.

6. DISCUSSION

MAIN FINDINGS

Our results largely reject the hypothesis that the determinants of household calorie availability and nutritional status for children 0-23 months old are different between urban and rural areas. For children 24-60 months old, the determinants still have significant overlap but some differentiation between urban and rural areas begins to appear, especially in factors having to do with the child's surrounding physical environment.

In urban and rural areas, much the same factors determine calorie availability. Only expenditure and household size exert significantly different effects, and even then the magnitude of the difference is not large. The most important factors are, as one would expect from a demand equation, income (proxied by expenditure), prices (as reflected in the community dummy variables), and demographics, such as household size. Urban-dwellers do seem to be slightly more sensitive to changes in incomes than rural-dwellers. This may reflect urban residents' lack of a natural-resource "cushion" to absorb income or price shocks and also their need to purchase, rather than grow, their own food. Household size, for reasons to be explored, initially exerts a larger negative effect in rural than in urban areas. Regional factors are also influencing calorie availability in ways beyond the effects specified in the model. Future research should focus on elucidating the causes for these regional differences.

For children 0-23 months old, the same factors explain nutritional status in urban and rural areas with no difference in magnitude. For these children, biological factors and maternal education have the greatest positive influence on growth. To a large extent, mothers are responsible for feeding these younger children and they largely control the interaction they have with their physical environment. Thus, it is logical that little urban-rural differences are found in this age group.

Analysis of determinants for the older children points out that not only are determinants different for urban and rural areas but also for older and younger children. In comparison with the younger children, children 24-60 months old are more mobile, they are weaned from the breast, they are starting to eat a variety of family foods, and they are increasingly exposed to environmental contamination, which results in high rates of infectious diseases and poor growth. Factors related to environmental hygiene and food safety thus become critical for their health and nutritional status. Our results confirm that environmental factors do play a large role in determining nutritional status of older children, but also point out that the nature of the threat is different in urban and rural areas.

EXPLAINING URBAN-RURAL DIFFERENCES

Urban and rural livelihoods and lifestyles obviously differ. Consequently, we hypothesized that the levels and determinants of food security and nutritional status in rural and urban areas of Mozambique would be different, too. We found that while levels of key determinants of food insecurity and malnutrition, such as expenditure or education, may differ between rural and urban areas, the nature of the determinants and the magnitudes of their effects are very nearly the same. On the other hand, we found that these differences in levels do not necessarily express themselves in differences in outcomes: the level of calorie availability is roughly the same in rural and urban areas, while levels of stunting differ quite dramatically.

What explains these results? For nutritional status of both younger and older children, most of the urban-rural difference does appear due to differences in the levels of critical determinants, such as in income or mother's educational level. For example, stunting of children 0-23 months old is much more prevalent in rural than in urban areas (39 percent versus 23 percent, respectively), but there were no significant differences in the determinants of their nutritional status. Within the context of the significant variables in our model, we explain this difference in urban-rural levels of stunting by noting that expenditure levels and maternal education are much lower in rural areas. Expenditure levels in rural areas are only about half those in urban areas, and only 12 percent of rural mothers are literate or have any education at all, while a much higher 45 percent of urban mothers do.

On the other hand, the levels of some critical determinants of calorie availability are also very different between rural and urban areas, but levels of food insecurity, as measured by calories/AEU/day, are much the same. Failure to take potentially higher activity levels in rural areas into account could potentially underestimate the level of food insecurity there; perhaps the levels of food insecurity, then, are not that similar. But in the end, even if adjusted for energy requirements or household composition, rural households actually do, on average, receive more calories than urban ones.

The observed higher level of calorie availability in rural areas is more likely due to regional, agroecological influences not specifically captured in the model. These regional differences can be large. For example, the regression analysis shows that residing in the rural northern provinces has a large positive effect on calorie availability, beyond that of the other variables included in the model. Such a result is reasonable, given the northern zone's higher levels of agricultural production, but the reasons for it are unclear. Perhaps cultural preferences of households in the region for low-cost, energy-rich foods are at work, as well as other non-income factors. Perhaps the data do not adequately capture the value of consumption for rural households that depend to a large extent on natural resources that they use without financial cost. More research along the lines of Sharma et al. (1996), who look at the ecoregional dimensions of malnutrition, and Huang and Bouis (1996), who consider the impact of non-income factors on consumption patterns, could shed light on the reasons for these regional, not strictly rural-urban, differences.

