Private and Public Determinants of Child Nutrition in Nicaragua and the Western regions of Honduras

Final Report

Research paper prepared for
THE LATIN AMERICAN RESEARCH NETWORK PROJECT
Inter-American Development Bank

Vincent David
Marco Moncada
Fidel Ordoñez

March, 2004

AP. Postal 4227, Tegucigalpa, M.D.C., Honduras
Tel. (504)238-8570/71; 237-2580; Fax (504) 238-8572;
E-mail: esa@esa.hn **Página Web: www.esa.hn**

Abstract

A multivariate regression model is presented, with nutritional indicators as dependent variables, and child, household and community level variables as the independent ones. The model includes interactions between education levels and overall level of community development, as well as estimates of community fixed effects. Two data sets are considered: the first comes from a 2001 nationwide household survey in Nicaragua while the second set was collected in the Western regions of Honduras in 2002, as part of an evaluation process for a family entitlement program. The results show that maternal stature, age difference with an older sibling, household size and income are the main determinants. Within the more homogeneous communities of Western Honduras, woman's education level is related to the child's nutritional status. The importance of individual community variables is much lower and the inclusion of community fixed effects does not alter much the other parameters. However, in the Honduran sample, overall community development (assessed through the community fixed effects) tends to have a small but significant and synergic effect on the impact of child and household variables. The cross sectional characteristics of this study and the complex design of entitlement or distribution programs prevent an adequate evaluation of those intervention within the poverty reduction strategies; while their impact does not appear to be currently significant on child nutrition, longitudinal studies are more appropriate to determine an impact. The improvement of intra-community targeting seems to be a key orientation for redesign. An improved socio-economic situation, sound population and family policies, and an appropriate preventive public health care still are safe investments towards improvement of child health and nutrition.

Authors' affiliation and contact:

Vincent David	Consultant, Public Health, ESA Consultores	vdavid@esa.hn
Marco Moncada	Economist, ESA Consultores	mmoncada@esa.hn
Fidel Ordóñez	Statistician, ESA Consultores	fordonez@esa.hn

Acknowledgements:
The authors would like to thanks Jere Berhman and Emmanuel Skoufias, from the Latin American Research Network, Rolando Morales, from CIESS – Econométrica, and Saul Morris, from London School of Hygiene and Tropical Medicine, for their comments on earlier drafts of the paper, and Raquel Gómez for her work on the organization of the workshops where ideas were productively shared by the research teams. As always, the responsibility for any error or omission in the text remains that of the authors.

Table of Contents

LIST OF TABLES AND GRAPHS

Tables

Figures

Annex 1 - Nicaragua

Annex 2 – Honduras

1. Introduction

The idea that individuals with better health are more productive is generally accepted in the academic world and among policy makers. Programs targeting the satisfaction of basic family and community needs are well seen by governments, especially, those intended to improve conditions in regions characterized as poor. In this sense, Honduras has executed, since the beginning of the 90´s, two major programs:

- the FHIS (Fondo Hondureño de Inversión Social - Honduran Social Investment Fund) focuses on providing poor communities with basic social infrastructure, such as schools, health centres and excreta disposal systems;
- the second program, PRAF (Programa de Asignación Familiar – Family Entitlement Program) focuses more directly on helping poor families, by providing them with cash transfers, through coupons aimed at improving the health of mothers and their children, as well as, the nutrition status of children in the household.

Nicaragua also has similar programs executed by the FISE (Fundo de Inversión Social y Económica - Social and Economic Investment Fund) and MIFAMILIA (Ministry of Family). These programs are based on the premise that social investment is currently low in these countries and consequently its social returns must be high. However, up to this date, most evaluations performed on these programs have mainly focused on determining whether or not the programmatic goals (number of beneficiaries, schools, health centres, coupons given, etc.) have been achieved; a rigorous evaluation, designed to measure the impact of each program, has not been done[1] yet, mainly because of difficulties in applying a cost efficient methodology. In the absence of precise impact evaluation, the assumption is that government programs improve substantially the nutritional status of children and the overall welfare of poor families. But there is no indication of the relative importance of social infrastructure creation and cash transfer programs. More generally, the factors determining child health are yet to be explored, and supply/demand constraints on increasing human capital have to be examined. An advancement of this knowledge will allow policy makers to make cost effective decisions in dimensioning social programs.

The objective of this paper, as stated in the Call for Research Proposals issued by the Latin American Research Network Project on "Child Health, Poverty and the Role of Social Policies" is to examine private and public determinants of child health; the extent to which the public and private determinants interact and whether interactions suggest gross substitution or complementarities; the extent to which the influence of the determinants of child health vary by age and gender of the child; and the types of programs and interventions that are associated with improved child health. The paper examines data from two Central American countries, Nicaragua and Honduras, collected in 2001 and 2002 respectively. Anthropometrical indicators of child growth and nutrition are used as *proxy* indicators of child health, due to the strong correlation existing between poor child health and child malnutrition in low-income countries.

Sections 2 and 3 provide some background information on the two countries, more specifically on child health and nutrition. Section 4 identifies the sources of information for this paper and summarizes methodological and sampling aspects specific to the source surveys. Section 5

[1] ESA Consultores carried out an impact evaluation for the subprojects executed by FHIS in Honduras before 1997, using the rate of poverty measured by unsatisfied basic needs ("Necesidades Básicas Insatisfechas") as the dependant variable for program impacts. The movement of other social variables was not linked to the program's performance.

addresses the study's methodology: if first considers the problems in measuring child health and nutrition; then reviews the analytical framework proposed by the network for this study; finally discusses the independent variables used in the analysis of determinants of child health/nutrition. Results for Nicaragua are covered in Section 6, starting with a descriptive analysis of the growth achievement indicators and of other selected variables, then looking at the results of the regression analysis. The results for Honduras are given in a similar fashion in Section 7. Section 8 provides some elements of discussion of the findings and comparison between the two countries (or, more properly speaking, between the two surveys) and Section 9 summarizes the conclusions of the paper. Detailed tables for each country are provided in separate annexes (Tables N1 to N8 for Nicaragua in Annex 1, tables H1 to H8 for Honduras in Annex 2).

2. Child Health and Malnutrition in Nicaragua

Nicaragua, with a territorial extension of 119,838 square kilometres and a total population of 4,357,099 (1995 Census), is a country with a long agricultural tradition, which has sustained the economy over time. Main export cultivations include coffee, sugar cane and cotton, while rice beans, corn and sorghum are grown for internal consumption. Other important economical sectors are cattle growing (both for meat and milk production), fisheries, and the more recent manufacture industry. The per capita GNP was estimated at US$430 in 1999 (World Bank Development Report). The 2001 Nicaragua Living Standards Measurement Survey (ENMNV-2001), from which data are analysed for this paper, also reveals that 15.1% of the population leaves in a situation of extreme poverty (27.4% in rural areas). 54.4% of the population is living in urban areas, mostly in the Pacific Region. The UNDP 2003 Human Development report, using 2001 data, indicates a Human Development Index of 0.643 for Nicaragua.

The infant mortality rate for the period from 1997 to 2000 was 45.2 per 1,000 live births. The leading causes of death among children under one year of age during this period were respiratory and cardiac problems originating in the peri-natal period, pneumonia, diarrhoea and gastroenteritis, bacterial sepsis of the newborn, and congenital malformations. The leading causes of death among children 1- 4 years of age were pneumonia, diarrhoea and gastroenteritis, and transport accidents. These figures are down from those obtained in the ESDENIC-85 survey, which estimated the infant mortality rate at 71.8 per 1,000 live births. Deaths of children under 1 year of age constituted 28.7% and 30.8% of all deaths in 1988 and 1990, respectively. The trend has been downward, and for 1996 it is estimated that the proportion decreased to about 21%.

The 1998 Nicaragua Demographic and Health Survey (ENDESA-98) found one out of every four children chronically malnourished and 9% of all children severely malnourished. The percentage of children in rural areas suffering from some degree of malnutrition was 32%, compared with 19% in urban areas. The mortality rate for all forms of malnutrition was 11 per 100,000 in 1998. Though iodine deficiency is not a public health problem in Nicaragua, there are high-risk groups in the South Pacific region where the prevalence of goitre in certain communities is over 20%. The nationwide prevalence rate for anaemia in children between the ages of 12 and 59 months was 28.4% with an average haemoglobin level of 10.6 mg/dl. However, both the ENDESA-98 and ENMNV-2001[2] surveys show that malnutrition is decreasing nationwide.

[2] ENDESA: National Health Survey, ENMNV: Living Standard Measurement Survey

3. Child Health and Malnutrition in Honduras

Honduras, a Northern neighbour of Nicaragua, has a territorial extension of 112,492 square kilometres with a population estimated at 6,530,331 in 2001 (Instituto Nacional de Estadísticas, 2001 Census). 44% of the population lives in urban areas, half of it in the two main cities of Tegucigalpa and San Pedro Sula. Yet, agricultural production still constitutes the majority of exports (coffee, bananas, fruits and more recently shrimps). Other major economic sectors include the manufacturing industries, located in free zones mostly in the Northern part of the country ("máquila") and tourism. Per capita GNP was estimated at US$760 in 1999 (World Bank Development report). According to the Poverty Line Method, 48.6% of the population lives in conditions of extreme poverty (60.9% in rural areas). The 2003 Human Development Index for Honduras is 0,667.

According to the 2001 National Epidemiology and Family Health Survey (ENESF-2001), the infant mortality rate was estimated at 34 per 1,000 live births (56 % of it was neonatal), between 1996 and 2000. The under-five mortality rate was 45 per 1,000 live births for the same period. Those figures are part of a continuing downwards trend observed in the last thirty years, although with a slower rate in the last decades (IMR was estimated at 39 at the end of the 80's); stabilized levels of peri-natal deaths at 19 per 1,000 live births are mostly responsible for this slowing down process. Acute respiratory infections and acute diarrhoea with dehydration were the leading causes of death in children under five.

The successive National Epidemiology and Family Health surveys have also shown a downward trend in the levels of chronic malnutrition in children aged 1 to 4 years, from 43.8% in 1987 to 32.9% in 2001 (height for age indicator). A similar decrease has been observed over time for global malnutrition (weight for age; from 24.1 to 18.4%) and for acute malnutrition (weight for height; from 1.9 to 1.0%). In 1996, The Micronutrient Survey found that 26% of non-pregnant women and 32 % of pregnant women were anaemic.