POLICY RECOMMENDATIONS

Our analysis demonstrates that income is an essential determinant of calorie availability and nutritional outcomes in both rural and urban areas. Despite some debate about the effectiveness of increasing income in reducing food insecurity and malnutrition (Subramanian and Deaton 1996; Bouis and Haddad 1992; Behrman and Deolalikar 1987), income-generation in both urban and rural areas is undoubtedly important for achieving food and nutrition security in Mozambique. The recent poverty assessment of the Ministry of Planning and Finance (MPF/UEM/IFPRI 1998) emphasized the importance of investing in education, in agricultural productivity, and in rural infrastructure, as key elements of a poverty-reduction strategy there. Continued support of social assistance programs in Mozambique, such as the urban cash transfer program, will also be necessary to help those who cannot participate in the labor market and receive the benefits of overall increasing economic growth.

Women's education is also important to improving children's nutritional status. In the long term, improving girls' formal education and women's literacy and job skills will raise household incomes. In Mozambique, not only did maternal education have a positive effect on young children’s nutritional status above and beyond the income effect, but it actually enhanced the positive effect of income among the 0-24 months old group. In the long-run, increases in both income and maternal education could have large pay-offs in terms of reducing childhood malnutrition in Mozambique. Although our study does not elucidate the mechanisms by which maternal education affects child nutrition, others have shown that education acts largely through greater knowledge and improved caregiving practices (Cebu Study Team 1991; Ruel et al. 1992; Ruel et al. 1999). Thus, well-targeted nutrition education programs to improve specific caregiving practices, such as child feeding, hygiene and use of health services, could in the short term help mothers make better use of their scarce resources and protect their child’s health and nutrition.

Given our results indicating the negative effect of larger percentages of preschoolers on nutritional status of 0-23 months old and of larger household size on calorie availability, attention should also be directed at attenuating these conditions. Higher incomes and higher levels of girls' and women's education will over time probably lead to reductions in fertility and lengthen time between births, resulting in smaller household sizes and lower proportion of children under 5 in the household over time, although there may scope for direct actions that can, in the shorter term, also assist families in exercising their preferences in this area. In the meantime, social assistance programs should be sure to take into account the additional needs of larger households.

The physical environment emerges as a key difference between urban and rural determinants of nutritional status for older children. In-house crowding exerts a negative influence on children's nutritional status in both urban and rural areas, but the urban environment seems to exert a greater negative impact. Programs in urban areas, then, should concentrate on providing sanitation, garbage disposal, and clean water to households, especially those with children under 5. Just providing the 37 percent of households that use well water with adequate amounts of safe water could improve nutritional status significantly. Further investigation is warranted to confirm the possible link between landholdings and a poorer household environment, but targeting these programs to urban households that have land may be a way to identify and reach the most affected groups.

In conclusion, our analysis indicates that, conceptually, the determinants of food security and nutritional status are not very different between rural and urban areas. But policymakers and program administrators cannot simply transfer their programs from rural to urban areas. Because the levels, if not the magnitude of the effects, of the determinants are different in each location, policymakers and program administrators must understand specific community-level conditions so that they can identify which of the key variables programs must address. Creating programs and making policies that are flexible and adequately reflect the needs, conditions, and resources in each community is quite a challenge, but on a more positive note, our findings suggest that many of the determinants will be similar, and in large part, policymakers and administrators can continue to utilize the conceptual frameworks and approaches they have developed to reduce food insecurity and malnutrition in both urban and rural areas.

TABLES

Table 1 Variable description, means, and standard errors: Calorie availability model[a]

Variables	Rural Mean	Rural Standard error	Rural n	Urban Mean	Urban Standard error	Urban n
Continuous variables						
Calories/day/AEU	3,033.34	58.28	4,454	2,834.52	92.85	2,009
Expenditure/day/capita (meticais)	4,796.72	135.08	4,454	10,476.83	981.74	2,009
Land per capita (hectares)[b]	.59	.04	4,238	.37	.03	835
Percentage of household < 5 years old	.14	.01	4,454	.15	.01	2,008
Percentage of household ≥ 5 and ≤ 17	.32	.01	4,454	.34	.01	2,009
Percentage of household ≥ 60	.06	.01	4,454	.05	.01	2,009
Household size (number of members)	4.70	.06	4,454	5.51	.15	2,009
Dummy Variables						
Highest level of education by adult male in household						
None/illiterate	.71	.01	2,566	.27	.04	386
Some but less than primary	.20	.01	791	.29	.02	499
Completed primary or more	.09	.01	302	.44	.04	851
Highest level of education by adult female in household						
None/illiterate	.91	.01	3,812	.54	.04	885
Some but less than primary	.06	.01	333	.25	.02	473
Completed primary or more	.02	.00	114	.21	.03	505
War migrant	.06	.01	4,454	.03	.01	2,009
Female household head	.21	.01	4,454	.22	.01	2,009
Seasons[c]						
Early rains (December-February)	.28	.04	4,454	.29	.07	2,009
Rains (March-May)	.24	.04	4,454	.39	.07	2,009
Harvest (June-August)	.19	.03	4,454	.25	.08	2,009
Post-harvest (September-November)	.29	.04	4,454	.07	.02	2,009
Regions						
Maputo	-	-	-	.07	.02	6,463
Secondary cities[d]	-	-	-	.06	.02	6,463
Other urban areas	-	-	-	.08	.02	6,463
Rural provinces, north	.26	.04	6,463	-	-	-
Rural provinces, central	.37	.04	6,463	-	-	-
Rural provinces, south	.16	.02	6,463	-	-	-

[a] Weighted to reflect number of households in the sample. Standard errors adjusted for survey design.
[b] Conditional on having an observation.
[c] For central and northern provinces. Periods begin and end one month earlier for southern provinces.
[d] Beira, Matola, and Nampula.

Table 2 Means and standard error, nutritional status model, 0-23 months[a]

Variables	Rural Mean	Rural Standard error	Rural n	Urban Mean	Urban Standard error	Urban n
Continuous variables						
Height-for-age Z-score	-1.35	.08	806	-0.72	.15	395
Child age in months	10.30	.29	806	11.16	.44	395
Expenditure/day/capita (meticais)	4,080.47	200.65	806	7,323.31	825.87	395
Land per capita (hectares)[b]	.39	.02	764	.25	.03	188
Percentage of household < 5 years old	.30	.01	806	.28	.007	395
Percentage of household $\geq$ 5 and $\leq$ 17	.30	.01	806	.34	.01	395
Percentage of household $\geq$ 60	.01	.00	806	.01	.002	395
Household size (number of members)	6.65	.18	806	6.96	.24	395
Rooms in dwelling per capita	.49	.02	802	.51	.03	395
Dummy Variables						
Female child	.55	.02	806	.56	.03	395
Highest level of education by adult male in household[b]						
None/illiterate	.61	.04	435	.27	.06	81
Some but less than primary	.27	.03	198	.32	.03	114
Completed primary or more	.12	.02	95	.41	.07	159
Mother's level of education[b]						
None/illiterate	.88	.03	607	.55	.07	192
Literate or any schooling	.12	.03	81	.45	.07	177
War migrant	.09	.02	806	.05	.02	395
Female household head	.10	.01	806	.11	.02	395
Seasons[c]						
Early rains (December-February)	.23	.05	806	.30	.08	395
Rains (March-May)	.32	.05	806	.37	.09	395
Harvest (June-August)	.18	.04	806	.28	.12	395
Postharvest (September-November)	.27	.05	806	.05	.02	395
Regions						
Maputo	-	-	-	.05	.01	1,201
Secondary cities[d]	-	-	-	.05	.02	1,201
Other urban areas	-	-	-	.13	.04	1,201
Rural provinces, north	.23	.04	1,201	-	-	-
Rural provinces, central	.39	.05	1,201	-	-	-
Rural provinces, south	.15	.03	1,201	-	-	-
Mother speaks Portuguese[b]	.32	.03	707	.78	.05	380
Mother had prenatal care[b]	.62	.04	699	.92	.05	377
Have latrine[b]	.36	.04	779	.68	.06	347
Use well water[b]	.49	.03	777	.44	.11	341
Use piped water or public tap[b]	.14	.03	777	.52	.11	341
Use river water[b]	.36	.03	777	.04	.03	341

[a] Weighted to reflect number of individuals in the sample. Standard errors adjusted for survey design.
[b] Conditional on having an observation.
[c] For central and northern provinces. Periods begin and end one month earlier for southern provinces.
[d] Beira, Matola, and Nampula.