4. Sources of Information

The material used for this study comes from two very different sources:

The 2001 National Household Survey on Measuring the Standard of Living (Encuesta Nacional de Hogares sobre Medición de Nivel de Vida del 2001). In Nicaragua this survey was carried out as part of the MECOVI project of the National Institute of Statistics and Censuses (**INEC**). It had coverage on a national level and compiled data regarding the characteristics of the house and the household, education achievements, economic activities, children and women's health and mortality, household consumption measured through spending, and sources of income and/or reception of benefits in cash or kind. The 2001 survey was a follow-up conducted in the same households as those covered by the initial 1998 survey. The sampling methodology was a two-step cluster process, where the primary sampling units were the census enumeration units, selected with a probability proportional to their population; within the urban segments, 12 dwellings were selected, while two clusters of 5 houses were selected in each rural segment, for a total of 4,676 houses

The Survey for the Measurement of Expenditures and Means of Living (La Encuesta de mediciones de gastos y medios de Vida). The Family Entitlement Program (PRAF) undertook this survey in 2002. It compiled data about the socio-economic profile of households in order to

provide PRAF with information about the country's poorest families. The objective was to use the information to determine the most appropriate interventions to improve family welfare and, especially, that of children. The sampling frame is quite different from that of the Nicaragua survey, or even from similar surveys conducted in Honduras (National Epidemiology and Family Health Survey, for instance). As the PRAF's aim is to provide support to the most disadvantaged sections of the population, the universe was purposively chosen to reflect this segment of the population: among each of 70 municipalities which obtained a low score in terms of height for age of school children (obtained during a School Census conducted in 1997), eight censal segments were selected on a systematic basis, with a probability of selection proportional to their population; in each segment, 10 households were then selected on the maps from a randomly chosen starting point, yielding a total of 5,600 households. Thus, it should be clear that the two populations surveyed are different, consequently limiting the scope of inter-country comparisons. When those comparisons are made, the respective sampling methodology needs to be taken into account.

5. Analytical Framework

5.1 Measurement of health and nutritional status

Quantitative measurement of health poses methodological problems, which have not yet been fully resolved (Abelin, 1987). A number of increasingly complex scales have been developed to assess the various aspects of health, including recently the Years of Life Lost (YLL) and Disability Adjusted Life Years (DALY), introducing aspects related to quality of life and self-perception of discomfort and disability (World Bank, 1993; Murray and Lopez, 1997). However, the application of complex measurement scales is more difficult when related to children (where the information depends on a caretaker and the scope of the remaining life is wide) and is rarely included in non-specific surveys or studies. The measurement of the end point of illness, that is, infant and child mortality, is now more systematically investigated as a part of nation-wide epidemiological and demographic studies, but often lacks a detailed evaluation of the relative importance of the biological, social, environmental and illness management related factors in the occurrence of early infant and child death. Self reporting of disease episodes and disease burden at the household level is often tainted by biases, linked to the perceived severity of illness and the ability to express feelings and sufferings, the socially-determined perception of disease, the assumed access or lack of access to health services that may have the potential to cure the disease and the possible discrimination of some family members in terms of access to health care.

Anthropometrics indicators of nutritional status are thus often used as proxy indicators for health, especially in children. Indeed, malnutrition is now considered not as just a clinical problem or the lack of any specific nutrient, but as a state in which the physical function of an individual is impaired to the point where he or she can no longer maintain an adequate level of performance of such things as physical work, resisting or recovering from the effects of disease, maintaining an adequate level of growth, or the processes of pregnancy or lactation (Biswas and Pinstrup-Andersen, 1985). Changes in malnutrition levels in developing countries through different type of interventions have been associated with corresponding changes in child survival (Pelletier and Frungillo, 2003).

Three anthropometrical indicators will be used as dependent variables in this study (WHO Global Database):

- Height-for-age: stunting, that is, a deficit in the height-for-age indicator, reflects a process of failure to reach linear growth potential as a result of sub-optimal health and/or nutritional conditions (repeated bouts of diseases, insufficient dietary intake). Stunting often starts after 3 months, and proceeds in a cumulative form, i.e., it usually cannot be reversed.
- Weight-for-height: low weight-for-height is usually associated with acute malnutrition (or wasting); it reflects more current nutrition, following a recent and severe process of weight loss, often linked to acute starvation and/or severe disease.
- Weight-for-age: is a reflection of both height-for-age and weight-for-height indicators. While it is commonly used in monitoring physical growth in children under five, its interpretation is more difficult, as it does not differentiate between acute and chronic malnutrition.

Growth achievement indicators are expressed as Z-scores (that is, the observed value of the parameter minus the median value in the reference population over the standard deviation value in the reference population), a measure that allows the use of summary statistics such as means and standard deviation. In addition to these continuous variables, nutritional status parameters can also be expressed as a dichotomous (1,0) variable that can show the probability of being malnourished (wasting or stunting), that is, if the weight for height or height for age Z-score, respectively, is below a defined cut-off point - usually set up at minus 2 Standard Deviations (SD).

5.2 The regression model

The paper follows the model proposed by the Network for this multi-country study, in which households are assumed to choose between child health H, leisure L, consumption of goods and services C, as if they are maximizing a household welfare function subject to the health production function constraint and budget constraint.

$$U = U (H, L, C; X_h) \qquad (1)$$

where X_h is a vector of household characteristics including the education level of the household head and his spouse. Child health is generated by a production function.

$$H = F (Y, X_i, X_h, X_C, \mu), \qquad (2)$$

where Y is a vector of health inputs such as nutrient intake, health care practices (immunization), and disease incidence, X_i, is a vector of child characteristics such as age, age difference with older or younger sibling, and gender, X_C is a vector of environmental factors that may have a direct impact on child health and μ is a vector summarizing all unobservable characteristics of the child, parents, household, and the community that affect child health. In addition, the choices of households are assumed to be limited by their full income constraint.

$$P_c C + WL + P_y Y = FI \qquad (3)$$

where P_c, W, P_y, are the price vectors of consumption goods, leisure and health inputs, respectively, and FI is full income including the value of the time endowment of the household and non-labor income. In this framework, the reduced form function for child health is.

$$H=\Phi (X_i, X_h, X_C, FI, P_c, W, P_y, \mu) \quad (4)$$

whereby the particular functional form of the function Φ(.) depends on the underlying functions characterizing household preferences and the health production function.

Estimates of the reduced form of (4) are thus obtained using the following regression function:

$$H_{i\,h} = \alpha + \beta_1 X_{i\,h} + \beta_2 X_h + \beta_3 FI_h + \gamma X_c + \eta_{i\,h} \quad (5)$$

where:

- $H_{i\,h}$ is the Weight-for-Age, Height-for-Age or Weight-for-Height Z- score for the i^{th} child in the h^{th} household;
- X_{ih} includes variables such as: age, sex, mother's height, age difference with older or younger siblings, incidence of diarrhea in the last 30 days;
- X_h consists of household characteristics including education level of the household head and the household woman (see definition in section 5.2 below), sex and age of the household head, age of the "woman of the household", age difference between the household head and household woman, household size, household beneficiary of intervention programs (program description in 5.3.2).
- FI_h is the household predicted income measured by the per capita household expenditure and controlling for endogeneity through instrumental variables;
- X_c is the vector of five community variables: proportion of household with adequate water supply, time to reach the nearest health center, price of corn, agricultural wages, proportion of households with children benefiting from vitamins/food supplements or receiving food/health coupons.

Equation (5) is calculated in two ways: first using the individual community variables included in X_c

$$H_{i\,h} = \alpha + \beta_1 X_{i\,h} + \beta_2 X_h + \beta_3 FI_h + \gamma X_c + \eta_{i\,h} \quad (5a)$$

Then, with community fixed effects:

$$H_{i\,h} = \alpha' + \beta'_1 X_{i\,h} + \beta'_2 X_h + \beta'_3 FI_h + u + \eta'_{i\,h} \quad (5b)$$

where u captures the effects of community observed variables.
In order to determine the contribution towards the community profile and the significance of community level observed variables, fitted values of community fixed effects are then regressed on all available community level observed variables

$$\hat{u} = \lambda Z_c + \eta \quad (6)$$

where $\hat{u}$ are the fitted values of community fixed effects and Z_c is a vector of all observed community variables.

A second regression analysis is conducted afterwards, looking for interaction among selected household characteristics and community level variables. For this purpose, we constructed an index of the five community variables included in the community vector X_c. These variables were selected on the theoretical assumption that they are related to child health and nutrition

status and also because some of them represent areas for intervention programs: public health infrastructure, provision of health care services, direct support to poor families, etc. The index component for each variable was calculated on the basis of the proportion of the value of the parameter compared to the highest value of this variable (the lowest in case of an unfavorable variable), and the overall index is an equal-weight average of all individual components. Household variables used to build interaction variables are those related to the secondary education of household head and to the primary education of the woman of the household. Equation (5) then becomes the following regression function:

$$H_{ih} = \alpha + \beta_1 X_{ih} + \beta_2 X_h + \beta_3 FI_h + \gamma X_c + \delta(X_h * X_c) + \eta_{ih} \quad (7)$$

As before, equation (7) is regressed without community fixed effects

$$H_{ih} = \alpha + \beta_1 X_{ih} + \beta_2 X_h + \beta_3 FI_h + \gamma X'_c + \delta(X_h * X'_c) + \eta_{ih} \quad (7a)$$

where, X'_c now represents an index of community variables, then with community fixed effects

$$H_{ih} = \alpha' + \beta'_1 X_{ih} + \beta'_2 X_h + \beta'_3 FI_h + u + \delta'(X_h * X'_c) + u + \eta'_{ih} \quad (7b)$$

Again, in order to determine the significance of community level observed variables, fitted values, of community fixed effects, are regressed on all community level observed variables.

$$\hat{U} = \lambda Z_c + \eta \quad (8)$$

where û are the fitted values of community fixed effects and Z_c represents all the community observed variables.

5.3 Selection of variables included in the model

Independent variables selected for inclusion in the regression model were similar in both countries, except when the design and structure of the respective databases warranted a particular specification, as indicated below. In both cases, the variables were grouped in four categories, corresponding to the generic terms of the model.

5.3.1 Child variables

Child variables include the *age* and *sex of the child*; a quadratic term was added to the age specification in earlier models, but was omitted in the final one, as it did not bring additional information. The other child-related variables are the *maternal stature,* available for the Honduras survey only, and the *age difference* (in months) between the child and either an older or a younger sibling. Both variables have been shown to impact on child's nutritional status, health and/or survival (Schmidt, 2002; Maine, 1981). Two methodological problems are related to those latter variables:

- in the Nicaraguan survey – and, to a certain extent, in the Honduran survey -, children under-5 were not directly related to their mother, so that the brotherhood link could not be formally established; instead we used a specification that considered as brothers children from the same household who had the same relationship (natural child) to the head of household. In some families, this may actually lead to include children from different

mothers, for whom the biological pathway between birth interval and nutritional status may in fact be non-existent, thus weakening the observed impact of these variables;

- in both surveys, the number of children who were measured and for whom a suitable sibling (younger or older) is present is much lower than the total number of children in the study; using only children with an older brother would remove 25% of the observations in Nicaragua and 22% in Honduras, while using only children with a younger brother removes 73 and 66% of the observations respectively . Thus a dummy variable is used in each case to indicate measured children that do not have an appropriate sibling.