Table 3 Means and standard error, nutritional status model, 24-60 months[a]

	Rural			Urban		
Variables	Mean	Standard error	n	Mean	Standard error	n
Continuous variables						
Height-for-age Z-score	-1.91	.09	957	-1.19	.10	557
Child age in months	41.25	.53	957	41.35	.53	557
Expenditure/day/capita (meticais)	4,061.35	206.64	957	7,606.66	677.27	557
Land per capita (has.)[b]	.40	.02	899	.31	.05	253
Percentage of household < 5 years old	.29	.01	957	.27	.01	555
Percentage of household ≥ 5 and ≤ 17	.34	.01	957	.37	.01	557
Percentage of household ≥ 60	.01	.00	957	.01	.00	557
Household size (number of members)	7.07	.14	957	7.63	.20	557
Rooms in dwelling per capita	.46	.01	952	.47	.01	557
Dummy variables						
Female child	.51	.02	957	.44	.04	557
Highest level of education by adult male in household[b]						
None/illiterate	.58	.04	480	.19	.03	92
Some but less than primary	.28	.03	234	.34	.04	164
Completed primary or more	.14	.02	124	.47	.04	240
Mother's level of education[b]						
None/illiterate	.89	.02	720	.56	.04	280
Literate or any schooling	.11	.02	101	.44	.04	243
War migrant	.10	.03	957	.04	.01	557
Female household head	.10	.01	957	.15	.02	557
Seasons[c]						
Early rains (December-February)	.27	.06	957	.36	.08	557
Rains (March-May)	.31	.05	957	.38	.08	557
Harvest (June-August)	.16	.03	957	.20	.07	557
Postharvest (September-November)	.26	.04	957	.06	.03	557
Regions						
Maputo	-	-	-	.05	.01	1,514
Secondary cities[d]	-	-	-	.05	.02	1,514
Other urban areas	-	-	-	.13	.04	1,514
Rural provinces, north	.23	.04	1,514	-	-	-
Rural provinces, central	.39	.05	1,514	-	-	-
Rural provinces, south	.15	.03	1,514	-	-	-
Mother speaks Portuguese[b]	.30	.03	826	.84	.03	528
Mother had prenatal care[b]	.62	.04	801	.95	.02	517
Have latrine[b]	.37	.04	922	.71	.05	490
Use well water[b]	.48	.03	908	.36	.06	491
Use piped water or public tap[b]	.13	.03	908	.62	.07	491
Use river water[b]	.39	.03	908	.02	.01	491

[a] Weighted to reflect number of individuals in the sample. Standard errors adjusted for survey design.
[b] Conditional on having an observation.
[c] For central and northern provinces. Periods begin and end one month earlier for souther provinces.
[d] Beira, Matola, and Nampula.

Table 4 Instrumental variable estimation test statistics

Potentially endogenous variable	F-statistic on Instruments: First-stage regressions	Durbin-Wu-Hausman F-statistic: Second-stage regressions
Total expenditure per capita (log)		
Calorie availability model		46.32 (Pr > 0.00)
Assets	1029.64 (2,6169)	
Assets* (urban-rural dummy)	2065.41 (2,6169)	
Nutritional status model, 0-23 months		0.40 (Pr > 0.53)
Assets	277.51 (1, 912)	
Nutritional status model, 24-60 months		7.75 (Pr > 0.01)
Assets	383.57 (1, 1220)	

Note: Total number of different household assets and vehicles is used as an instrument. Since the expenditure variable appears alone and in interaction with the urban-rural dummy in the calorie availability model, that model has two instruments.