In the Nicaragua survey, we also used the *occurrence of diarrheal diseases in the last 30 days* as a dichotomous (Yes/No) variable reflecting propensity to illness, as the question was asked from all children under five in the household. In the Honduras survey, the question was only asked for children up to three years of age; in order to avoid loss of information - as it would have been hazardous to extrapolate diarrheal rates in older children and assign in a non-random manner the probability of having suffered diarrhea to individual children - we used the proportion of under-three children who suffered from diarrhea in the previous 15 days as a community-level variable.

5.3.2 Household variables

Household variables are mostly related to the age, gender and level of education obtained by adults in the house, a key determinant of nutritional and care-seeking practices, also clearly correlated with socio-economical level. In the Nicaraguan survey, the child-mother link cannot be established formally from the database; in the Honduras survey, it is only available for children who were measured and for whom the mother's height was also measured. Thus, in both surveys, we use the level of *education of the household head* and that of the woman who is either the head of household or the spouse/companion of the household head (thereafter called the "*woman of the household*"), on the premise that she will most often be the mother of the household's children and that, in any case, she will be the female person making child-care decisions in the household. Education level is introduced as a categorical variable, using values that have been recognized as operative in previous surveys in the region: no schooling or adult-type education/primary school/secondary school or beyond.

Other household variables originally included *age of the household head*, *age of the "woman of the household"*, and *age difference between the household head and the woman of the household*, but those were omitted in the final model, as they never reached any level of significance. The last variable was supposed to reflect the relative situation of strength of the woman responsible for child-health decision making in terms of authorizations for care seeking or use of the household's resources for child health, whereby a high age difference may mean more limited capacity for decision making. A dummy variable was included to identify the cases where the woman of the household is neither the household head herself nor the spouse of the household head, as a different family relationship (mother, daughter, aunt) would undoubtedly modify the decision making relationships in quite different ways.

The *household size* is used as a variable assumed to be affecting the nutritional status of children, as large families might have major problems taking care of all siblings. A number of authors consider household size as an endogenous variable, with family tending to alter their fertility decision on the basis of changes in the health/nutritional status of already born children. We consider that in the Central American context, the endogeneity of this variable is small due to the

fact that most families do not really plan the number of children they would like to have, for cultural and religious traditions.

The intervention programs executed by the government or other NGOs are represented by the following variables:

- *Households having received food or health support from organizations in the community*, and *Households with beneficiaries of "mother and child" coupons*, are the variables analyzed at the household level in Honduras;
- *Households benefited with food donations or participating in food for work programs* and *Households with a child receiving vitamins/food supplements in health centers* are the variables used in the regression for Nicaragua.

In both surveys, those variables are dichotomous (1,0) when considered at household level.

5.3.3 Income proxy variable

The natural logarithm of annual per capita household expenditures is used as a proxy for household income, as it better reflects an averaged-over-time situation in cases where income (especially cash income) may be irregular in nature. We then use a vector of instrumental variables such as household assets and desirable characteristics of dwelling in order to control for endogeneity of the income proxy variable. Only assets that had statistically significance in an initial regression of the per capita household expenditures on the original 15-item list were included in the second-stage regression equation that provided the predicted per capita household expenditures used in the further stages of the analysis. The original list of household goods or desirable characteristics of dwelling includes: ownership of television set, radio transistor, HiFi sound system, tape recorder, refrigerator, stove, microwave oven, washing machine, sewing machine, car, cattle, horse(s), external walls made of brick or stone, roof of clay tiles or asbestos, and non dirt floor.

5.3.4 Community variables

The analysis uses cluster-level variables to account for community-fixed effects. Using cluster (community)-level variables also allows using variables for which not all households in the cluster include information; for instance, not all households included women in reproductive age who had had a delivery over the last two years. Those variables are grouped in several categories:

- Public health infrastructure: *Proportion of households with water tap within the house or within the compound*; *Proportion of households with toilet or washable latrine*
- Economic situation: *Food prices and Wages.* We use the prices of three basic staple foods for both countries: rice, corn and beans, as well as the price of a more child health and nutrition-related item, that is, the tin of powdered milk; we include two variables reflecting the level of wages: one relates to agricultural wages for workers employed on a permanent basis or as day laborers (that is, excluding landowners employing other people or working on a self-sufficiency basis), the other to non-agricultural wages, excluding professionals. In the case of Nicaragua, a dummy variable has been introduced for the lack of information on agricultural wages, to avoid the loss of a significant number of observations for this variable. In this case, the average of the existing observations is reassigned to the wages variable before running the regression.

- Health care services: the *Average distance (in minutes) from nearest health* center represents the access to health services; two variables are related to coverage and effectiveness of health care delivery – the *Proportion of children appropriately immunized for their age*, and that of woman having had an *Institutional delivery in the last two years* -, as information on availability of specific inputs, such as health personnel, drugs, etc., and quality of services was not collected in the surveys (Collier, Dercon and McKinnon, 2002; Noorali, Luby and Rahbar, 1999). At the individual household level, these variables may be somehow correlated with household characteristics in terms of resources and care-seeking practices; at community level they would reflect more the capacity of the service providers to deliver health care services, although we cannot discard the element of personal choices.
- Presence of government or other institutions with support programs, to reflect the specific inputs of poverty-reduction programs
  - in Nicaragua: *Proportion of households receiving food for work, food donations*, and *Proportion of households with children having received food and vitamin supplements at a health center*
  - in Honduras: *Proportion of households receiving food or health services from an organization present in the community*,and *Proportion of households with beneficiaries of the Mother and Child Coupon (Bono Materno Infantil)*[3]. We also used as another community-level variable the *Implementation in that community of the Community-based Integrated Child Care program (AIN-C)*, a growth monitoring/promotion program introduced by the MOH and executed in selected target communities by NGOs or public sector health providers.

From the initial set of community observed variables, five were selected to enter the equation (5) as community variables. Those variables represent the categories mentioned above as well as different areas of problems or intervention. However, all variables are taken into account in the equation defined for the regression of fitted values of community fixed effects on community observed variables. The same five variables chosen for regression of equation (5) are also included in the index of community variables used in equation (6).

5.4 Step by step inclusion of independent variables

Ideally, the right side of equation (5) and other derivates should only include pre-determined (exogenous) independent variables. To various degrees, household expenditures, household size, age difference with siblings, reception of food donations or coupons could be considered as endogenous variables, that is, possibly affected by changes in the dependant variable (Becker, 1981). We deal with the issue of endogeneity of the expenditure variable by instrumenting it through ownership of household goods. To control for the possible endogeneity of other variables, a step-by-step inclusion of independent variables in the basic model is used. The initial, parsimonious model includes only *age* and *sex* as child variables; *education of the household head*; *education of household woman and sex of the household head* make up the household variables, and as income variable the model uses the natural *logarithm of predicted expenditures*. The group of five "marker" community variables is introduced in all models. Then, the potentially endogenous variables are introduced one by one, leading to the final and more

[3] This represents direct cash transfers to the families, in the form of coupons, the delivery of which is contingent upon attendance to selected health/nutrition services.

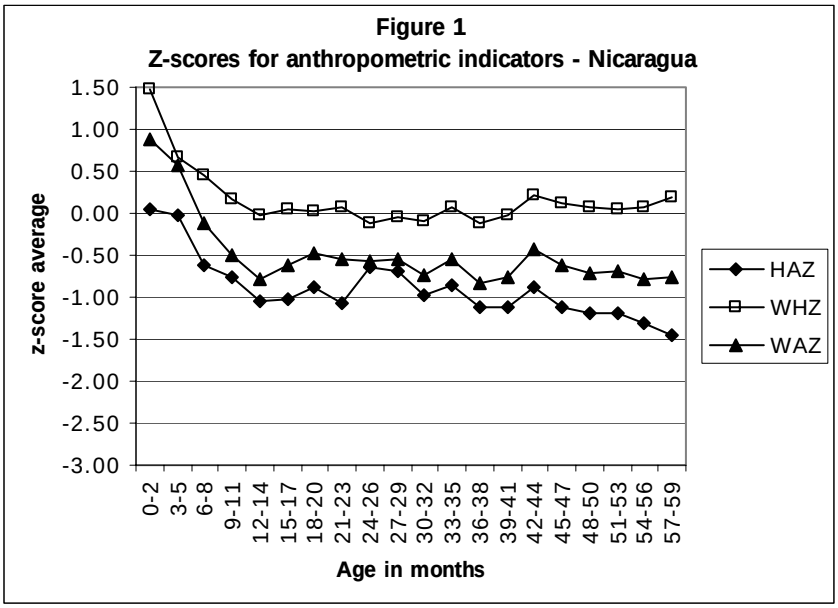
complex specification. This step-by-step introduction of new variables in the equation allows seeing the robustness of the coefficients estimates of the previous regressions, permitting the selection of variables use in a final model.

6. Nicaragua Results

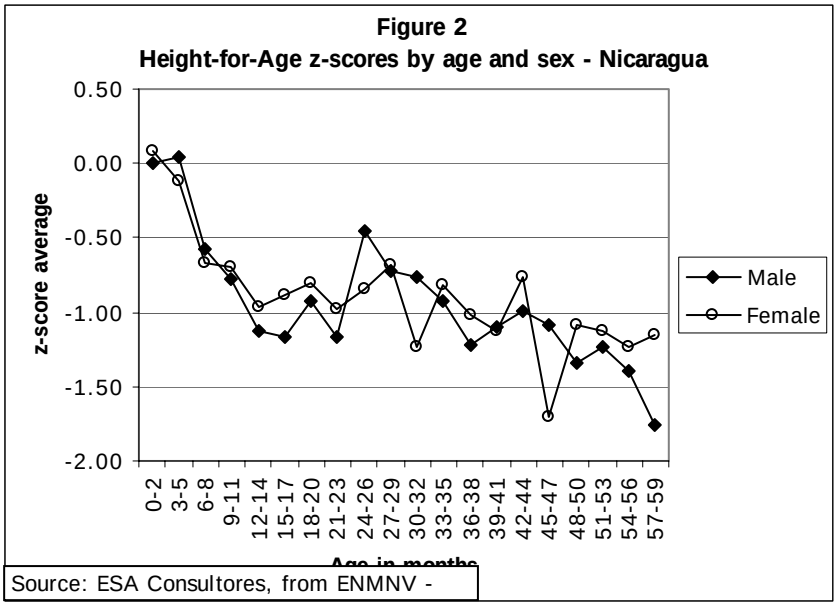
6.1 Growth achievements of children

Table N1 provides the mean Z-scores for the three indicators for children aged 0-59 months (under 5 years), stratified by age group, sex and urban/rural location. The mean Height-for-age Z-score is –0.92, corresponding to a proportion of malnourished children (below – 2 Standard Deviations) of 17.6%. The mean Z-score decreases overall with increasing age, as expected, and urban averages are higher than rural ones (-0.67 versus –1.13 respectively).