Table 5 Calorie availability model[a]
Dependent variable: calories per day per adult equivalent unit

	Rural		Urban	
Independent variables	OLS	2SLS	OLS	2SLS
Expenditure per capita (log)[b, c]	1077.5*	341.6*	751.6*	396.1*
	(40.7)	(102.8)	(44.4)	(72.9)
Adult male, literate or some school	-112.7*	-34.3	-112.7*	-34.3
	(44.0)	(46.2)	(44.0)	(46.2)
Adult male, completed primary or more	-191.2*	-47.8	-191.2*	-47.8
	(53.4)	(57.2)	(53.4)	(57.2)
Adult female, literate or some school	-53.4	21.6	-53.4	21.6
	(52.7)	(54.9)	(52.7)	(54.9)
Adult female, completed primary or more	-105.2	67.9	-105.2	67.9
	(68.3)	(73.5)	(68.3)	(73.5)
War migrant	-16.2	-74.3	-16.2	-74.3
	(74.1)	(76.7)	(74.1)	(76.7)
Land (has.) per capita (log)	3.8	3.7	3.8	3.7
	(3.4)	(3.5)	(3.4)	(3.5)
Percentage of household	921.0*	650.3*	921.0*	650.3*
<5 years old	(133.0)	(140.2)	(133.0)	(140.2)
Percentage of household	306.6*	201.9*	306.6*	201.9*
≥60	(96.7)	(100.3)	(96.7)	(100.3)
Percentage of household	231.0*	145.9	231.0*	145.9
≥ 5 and ≤17	(107.8)	(111.4)	(107.8)	(111.4)
Household size[c]	-241.7*	-412.9*	-233.3*	-299.5*
	(32.4)	(40.2)	(34.2)	(36.7)
Household size (squared)[c]	12.1*	20.1*	8.7*	10.9*
	(2.1)	(2.4)	(2.0)	(2.1)
Female, household head	56.9	-19.6	56.9	-19.6
	(54.1)	(56.3)	(54.1)	(56.3)
Early rains	-408.1*	-477.8*	-408.1*	-477.8*
	(233.7)	(240.8)	(233.7)	(240.8)
Harvest	-472.6*	-525.6*	-472.6*	-525.6*
	(217.2)	(223.8)	(217.2)	(223.8)
Postharvest	-339.2	-398.0	-339.2	-398.0
	(267.6)	(275.7)	(267.6)	(275.7)
Secondary cities	-64.5	-7.5	-64.5	-7.5
	(448.0)	(461.5)	(448.0)	(461.5)
Other urban areas	-778.7*	-1067.8*	-778.7*	-1067.8*
	(456.3)	(471.6)	(456.3)	(471.6)
Rural provinces, north	-1443.5*	1491.9	-1443.5*	1491.9
	(784.1)	(1217.6)	(784.1)	(1217.6)
Rural provinces, central	-3372.0*	-297.1	-3372.0*	-297.1
	(737.0)	(1196.4)	(737.0)	(1196.4)
Rural provinces, south	-4346.1*	-648.0	-4346.1*	-648.0
	(756.2)	(1261.8)	(756.2)	(1261.8)
Missing observation				
Adult male education	31.4	56.7	31.4	56.7
	(67.2)	(69.3)	(67.2)	(69.3)
Adult female education	-275.6*	-233.5*	-275.6*	-233.5*
	(76.8)	(79.2)	(76.8)	(79.2)
Land per capita	-430.1*	-426.1*	-430.1*	-426.1*
	(157.1)	(161.8)	(157.1)	(161.8)
Community dummy variables[d]				
R^2	.38	.34	.38	.34
F	14.75	10.95	14.75	10.95
N	6,462	6,461	6,462	6,461

Note: * = significantly different from zero at 10 percent or higher level.
[a] Standard errors are reported in parentheses. 2SLS estimates are preferred.
[b] Endogenous variable, predicted by assets.
[c] Coefficient differs between rural and urban models.
[d] Not reported. Prob>F, 0.00 (OLS), 0.00 (2SLS).