The time dimension of the physical growth indicators and the similarity of the curves for boys and girls can better be appreciated in a graphical form, as provided in **Figure 1**, which shows the cumulative occurrence of chronic malnutrition, starting from the sixth month.



There is no significant gender difference, as has been observed too in other Latin American countries: boys scored –0.96 and girls –0.88. Figure 2 shows the average z-scores for the height-for-age indicator by sex.



Weight-for-height scores are very close to the median, with a mean score of 0.15, that is, a proportion of malnourished children of 1.0%, again lower in rural areas (0.10) than in rural areas (0.20); gender differences are minimal, with 0.13 for boys and 0.16 for girls. The highest rates of (relative) wasting occur during the second and third year, at a time when increased mobility exposes the child to repeated pathogen contamination, while his/her immunity is building. A proportion of 2.5% of acutely malnourished children is commonly expected in normally distributed, standard population.

The weight-for-age indicator shows intermediate values, with a mean z-score of –0.50 (that is, 8.0% of children under –2SD), an urban mean double of the rural figure (-0.31 versus –0.66) and no major gender difference (-0.52 for boys and –0.48 for girls).

Those figures are somehow more optimistic than those obtained during the 1998 Nicaragua Demography and Health Survey (Encuesta Nicaraguense de Demografia y Salud – ENDESA), with a similar sampling frame, as seen in Table 1, and may reflect an overall improvement in the nutritional and health status of Nicaraguan children over time.

Table 1: Comparison of anthropometric indicators between the 1998 and 2001 surveys - Nicaragua

	ENDESA 1998		ENMNV 2001	
	Mean z-score	% Malnourished	Mean z-score	% Malnourished
Height-for-Age	-1.2	24.9	-0.92	17.6
Weight-for-Height	0.1	2.2	0.15	1.0
Weight-for-Age	-0.7	12.2	-0.50	8.0
Number of observations	6,497		2,676	

Source: ESA Consultores, from ENDESA 1998 and ENMNV 2001

We explored directly the relationship of growth indicators with other variables of interest, known to influence nutritional status. Table N2 shows the proportion of malnourished children

according to different characteristics, such as household income (proxied by household per capita expenditures) or level of education of the household head.

Children with an age difference lower than 18 months with their older sibling had a proportion of low height for age of 27%, as compared to 17.5 in children with a longer birth interval[4] ($p<0.05$). The age difference with a younger sibling is more observable in terms of acute malnutrition, where children less than 15 months older than their brother are being malnourished in 2.4% of cases, versus 0.4% when the interval is longer (not statistically significant). Those results are consistent with physiological mechanisms of malnutrition: in the relationship with the older brother, a short birth interval means less time for the mother to recover from the increased energy requirements linked to pregnancy, child birth and lactation, thus a sub-optimal quality of the inter-uterine nutrition for the index child, leading to prenatal stunting; conversely, the causal link between malnutrition and subsequent birth is often related to premature weaning, sudden decrease in optimal quality nutrients and increased exposure to pathogens (through bottle milk), leading to acute malnutrition (wasting).

Joint occurrence of diarrhoea and respiratory infection in the month previous to the survey is also linked to increased chronic malnutrition (23.2% versus 15.85 when only one infection is present, also the difference is not statistically significant at the 5% level); curiously, the figures for acute malnutrition are similar in both groups (1.4 versus 1.2%), indicating that, as formulated, this indicator would better reflect the overall burden of diseases and its impact on the child growth over time, rather than a direct relation between increased nutrient loss and impaired growth; that latter relation could be better reflected by an indicator that would take into account the length and severity of the diarrhoeal episode.

Levels of malnutrition, especially for the height-for-age indicator, for which all the following differences have an associated p value <0.05, show clear relationships with the level of education of the head of household, going from a proportion of 22.8% of malnourished children in households where the head has no education to 2.8% when the head of household has achieved at least secondary schooling. The relation is also true for the educational achievements of the woman of the household and when women are heads of household. The range of malnutrition rates is even wider when related to income (as proxied by household per capita expenditure), going from 31.3% in the poorest quintile to 4.7% in the richest. Household size is also inversely correlated with the proportion of malnutrition. For all variables, the same differences are observed for the weight-for-age indicator (although with a narrower range). Results for the weight-for-height indicator are not univocal.

Better water and sanitation conditions (at household level) are also associated with lower levels of malnutrition, as is a lower distance to the nearest health centre.

6.2 Determinants of Child Growth

6.2.1 Cross-Sectional Estimates without interaction

This section presents the estimates of equation (5) and (6). The dependent variables are the Z-scores for Height/Age, Weight/Height and Weight/Age. The distribution parameters (mean,

[4] The cut-off point for age differences were selected for showing the largest difference in one of the anthropometric indicators, in this case 18 months for Height-for-age and 15 months for weight-for-height.

standard deviation and number of observations) for the independent variables used in the regression are given in Table N3. Table N4 presents the estimated results of the step-by-step inclusion of independent variables in the basic model for the height-for-age variable. The initial model includes two child variables (*age and sex*), six household variables and six community variables and the final one has five child variables, nine household variables and six community variables. The values of the estimated coefficients and their respective significance level do not vary much when new variables are included in the model, and the adjusted R square improves from .1380 for the initial model to .1544 for the final model. The estimated coefficient for *Household woman with primary education* and its significance level decrease when the variable of *household size* is included (being this variable the only one experimenting change), suggesting that women's education impact on children's nutrition status depends on the size of the family. Thus, the more complex model is used in the following sections of the study.

Table N5 presents the values of the regression coefficients and their standard error for a national sample of children aged 0-59 months. The first column presents Ordinary Least Squares (OLS) estimates for Height/Age [equation (5a)], which may be biased by not accounting for endogeneity, measurement error in the income variable or the influence of omitted unobserved community characteristics (such as the distribution of a program of direct cash transfer in some communities). The second column of estimates includes community fixed effects to control for bias due to some unobserved community variables [equation (5b)]. The third and fourth columns represent similar estimates for the dependent variable Weight/Height, and the fifth and sixth columns for Weight/Age.

.

Child Characteristics. The mean age of children in the sample is 30.0 months. As shown in Figure 1, malnutrition increases with the age of the child. Thus, as expected, the *age of the child* is related to malnutrition as measured by height-for-age or weight-for-height indicators in a cumulative manner. In addition to the linear term, a product term is included, that shows the same pattern. *Child's sex* is not strongly related to either stunting or wasting; the regression coefficients for this variable are not statistically significant at a 10% level. In Nicaragua, as in many other Latin American countries, there is no evidence of parental preferences leading to gender-based discrimination in terms of infant feeding and nutrition. The estimated value for the coefficient related to *Age difference with an older sibling* is low (.005) but statistically significant for the height-for-age and weight-for-age indicators, which indicates a positive impact of longer birth intervals on child's health. The results for the variable *Age difference with a younger sibling* are not statistically significant. The *incidence of diarrhoea* among young children has a significant and negative correlation with all three indicators of growth achievement (coefficient = -.151 for HAZ).

Household Characteristics. Among the household variables, only a secondary education level of the household head is significantly related to the child's chronic nutrition status, with an estimated coefficient of 0.1413 (0.1745 in equation 5(b)). Surprisingly, woman's education does not show the impact that one may expect on reducing stunting or wasting; a possible – partial - explanation for this may lie in the fact that in urban areas educated women have joined the workforce and leave their child to care to other persons, who might not provide him/her with the proper care. The household size in negatively correlated with the height-for-age (-0.0345) and weight-for-age z-scores (-0.033), indicating an impact on the overall availability of food and disease burden, rather than an acute influence on wasting. Finally, among variables reflecting direct interventions, the presence within the household of a child receiving vitamin or food

supplements in a health centre is negatively and significantly associated to chronic nutritional status (-0.115, $p<0.1$), probably as an effect of targeting on a priority basis food and vitamin supplements to children with pre-existing poor health and nutritional status, thus creating a program placement effect..

Income Variable. In Nicaragua, where there is a large proportion of rural population, the household expenditures is a better indicator than household income as, usually, income may be underestimated because household domestic production of food is not included in the reported income. As indicated in the methodology section, we eventually used the per capita household expenditures predicted on the basis of possession of household goods and dwelling characteristics - 11 items). This variable is strongly related to all three nutritional indicators, with a high value of the coefficient (0.723 for chronic malnutrition).

Community variables. The community variables selected for the analysis each represent a category of factors that characterize this community and may lead to various types of interventions that may impact on the child's nutritional and health status:

- the proportion of households with tap water within the house or compound reflects the overall sanitation status of the community and an important area for investment in human capital;
- the travel time to the nearest health centre gives an idea of the access to health services, though the quality aspects of those is not covered by this indicator;
- the daily wages of agricultural workers provides an estimate of monetary resources available to a section of the population;
- the price of corn reflects the costs of obtaining the basic inputs for nutrition and survival;
- while the proportion of households with children receiving food or vitamin supplements gives an indication of the intensity of direct support programs.

Unfortunately, none of these variables appear to be impacting in a statistically significant manner on the nutritional status of children in the communities. The fact that all coefficient are negative, a counter-intuitive finding in four out of five cases, even in the context of statistical non-significance, could correspond to the non-random distribution of the support programs, which would tend to be located in the poorest, least favourable areas, whereby the indicator would reflect this distribution rather than the actual impact of the programs.

When recalculating the regression equation with community fixed effects, the results of which are shown in the second, fourth and sixth column of Table N5, no major variation is observed in the child-level and income-level coefficients. The estimate for the income variable comes down from 0.7229 to 0.6321 (for height-for-age), but is still strongly significant, after taking into account the fact that wealthier, better-equipped communities may have better health conditions. The relative importance of the other coefficients remains similar in both forms of the equation. Of interest is the slightly higher level of significance of secondary education for the household head or primary education for the "woman of the household", indicating that those individual attributes may be replaced/hidden by shared knowledge in the communities. For the three indicators, the predictive value of the regression equation is improved by taking into account those community-fixed effects, as assessed through the adjusted r-squared (up from 0.1544 to 0.1703 in the case of the height-for-age indicator). The F test for the height-for-age and weight-for-height regressions fails to reject the null hypothesis that community-fixed effects have a significant impact on nutritional status on their own; this test is however significant for the

weight-for-age variable ($p<0.01$). The overall picture, added to the lack of significance of the community variables considered individually, would lead to attribute a wider role to child-specific and household level variables in the determination of children's nutritional status.

Table N6 shows the estimates of the regression coefficients for the fitted values of the community-fixed effects derived from the second form of equation (5b) and regressed on the 13 community observed variables (the presence of diarrhea in the previous month was included as a child level variable in Nicaragua and the AIN-C program is specific to Honduras). Most of the coefficient estimates have statistically significant values at the 5% or even 1% level, except for institutional delivery, price of corn, rice and powdered milk, and non-agricultural wages for the stunting indicator; sanitation indicators and time to reach the health centre for the wasting indicator; and price of rice and agricultural wages for the global malnutrition indicator. The predictive value of the selected variables is higher for the weight-for-height (wasting) indicator (r-squared = 0.1469) than for weight for age (0.1078) and height-for-age (0.102), indicating that other variables would be needed to obtain a better estimate of community fixed-effects for this indicator. However, the overall gain in predictive value obtained in better specifying community-level fixed effects for the estimates of height-for-age z-score may not be large enough to warrant much more detailed analysis.

6.2.2 Cross-Sectional Estimates with Variables interaction

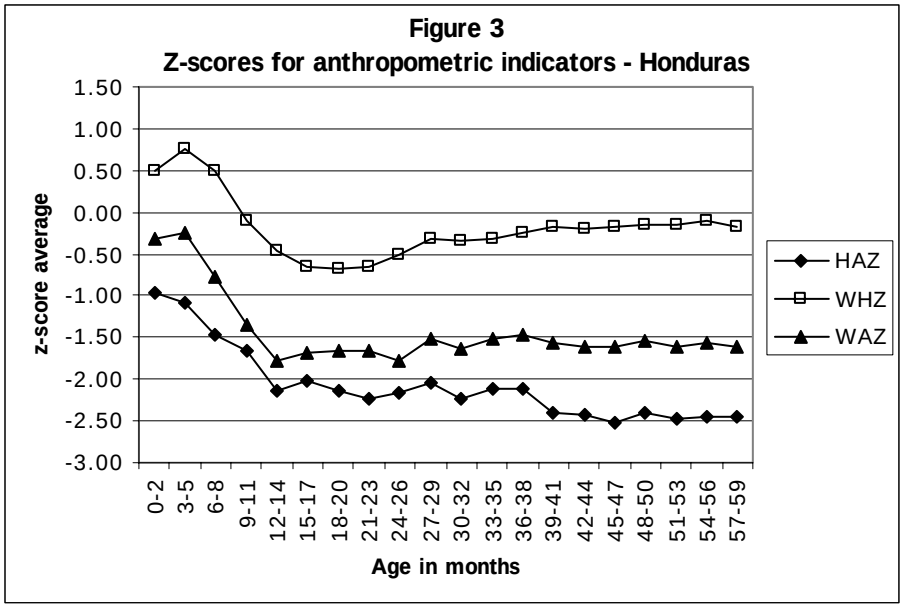
The introduction in the regression equation of a community index based on the five community variables in equation (5) and of two interaction variables between this index and the levels of education of the household heads and the woman of the household does not produce major variations in the estimates of the regression coefficients, as shown in tables N7 and N8. Coefficients that had a statistically significant value remain as such. The value of the coefficient corresponding to the community index is low and not significant for all three indicators. There appears to be no interactive effect between the education variables for the household head and the woman of the household and the community index. The predictive value of the regression equation, as assessed by the adjusted r-squared coefficient, is not improved by the addition of the community index or the interaction variables. Using community fixed effects instead of individual community variables does not change the overall picture.

7. Honduras Results

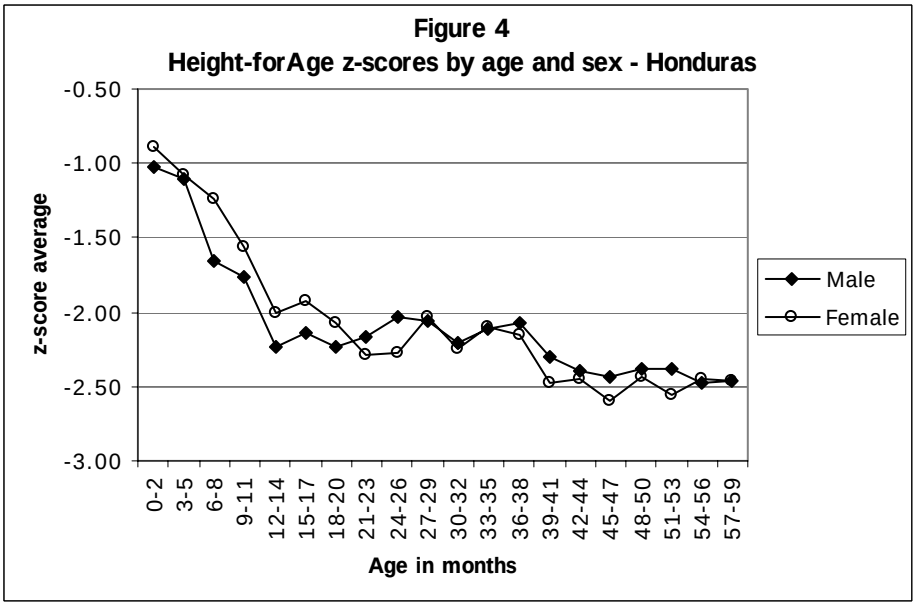
7.1 Growth achievements of children

Due to the purposive nature of the sampling mechanisms, the nutritional picture offered by the PRAF survey in Honduras is much bleaker, as can be seen from the results provided in Table H1. The mean z-score for the Height-for-Age indicator is –2.10, indicating a proportion of malnourished children as high as 53.6%, including 21.6% severely malnourished (<-3SD).

The mean z-score for children 0 to 2 month old is already –0.96, indicating a prenatal growth deficit that could be linked to genetic endowment (mother's stature, see below) or poor intra-uterine nutritional intakes. The stunting process is relatively quick, as seen in Figure 3, with the average z-score reaching –2.14 after the first year, then accumulating in a slower trend, down to –2.46 before the fifth birthday.



There is no gender difference, with an average score of –2.10 for boys and –2.09 for girls, except for children under two years of age, whose malnutrition status deteriorates faster for boy than for girls, as is shown in Figure 4 but recovers in subsequent years. Rural malnutrition rates are quite higher than rural ones (-2.19 versus –1.57; 56.9% malnourished versus 34.2% respectively).



The Weight-for-height indicator shows that those children have a good enough start in the first three months, as they tend to be generally exclusively breastfed, but very quickly deteriorate with a very discernable peak of acute malnutrition, down to –0.67 (4.6% malnourished) during the second year of life. Once again the urban average is twice better than the rural one (-0.11 versus –0.22) while gender differences are much lighter (-0.22 for boys and –0.19 for girls).

The mean weight-for-age z-score is –1.45 (that is, an average of 30.4% malnutrition), identical for boys and girls. The mean score for urban children is –1.07, that for rural kids is –1.51.

The comparison with the National Epidemiology and Family Health Survey (Table 2) confirms the specificity of the PRAF sample versus the nation-wide population. The mean z-score for children between 3 and 59 months of age in the ENESF is –1.35 for the height-for-age indicator, corresponding to a proportion of malnourished children of 29.2%. The proportions of malnutrition for weight-for-height and weight-for-age are 1.0 and 16.6% respectively.

Table 2: Comparison of anthropometric indicators between surveys - Honduras

	ENESF - 2001		PRAF - 2001	
	Mean z-score	% Malnourished	Mean z-score	% Malnourished
Height-for-Age	-1.35	29.2	-2.10	53.6
Weight-for-Height	-0.09	1	-0.21	1.6
Weight-for-Age	-0.93	16.6	-1.45	30.4
Number of observations	5,609 (children 3-59 months)		5,307 (children 0-59 months)	

Source: ESA Consultores, from ENESF-2001 and PRAF-2002

Simple 2 x n tables, as presented in Table H2, allow a first review of the relationships of malnutrition with other variables relevant to child health. Maternal endowments (measured through maternal stature) is directly and inversely related to the height-for-age indicator, with the proportion of "stunted" children going down from 75.2% to 29.3% when maternal stature increases. It should be noted that the Western Region of Honduras, where most of the sample comes from, is home to the Lenca indigenous group, who generally are of shorter stature than the general "ladino" population.

In this population, the relationship between malnutrition and age difference between siblings is not as apparent as in the Nicaragua survey. While the proportion of stunted children is slightly higher (61.3 versus 55.0%) for children with wider age difference with an older sibling, an inverse relation appears with regards to age difference with the younger sibling (55.3 versus 70.1%). Yet the proportion of wasted children is expectedly higher in children with smaller age difference with their younger sibling (2.5 versus 0.9%).

The relationships between malnutrition and household level variables such as education level of the household head or woman of the household, household size and per capita household expenditures is similar to that observed in Nicaragua, but the observed ranges of malnutrition are on a higher part of the scale; for instance, the proportion of stunted children varies between 67.6 and 31.2%, depending on the quintile of household expenditures. Sanitary infrastructure (toilets and tap water), distance in time from a health centre and timely immunization schedule are also associated with lower proportion of stunted children, while the relationship of those variables with the other indicators is less clear.

7.2 Determinants of Child Growth

The variables in this analysis have been selected on the basis of availability of information and on the significance shown in previous research. Table H3 shows the mean (for continuous variables) and the percentage (for categorical variables) and their respective standard deviation for all the independent variables used in the regressions.

7.2.1 Cross-Sectional Estimates without interaction

This section presents the estimates of equation (5) and (6). The dependent variables are the Z-scores for Height/Age, Weight/Height and Weight/Age. Table H5 presents the estimated results of the step-by-step inclusion of independent variables in the parsimonious model. The initial model includes two child variables (*age and sex*), six household variables and five community variables, and the final model has five child variables, nine household variables and five community variables. The values of the estimated coefficients and their respective significances do not vary much when new variables are included in the model, and the adjusted R square improves from .3046 for the initial model to .3255 for the final model. As in the Nicaraguan case the estimated coefficient for *Household woman with primary education* and its significance level decrease when the variable of *household size* is included, suggesting that women's education impact on children's nutrition status is correlated with the family size.

Table H5 presents estimates of equation (5a), for mostly rural children from the Western part of Honduras, aged 0-59 months. The first column presents OLS estimates for Height-for-Age, the second column of estimates includes community fixed effects to control for bias due to some unobserved community variables, as per equation (5b). The third and fourth columns represent similar estimates for dependant variable Weight-for-Height, and the fifth and sixth columns for Weight-for-Age.

Child Characteristics. As shown in Figure 3, malnutrition increases with the age of the child, the malnutrition process starting even before birth; the *age of the child (*mean: 30.5 months) is directly related to malnutrition as measured by z-scores of height/age or weight/height.