Table 6 Nutritional status model, 0-23 months[a]

Dependent Variable: Height-for-age Z-score

Independent variables	Rural OLS	Rural 2SLS	Urban OLS	Urban 2SLS
Female child	.36*	.36*	.36*	.36*
	(.10)	(.10)	(.10)	(.10)
Age in months	-.13*	-.13*	-.13*	-.13*
	(.03)	(.03)	(.03)	(.03)
Age squared	.002	.002	.002	.002
	(.001)	(.001)	(.001)	(.001)
Expenditure per capita (log)[b]	.26*	.38*	.26*	.38*
	(.10)	(.21)	(.10)	(.21)
Adult male education, literate or some school	.01	-.001	.01	-.001
	(.13)	(.13)	(.13)	(.13)
Adult male education, completed primary or more	-.003	-.03	-.003	-.03
	(.17)	(.17)	(.17)	(.17)
Mother's education, literate or any schooling	.37*	.35*	.37*	.35*
	(.16)	(.16)	(.16)	(.16)
War migrant	-.006	.01	-.006	.01
	(.22)	(.22)	(.22)	(.22)
Land (has.) per capita (log)	.01	.01	.01	.01
	(.01)	(.01)	(.01)	(.01)
Percentage of household < 5 years old	-1.35*	-1.31*	-1.35*	-1.31*
	(.67)	(.68)	(.67)	(.68)
Percentage of household ≥ 60	-1.29	-1.25	-1.29	-1.25
	(1.38)	(1.38)	(1.38)	(1.38)
Percentage of household ≥ 5 and ≤ 17	-.05	-.002	-.05	-.002
	(.52)	(.52)	(.52)	(.52)
Household size	-.02	.001	-.02	.001
	(.10)	(.11)	(.10)	(.11)
Household size (squared)	.008	.007	.008	.007
	(.006)	(.006)	(.006)	(.006)
Female, household head	-.03	-.02	-.03	-.02
	(.23)	(.23)	(.23)	(.23)
Early rains	-.53	-.51	-.53	-.51
	(.61)	(.61)	(.61)	(.61)
Harvest	.21	.18	.21	.18
	(.67)	(.68)	(.67)	(.68)
Postharvest[c]	-3.71*	-3.70*	-1.04	-1.03
	(1.07)	(1.07)	(1.05)	(1.05)
Mother speaks Portuguese	-.02	-.03	-.02	-.03
	(.14)	(.14)	(.14)	(.14)
Rooms per capita	.23	.21	.23	.21
	(.21)	(.21)	(.21)	(.21)
Prenatal care	.17	.18	.17	.18
	(.16)	(.16)	(.16)	(.16)
Latrine	-.14	-.13	-.14	-.13
	(.13)	(.13)	(.13)	(.13)
Well water	.02	.01	.02	.01
	(.18)	(.18)	(.18)	(.18)

(continued)

Table 6 (continued)

Independent variables	Rural OLS	Rural 2SLS	Urban OLS	Urban 2SLS
River/lake water	.25	.25	.25	.25
	(.21)	(.21)	(.21)	(.21)
Missing observations				
Adult male education	.10	.10	.10	.10
	(.26)	(.26)	(.26)	(.26)
Mother's education[c]	.59	.55	-.55	-.57
	(.40)	(.40)	(.48)	(.48)
Land (has.) per capita (log)	.13	.12	.13	.12
	(.42)	(.42)	(.42)	(.42)
Mother speaks Portuguese[c]	-1.23*	-1.22*	.28	.26
	(.55)	(.55)	(.72)	(.72)
Prenatal care	-.10	-.09	-.10	-.09
	(.40)	(.40)	(.40)	(.40)
Latrine[c]	-.45	-.45	.41	.37
	(.37)	(.37)	(.36)	(.36)
Source of water	.42*	.42*	.42*	.42*
	(.25)	(.25)	(.25)	(.25)
Community dummy variables[d]				
R^2	.23	.23	.23	.23
F	2.27	2.26	2.27	2.26
N	1,197	1,197	1,197	1,197

Note: * = significantly different from zero at 10 percent or higher level.
[a] Standard errors are reported in parentheses. OLS estimates are preferred.
[b] Endogenous variables, predicted by assets.
[c] Coefficient differs between rural and urban models.
[d] Not reported. Prob > F., 0.01 (OLS), 0.01 (2SLS).