Maternal height: this variable controls for unobserved prenatal endowment linked to both genetic factors and intrauterine conditions; it thus shows variations in height across healthy population. Maternal stature is strongly and positively correlated to height- and weight-for-age z-scores (0.066 and 0.043, respectively), but is not strongly related to acute malnutrition (weight-for-height). The average maternal height is 148.4 centimetres, which is certainly lower than the national Honduran average; this is so due to a high concentration of indigenous women (who are known to have lower height) in the sample. Mother's height seems to have a direct influence on child's height at birth; Figure 3 shows that height-for-age z-scores for newly born children are around –1, this indicates the child is malnourished before birth or has a genetic height which is lower than an international standard average height. However, the poor living conditions that prevail in the area where the sample was taken from suggests that children are mainly malnourished *in utero*. For the whole age group, *child's sex* is not related to child malnutrition; the regression coefficients for this variable are not statistically significant. In Honduras, there is not evidence of parental preferences leading to gender discrimination for child nutrition and feeding.

Age difference with an older sibling, the estimated value for this variable is low (.0049) but statistically significant, indicating a relative positive influence of extended birth intervals on child's health. The results for the variable *Age difference with a younger sibling* can be interpreted in similar lines, the wider the age difference, the better the child's nutrition status is. The related coefficient is in the same range as for age difference with an older sibling (.0098) and highly significant (which is different from the Nicaraguan observations). One may assume that, in a more marginal and poorer population, such as the PRAF sample, the acceleration of

successive births may have a stronger impact on child nutrition (although the impact on weight/height results does not appear to be significant as the 2 x2 tables would have led to think).

Household Characteristics.

In the sample, 22% of the women of the household had adult or no education, 74% had primary school and 4% had high school or more. *Education of the household head* is a proxy variable to see the impact of fathers education on the child's health; similar proportions of persons with primary or secondary schooling were found in this group. Since mothers usually play an important role concerning the child's well being, it is not surprising that this variable is positively related to the child's health, in particular viewed through height/age results (the estimated coefficient is 0.0955 for women with primary schooling). In periods of food shortage (that is, when acute malnutrition occurs) the role of women's education in improving child's health is not so univocal. The coefficient for the variable *woman of the household has secondary schooling* has no statistical significance when related to the variable *height for age*, probably because of a low number of observations in this category, however, there is a significant relation to the variable *weight for height*, specially when one controls for community fixed effects.

The household size has a negative relation with child's health status (-0.0346 for HAZ): the greater the number of people living in a household, specially in areas with large percentages of poverty, the more likely are children going to suffer some kind of malnutrition.

The beneficiary variables at household level *food and health services received from the community* and *beneficiaries of food/health coupons* do not show a clear relation with the variable *height for age* but the reception of food from the community does show a positive relationship with *weight for height*. This last result is somehow intuitive; when acute malnutrition occurs, when food is scarce in the household, one expects that community programs, aimed at providing basic food necessities for families, have an impact on alleviating acute malnutrition. The programs oriented on transferring cash to poor families do not show any relation in improving children's nutritional status in any of its dimensions; the reasons for this are not clear, one possible explanation is that most families in the sample receive these cash transfers, therefore, the program's effects are not be captured in the regression. Another possible explanation is that these cash transfers do not modify the food consumption patterns of the families, the extra cash received serves for food but an equal amount of income is used in the purchasing of other commodities. Finally, the coupons given to the families by PRAF represent a small amount of money (US$4 a month), which may have a low impact in a family's budget.

Income Variable. Reported household income can be inaccurate due to fluctuations during the year, and also because part of the real household income comes from domestic agriculture and farming activities, which many times are not reported as income. Instrumental variables (household assets and dwelling characteristics) are used to control for the remaining potential endogeneity of the proxy variable used here, that is, the natural logarithm of the per capita household expenditures. The estimates suggest that this variable has a clear positive impact in reducing child's chronic malnutrition (coefficient for height-for-age: 0.5995): it is important to mention that this sample comes from a region characterized as poor and rural, where increases in household income will definitely improve the family living standards and consequently the child's health. When one controls for community fixed effects, the income proxy coefficients for height-for-age and weight-for-age increase – a difference from the Nicaraguan situation – indicating in this case that within a poor homogeneous context, the impact of individual

differences in household income (expenditures) tends to be emphasized by the calculation process. The impact on the weight-for-height variable remains initially not significant, a possible explanation for this lying in the fact that most farmers cannot markedly increase their expenditures on food when acute malnutrition occurs.

Community variables. The proportion of households with *tab water* is 67% of the sample, and this variable is positively correlated with long term malnutrition, but not so with short term ones. The second community variable is *time to reach a health centre;* the corresponding average time for this variable is 51 minutes, with a large standard deviation. In the regression the coefficients for this variable are not significant, suggesting that travel distance to the health centre does not play a role in defining the nutritional status of the child.

The third variable is *Proportion of households beneficiary of "Mother & Child Coupons",* which represents the intensity of government program interventions through direct cash transfers to poor families with mothers and young children. It is quite accepted among policy makers that programs like this one have a high impact in reducing child malnutrition in poor communities if coupons are given to those families with infants and young children, who have the most problems in obtaining cash; this thinking is in line with the finding in this paper that income is one of the most important variables affecting the nutrition status of the child in poor communities. The coefficient estimates for this variable are not significant at the community level, this is also consistent with the finding at the household level, where the impact of this variable is not clear.

The fourth variable is *price of corn,* this cereal is widely consumed on an everyday basis in the region; the coefficient estimates for this variable are not statistically significant, this could be explained by the fact that corn is consumed by everyone, even when cash is scarce, since corn is produced by most families and the price becomes only relevant when families have no cash or food at all. The fifth variable is *agricultural wages;* this variable is related to child's health, according to the results of the regressions. The fact that this sample is a relatively homogeneous group, mainly constituted of poor farmers, probably explains why an increase in agricultural wages will improve the household's situation and consequently contribute to improving child's nutritional status.

When **community fixed effects** are taken into account in the model, as shown in the second, fourth and sixth column of Table H6, the various variables overall conserve their level of significance. The importance of the impact of female education on long term malnutrition diminishes (from 0.0955 to 0.0495 in the case of primary schooling), which may indicate a certain level of experience sharing in communities. The coefficient for *Women of the household with secondary school* becomes more significant in relation to short-term malnutrition, when this community effects are being considered. The impact of household expenditures remains significant for the three independent variables when community fixed effects are taken into account. In those relatively more homogeneous communities – as compared to Nicaragua – small differences in income (as assessed through per capita expenditures) could make a major difference in child's nutrition and well-being. It should be noted that, in the case of this Honduran sample, the impact of community fixed effects as a whole is highly significant for all three nutritional indicators (F test for $u_i = 0$ with $p<0.01$), with value of the rho coefficients (proportion of the variance attributable to u_i) higher than in the Nicaragua sample (0.253 to 0.274 versus 0.158 to 0.197).

When **fitted values of community fixed effects** are regressed on all 15 community-level observed variables, it can be noticed from the results of table H6 that the selected community variables have less explanatory power on the fitted values of the community fixed effects than was the case in Nicaragua, with adjusted r-squared coefficients ranging from 0.0801 to 0.1017. Three variables do not contribute to the distinctive profile of the communities, as assessed by the community fixed effects: the effect of the *implementation of the community-based integrated child health program* maybe hampered par its recent development in some communities as well as by the problems encountered in matching communities in the AIN-C and survey listings, leading to false positives or false positives in the assignment of the value of the variable; conversely, the status of immunization campaigns, a national priority for may years, may be too homogeneous for the *timeliness of immunization* to constitute a valid criteria of community definition; the price of the powdered milk, finally, could be irrelevant in a group of rural communities with high levels of initial breast feeding and lack of means to substitute with artificial milk. As for the Nicaragua sample, the inconsistencies in the sign of the regression coefficients and the lack of direct relationship between the community variables to the nutritional outcomes through the community fixed effects make individual interpretation of the results more hazardous. The predictive value of the selected variables , as assessed by the adjusted r-square, is generally lower than that observed in Nicaragua (0.080, 0.1017 and 0.0662 respectively).

7.2.2 Cross-Sectional Estimates with Variables interaction

This section discusses the estimates of regression coefficients for equation (7), as presented in Table H7. As in previous tables, the first column presents OLS estimates for Height-for-age, the second column includes community fixed effects to control for bias due to some unobserved community variables. The third and fourth columns represent similar estimates for dependant variable Weight-for-Height, and the fifth ant sixth columns for Weight-for-Age. The construction of a community index and the selection of interaction variables have been described in Section 5.2.

When interactions are allowed into the model, with or without community fixed effects, the coefficients estimates for the child variables remain virtually the same. However, the primary education of the woman of the household becomes a much more significant factor in all three dimensions of nutritional status. There is a significant, generally negative, interaction between this variable and the index of community characteristics, constructed in such a way that a higher score on the index corresponds to better of communities. The same results are also observed for the impact of household head's secondary school on height-for-age and weight-for-age indicators. Thus it would seem that the overall level of development/capacity of the community would tend to equalize/hide the individual role of educated adults in the households, this role becoming more apparent when taking into account this interaction. The negative value observed for the interaction variable may thus indicate that the overall status of the community could substitute for household heads' or women's education.

Household per capita expenditures remains a robust estimate in all regressions, as interactions and community fixed effects do not affect this estimator. The index of community variables has a significant but minimal effect on the long and short-term nutritional indicators (.0148, .0128, .0063). The predictive value of equation (7) is not significantly improved over equation (5) as assessed through very similar adjusted r-squared coefficients. The F test for the community fixed effects remains highly significant for all three indicators. The regression of Fitted values of

community fixed effects on community observed variables does not yield markedly different results, both in terms of value of the coefficients or of levels of significance, as seen in Table H8.

8. Sensitivity analysis, variants and discussion

8.1. Differences between countries

As mentioned earlier, comparisons between the two surveys should carefully take into consideration the differences in the populations surveyed:

- on one hand, the Nicaragua survey was conducted nation-wide and thus the information represents the full extent of the country's population;
- on the other hand, the Honduras/PRAF sample was purposively designed to reflect the situation of actual or potential beneficiaries of monetary assignation programs in municipalities classified as low-scoring in terms of school child nutrition.

Yet, those differences may and will actually shape the results of the study of the determinants of child health and nutrition from different perspectives, which may be helpful in terms of drawing inferences and operational implications.

A first striking difference appeared in the background sections 2 and 3 of this paper. Nicaragua is considered the poorest country in Central America, with a per capita GNP of approximately US$430, and with 55% of its population falling below the poverty line (including 15.1% considered to be in extreme poverty). Honduras is also considered one of the poorest countries in Latin America, with a per capita GNP of approximately US$760 and with 70% of its population considered poor (including 48.6% is in extreme poverty). The issue that comes to mind is the discrepancy between per capita GNP and proportion of people living in extreme poverty between the two countries. Part of the answer lies in the way of measuring poverty: consumption is used in Nicaragua, while in Honduras poverty is measured by income. Other factors that may contribute to the apparent discrepancy are the lower cost of the basic food basket in Nicaragua where, for instance, the cost of meat and milk products is lower than in Honduras, and the better yield of money in Nicaragua in terms of adjustment for purchasing power parity; the actual per capita income turns out to be somewhat similar, at US$2,400 for Nicaragua and US$2,800 for Honduras.

8.2. Specification of the income proxy variable

As mentioned in the methodology section, household expenditures are often used as a proxy for the household income in situation where (cash) income may be irregular in nature, and as a way to account for the possible endogeneity of this income variable, that is, its relationship with the dependent outcome variable, illustrated by the fact that a family member may be forced to stop working and earning income in order to take care of a sick children, or conversely, may abandon studies and take up some form of paid employment in order to buy the needed medicines. While, in principle, household per capita expenditures would tend to better reflect an averaged income situation over a longer period of time, they could still in theory suffer from the same endogeneity problem. From the available databases, we thus looked for an instrumental variable that would partially solve this problem and used a predicted value of per capita household expenditures, on the basis of possession of selected household goods and animals, as well as desirable

characteristics of the dwelling. Non-significant items on the initial regression of per capita household expenditures on those 15 asset variables were discarded, leaving the following items:

- for Nicaragua: ownership of TV, HiFi equipment, tape recorder, fridge, stove, dishwasher, four-wheel vehicle, cattle, non-earth house floor, brick or stone walls, tile or corrugated sheet roof (total: 11 items)
- for Honduras, the same, except for the dishwasher, and adding ownership of radio transistor, microwave oven and horse(s), for a total of 13 items.

The distribution of a simple index (number of items owned) allows some inter-country comparison, as seen in Figure 5. In spite of a lower number of potential items, the Nicaragua sample has a significantly higher average number of household items (3.6) than the regional Honduras sample (2.9, $p<0.05$), with a wider variance, reflecting the nation-wide sampling process as opposed to the focalization of the Honduras sample in poor departments.

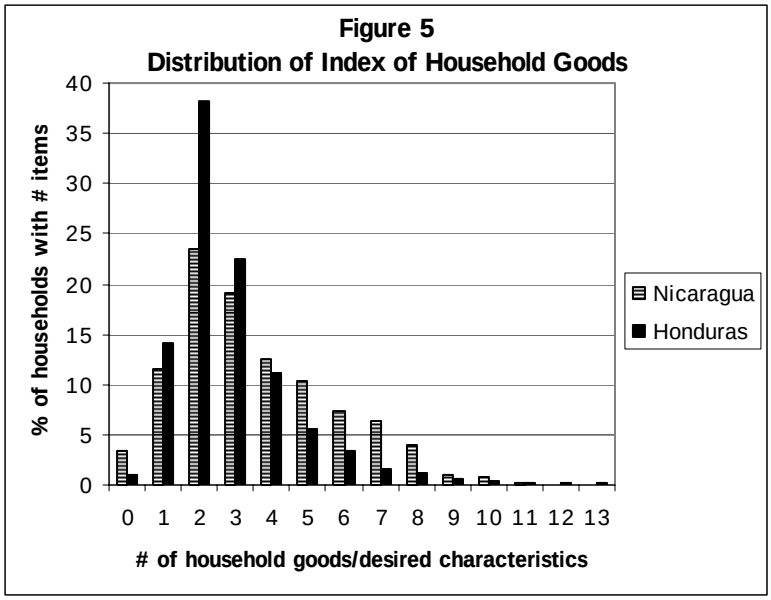


Table 3 shows a comparison of the main regression coefficients for both countries, using the observed and the predicted household per capita expenditures in equation (5). In both cases, the coefficient for the income proxy variable increases when using the predicted value, and the increase is proportionally higher for the Honduras sample (from 0.237 to 0.5600). Our interpretation is that the instantaneous – observed – household expenditures, in a population globally living in poor conditions, are somehow homogenized at a low level (that is, there cannot be much difference in the composition of the basic food basket for day-to-day, survival, consumption), whereas the predicted value, indexed on the ownership of household goods/desirable dwelling characteristics, a more permanent situation, reflects better this left-skewed distribution of poverty, observed in Figure 5, and thus gives a higher weight to the income proxy variable, a change even more sensitive in the context of Western Honduras.

Table 3: Comparison of regression coefficients when using observed or predicted per capita household expenditures

	Nicaragua		Honduras	
Variable	**Observed**	**Predicted**	**Observed**	**Predicted**
Age	-.0163 ***	-.0162 ***	-.0199 ***	-.0200 ***
Sex	.0706	.0422	-.0286	-.0204
Maternal height			.0683 ***	.0661 ***
Age difference with older sibling	.0040 ***	.0045 ***	.0056 ***	.0049 ***
Age difference with younger sibling	-.0045	-.0057	.0138 ***	.0141 ***
Incidence of diarrhea	-.1520 ***	-.1506 **		
Household head has secondary schooling	.1830 *	.1413	.2215 **	.0644
Woman of household has primary schooling	.0438	.0847	.0963 **	.0955 **
Woman is household head	-.0197	-.0427	.0542	.0669
Household size	.0018	-.0345 ***	-.0112 *	-.0346 ***
Per capita household expenditures	.5592 ***	.7229 ***	.2367 ***	.5995 ***
n	2,298	2,298	4,102	4,066

Source: ESA Consultores, from ENMNV-2001 and PRAF-2002
Levels of significance: * = p<0.1; ** = p<0.05; *** = p<0.01

Given the existing, real-life, observations of people pawning their TV set or selling heads of cattle in order to face a catastrophic health situation, one could argue that even household expenditures predicted on the ownership of goods/animals/desirable dwelling characteristics is not a fully exogenous variable, but it does constitute the best alternative with the data sets available to the study team.

Two other variables register a change in the value of coefficients and levels of significance when moving from observed to predicted expenditures: the impact of 2ry education for the household head disappears, showing the relative power of chronic poverty over education; conversely, the household size becomes significant, meaning more constraints on large family in chronic poverty situation.

8.3. Categorization of the intervention variables

Programmatic health/nutrition variables (such as benefiting from MCH coupons, or receiving food for work) were identified for each country data set, and an appropriate level of insertion into equation (5) was sought for them. Considering those variables as part of the vector of community variables would emphasize the programmatic aspects, such as the extension or intensity of the intervention, as well as the targeting of beneficiary communities. Including them as household variables would rather reflect the capacity of the household to benefit from existing program or the intra-community targeting aspects of the intervention. Table 4 below, presents a theoretical

framework for possible models of equation (5), depending on the level of insertion of the independent programmatic variables.

Table 4: Theoretical Framework for Insertion of Programmatic Intervention Variables

	Regression model		
Level of insertion of variables	Without community variables	With community variables	With community fixed effects
Household	1	4	7
Community	2	5	8
Both		6	

Running the regression for the Height-for-Age dependent variable corresponding to the feasible models in Table 4 produced the respective coefficients for those variables shown in Table 5.

Table 5: Changes in the coefficients of the programmatic intervention variables in the regression of height-for-age, depending on their level of insertion

Programmatic Intervention Variables	Regression Model				
	1	4	5	6	7
Nicaragua					
Household receives food for work or food donations [H]	.0830	.0809		.1190	.0936
Household includes child receiving food/vitamins supplements [H]	-.1188 **	-.1676 ***		-1548 **	-.1431 ***
Proportion of households receiving food for work or food donations [C]			-.0012	-.0028	
Proportion of households with child receiving food/vitamins supplements [C]			-.0024	-.0010	
Adjusted R-square	0.1664	0.1488	0.1465	0.1484	0.1703
Honduras					
Household receives food or health support from organization [H]	.0201	.0551		.1167 *	-.0036
Household with beneficiary of MCH coupons [H]	-.0911 **	-.0933		-.2592 ***	-.1428 **
Proportion of households receiving food or health support [C]			-.0007	-.0019	
Proportion of households with coupons beneficiaries [C]			.0004	.0044 **	
Adjusted R-square	0.3375	0.3324	0.3313	0.3348	0.3347

Source: ESA Consultores, from ENMNV-2001 and PRAF-2002

Model 1: programmatic variables as household variables, no community variables

Model 4: same + community variables (except programmatic variables)

Model 5: programmatic variables as community, but not household variables

Model 6: programmatic variables at both community and household levels

Model 7: programmatic variables at household level, with community fixed effects.

Levels of significance: * = p<0.1; ** = p<0.05; *** = p<0.01

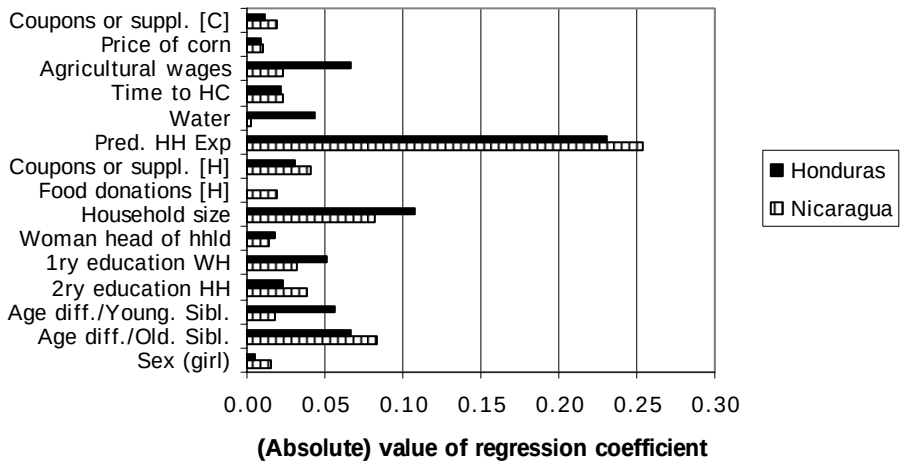
The value of the coefficients for programmatic variables considered as household variables seems much higher than that when those variables are inserted in the model at community level, another possible indication of the relative importance of household-based factors in the determination of

child's nutritional/health status[5]. Model 6, using programmatic variables at both household and community levels, allows us to observe programmatic effects with those two perspectives of inter- and intra-community targeting; in addition, it offers the highest predicted value (as Model 1 does not include community variables and is thus not suitable for this study): it was thus used as the basic form of equation (5) in the study.