Table 7 Nutritional status model, 24-60 months[a]
Dependent variable: Height-for-age Z-score

Independent variables	Rural OLS	Rural 2SLS	Urban OLS	Urban 2SLS
Female child	-.03	-.03	-.03	-.03
	(.08)	(.08)	(.08)	(.08)
Age in months	-.02	-.03	-.02	-.03
	(.03)	(.03)	(.03)	(.03)
Age squared	.0002	.0003	.0002	.0003
	(.0004)	(.0004)	(.0004)	(.0004)
Expenditure per capita (log)[b]	.27*	.70*	.27*	.70*
	(.09)	(.18)	(.09)	(.18)
Adult male education, literate or some school	.06	.02	.06	.02
	(.12)	(.12)	(.12)	(.12)
Adult male education, completed primary or more	.16	.08	.16	.08
	(.14)	(.14)	(.14)	(.14)
Mother's education, literate or any schooling	.17	.10	.17	.10
	(.13)	(.13)	(.13)	(.13)
War migrant	.03	.05	.03	.05
	(.19)	(.19)	(.19)	(.19)
Land (has.) per capita (log)[c]	.03	.03	-.02*	-.02*
	(.02)	(.02)	(.01)	(.01)
Percentage of household < 5 years old	-.68	-.62	-.68	-.62
	(.58)	(.59)	(.58)	(.59)
Percentage of household ≥ 60	-.99	-.85	-.99	-.85
	(.99)	(1.0)	(.99)	(1.0)
Percentage of household ≥ 5 and ≤ 17	-.12	-.04	-.12	-.04
	(.46)	(.46)	(.46)	(.46)
Household size	.13	.20*	.13	.20*
	(.09)	(.10)	(.09)	(.10)
Household size (squared)	-.006	-.009*	-.006	-.009*
	(.005)	(.005)	(.005)	(.005)
Female, household head	-.19	-.13	-.19	-.13
	(.19)	(.19)	(.19)	(.19)
Early rains[c]	-2.63*	-2.46*	-.08	.03
	(.82)	(.84)	(.53)	(.54)
Harvest	-.03	-.10	-.03	-.10
	(.47)	(.48)	(.47)	(.48)
Postharvest	-.38	-.24	-.38	-.24
	(.80)	(.80)	(.80)	(.80)
Mother speaks Portuguese	.14	.12	.14	.12
	(.12)	(.12)	(.12)	(.12)
Rooms per capita	.53*	.35*	.53*	.35*
	(.20)	(.21)	(.20)	(.21)
Prenatal care	.02	.02	.02	.02
	(.14)	(.14)	(.14)	(1.4)
Latrine	-.10	-.07	-.10	-.07
	(.12)	(.12)	(.12)	(.12)
Well water[c]	-.09	-.07	-.72*	-.73*
	(.20)	(.20)	(.23)	(.24)
River/lake water	-.22	-.18	-.22	-.18
	(.21)	(.21)	(.21)	(.21)

(continued)

Table 7 (continued)

Independent variables	Rural OLS	Rural 2SLS	Urban OLS	Urban 2SLS
Missing observations				
Adult male education	.24	.23	.24	.23
	(.21)	(.21)	(.21)	(.21)
Mother's education	-.64*	-.70*	-.64*	-.70*
	(.40)	(.40)	(.40)	(.40)
Land (has.) per capita (log)[c]	.35	.38	-.35	-.42
	(.56)	(.57)	(.59)	(.60)
Mother speaks Portuguese	.65	.63	.65	.63
	(.43)	(.44)	(.43)	(.44)
Prenatal care	-.21	-.21	-.21	-.21
	(.25)	(.26)	(.25)	(.26)
Latrine	.14	.03	.14	.03
	(.21)	(.22)	(.21)	(.22)
Source of water[c]	-.22	-.22	.06	.13
	(.34)	(.34)	(.24)	(.25)
Community dummy variables[d]				
R^2	.14	.12	.14	.12
F	1.86	1.85	1.86	1.85
N	1,509	1,509	1,509	1,509

Note: * = significantly different from zero at 10 percent or higher level.
[a] Standard errors are reported in parentheses. 2SLS estimates are preferred.
[b] Endogenous variables, predicted by assets.
[c] Coefficient differs between rural and urban models.
[d] Not reported. Prob > F, 0.00 (OLS), 0.00 (2SLS).

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