8.4. Relative importance of independent variables

Using standardized (beta) coefficients (which measure the change in the dependent variable - measured in standard deviations – produced by a one-standard-deviation change in the independent variable) allows a better comparison of the relative importance of the impact of individual variables on the nutritional/health status. Those coefficients were calculated again for the basic form of equation (5) for the height-for-age variable in both samples and are summarized in Figure 6. The absolute value of standardized coefficients is graphed; variables that only exists in one survey – *Maternal height* for Honduras and *Incidence of diarrhea* for Nicaragua have been removed for more accurate comparison; *Age of the child*, the variable with the highest coefficient and – as mentioned earlier, an accompanying rather than explanatory variable – has also been removed to better evaluate the other variables). Additional version of this comparison – not shown here – had indicated that maternal height, in the Honduras sample, had the second most important impact in terms of standardized coefficients.

Figure 6
Comparison of standardized coefficients for H/A



The most important factor in both samples is the predicted value of household per capita expenditures (0.25 in Nicaragua, versus 0.23 in Honduras). Next in importance are the household size and the age difference with the older sibling in both samples, then the age difference with younger siblings, primary education of the woman of the household, the water connection situation and the agricultural wages in Honduras, observing a good match between highest values of standardized coefficients and high levels of significance of the relevant variable.

[5] Note, however, that this difference, linked to the difference of scales, almost completely disappears, when comparing standardized (beta) coefficients estimated in Model 6: for Honduras the values of those standardized coefficients are -0.045 and –0.087 respectively, when inserted at household level, versus –0.041 and 0.075 when inserted at community level; corresponding values in the Nicaragua sample for household-level values of the coefficients are 0.027 and –0.055 and for community level values 0.024 and –0.013.

8.5. Children under two years of age

It has been demonstrated that the first two years are really the most critical for the growth and development of the child, and a number of programs actually focus on targeting children in this age range. In order to detect any difference in the relative importance of the determinants of child health and nutrition for this cohort of younger children, we run the whole set of regressions based on equation (5) for children aged 0-23 months. Table 6, summarizes the values of the regression coefficients for selected variables in both population for the height-for-age indicator.

Table 6: Comparison of regression coefficients for two groups: children 0-59 months old and children 0-23 months old

	Nicaragua		Honduras	
Variable	**0-59 mths**	**0-23 mths**	**0-59 mths**	**0-23 mths**
Age	-.0162 ***	-.0567 ***	-.0200 ***	-.0664 ***
Sex	.0422	.0391	-.0204	.1300 ***
Maternal height			.0661 ***	.0642 ***
Age difference with older sibling	.0045 ***	.0032 *	.0049 ***	.0016
Age difference with younger sibling	-.0057	.0910 **	.0141 ***	-.0004
Incidence of diarrhea	-.1506 **	-.0935		
Household head has secondary schooling	.1413	-.0604	.0644	-.3408 **
Woman of household has primary schooling	.0847	-.0166	.0955 **	.1004
Woman is household head	-.0427	-.0948	.0669	.1607 **
Household size	-.0345 ***	-.0471 ***	-.0346 ***	-.0333 ***
Per capita household expenditures	.7229 ***	.7742 ***	.5995 ***	.6136 ***
n	2,298	907	4,066	1,609

Source: ESA Consultores, from ENMNV-2001 and PRAF-2002
Levels of significance: * = p<0.1; ** = p<0.05; *** = p<0.01

As expected, the importance of the age variable increases in the younger population where the growth rate is higher. Predicted household expenditures and household size remain significant variables. The results for the sex variable confirm the observation made earlier in Section 7.1 that girls have a slight nutritional advantage in the early months, which they loose over the following years. In Honduras, secondary education of the household head and having a female as head of the household are more important for younger children, while the woman's primary education appears to play a bigger role in the later stages of child's growth. In both countries, the age differences with siblings loose some of their significance, probably as a result of the decreasing number of observations linked to the lack of suitable sibling.

8.6. Substituting biological mother for "woman of the household"

Given the structure of the databases we have been working with, we assumed that the "woman of the household", whether or not she was the biological mother of the observed child, would have a

similar role to the mother's in the child's development. For the Honduras sample, however, we were able to trace the biological relationship in the database for a sub-set of observations and recalculate the regression equations (5) to (8). Table 7 shows the value and significance level of selected coefficients for the two methods.

Table 7: Comparison of regresion coefficients for height-for-age variable in Honduras, using "woman of the household" or "Biological mother" variables

	Biological mother		Woman of the household	
Variable	**No interaction**	**With interaction**	**No interaction**	**With interaction**
Maternal height	.0655 ***	.0658 ***	.0661 ***	.0664 ***
Woman has 1ry schooling	.1233 ***	.2238	.0955 **	.3519 **
Woman has 2ry schooling	.2153 **	.2268 **	.1331	.1516
Household size	-.0357 ***	-.0362 ***	-.0346 ***	-.0350 ***
Ln Predicted Per capita household expenditures	.5898 ***	.6010 ***	.5595 ***	.6121 ***
Hhld receiving food or health support from organization	.0341	.0320	.0346	.0334
Hhld with beneficiary of MCH coupons	-.0997	-.1353 ***	-.0880	-.1357 ***
Interaction between woman's 1ry education and Community Index		-.0029		-.0074 *
Adjusted R-square	0.3244	0.3244	0.3255	0.326
n	4,073		4,068	

Source: ESA Consultores, from PRAF-2002

Levels of significance: * = p<0.1; ** = p<0.05; *** = p<0.01

The results show indeed that the main coefficients were not affected by this substitution, thus justifying the process adopted for both countries. However, one should note that there seems to be a more positive interaction between the community index and the level of education in the case of the woman of the household, possibly indicating that improved community characteristics would tend to increase the woman's confidence and capacity in raising a child as would his/her real mother. This feature does not apply in the case of the biological mother, whose level of education (primary) looses its significance when including the interaction variables.

8.7. Public interventions and private contributions

A traditional view of the factors influencing child health and nutrition opposes private determinants, such as parental education and income, and usually seen as household-level variables, depending upon individual efforts and achievements, to public interventions such as development of sanitary infrastructure, access to health services, delivery of specific benefits such as cash transfers, etc., included here and elsewhere as community-level variables. A more complex – and maybe more useful – model would in addition look at other dimensions of possible determinants/interventions. One could differentiate between long-term policies aimed at improving the overall shape of the economy, and thus the earnings of the household, or the national education system, leading to improved educational achievements and increased employment opportunities for household heads and mothers, on one hand, and short-term, ad-hoc

interventions aimed at helping specific sub-groups of the population to take better advantage of these policies, or at breaching the existing gaps in the context of a poverty reduction strategy, on the other end. From an operational point of view, we also need to consider the existence and feasibility – political, social, financial and technical – of public interventions aimed at modifying the determinants of child health identified through a variety of studies. Indeed we inserted in this model some of the "intervention" variables at both levels to reflect either the intensity or coverage of public interventions or the capacity of individual households to access and use these programs, as well as the related aspects of inter- and intra-community targeting.

From the results obtained here, it seems clear that individual and household-level factors are still the main determinants of child health, as assessed through those three indicators of nutritional status. Maternal biological endowments, measured through maternal height, are the key variable in the Honduras sample, susceptible to short-term interventions such as maternal nutrition and care during pregnancy, but also likely to improve over generations through the cumulative impact of all other interventions. Although that variable was not available in the Nicaragua sample, it would be fair to assume a similar pattern. The importance of maternal endowments has also been pointed out by other studies in Ghana (Alderman, 1990) and Indonesia (Schmidt, 2002), although the former points out at the role of womb environment during the prenatal period rather than at genetic factors, since father's height does not seem to be related to child nutrition in such a significant way.

Household income comes second in relative importance: while its overall determinants may be the status of the national economy and the employment opportunities, its impact also depends on the size of the family, that is, the number of people who have to leave from this income, leading to long-term population and family planning policies. Those policies, with emphasis on spacing – in addition to limiting – births, also affect in turn personal factors such as the age difference between siblings, which have been identified, through clear biological links, here and in other studies, as critical factors for the child's growth. Curiously, the findings on income seems to contradict those from a much earlier study in Nicaragua (Wolfe, Berhman, 1982), where income is not an important factor, compared to number of siblings, for instance. The discrepancy may indicate a relative deterioration of the economic situation over the last 20 years separating the two studies, an event that would contribute to raise the role of income as a determinant of child growth and nutrition. Other studies in different settings such as Brazil and Vietnam (Thomas, Strauss, Henriques, 1990; Glewwe, Koch and Nguyen, 2002) have also found a significant but rather weak impact of increased income.

In Nicaragua, education levels of the household head or the woman of the household are not significantly related to any of the nutritional status indicators; when such an effect briefly appears, as is the case for the height-for-age variable, it is nullified by the inclusion of interaction variables with an index of community characteristics. In the Honduras sample, however, the impact of primary education for the woman of the household is present for the height-for-age and weight-for-age indicators and appears stronger ($p<0.01$) when interaction variables are included in the model; similarly, some level of significance of the primary education level of the head of household appears when the corresponding interaction variable is introduced in the model. As the sign of the interaction variables' coefficients is negative, the interpretation is that individual deviances in education level are diluted by the overall achievements of the community in this and other areas. While this situation may limit the potential impact of positive deviances in

individual households, it may imply that there exists a certain level of community sharing that may benefits households with low levels of educational achievements (Christiaensen, 2001).

As educational achievements and household income are often closely correlated, we explore the role of the former variables across a range of income, running the regression for equation (5) for each quintile of the predicted per capita household expenditures. In Nicaragua, only in the higher income bracket does the education of the household head seem to have an impact on its own, while woman's education remains non significant (see Table 8). In the Honduras sample, the education variables acquire different levels of significance for different quintiles, without being able to observe any systematic pattern of increasing or decreasing influence of those variables across the range of expenditures. It should be noted that, in the poorer, more homogeneous communities of the Honduras sample, even within each quintile of expenditures, that variable (expenditures) maintains a significant impact on the nutritional indicators. It seems thus that any effect of improved education status for the household head or the woman of the household is mediated by the changes in income.

Table 8: Coefficients for education and income proxy variables in the regression of height-for-age by quintile of predicted per capita expenditures

	Nicaragua					Honduras				
Expenditures quintiles (low to high)	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Household head has 1ry education	-.2514 *	.3516 **	.0108	-.1115	.4582 **	-.1285	-.0286	.0707	.0242	-.0171
Household head has 2ry education	.0644	.1207	-.2615	.0165	.3966 *	-.7789	.1608	.7180 **	.2899	-.0199
Woman of household has 1ry education	.1380	-.2028	.0827	.0125	.1725	.2061 **	-.0761	.0384	.1850 **	.0507
Woman of household has 2ry education	.1139	-.4674	.1782	-.1801	.1455	1.7832	-.2313	.5299	-.2873	.1329
Ln Predicted Per capita Household Expenditures	.5508	.7063 ***	.3674	.2123	.6376	.5321 **	.4765 **	.4205 ***	1.1655 ***	.4254 ***
n	481	463	476	464	414	853	847	826	809	728

Source: ESA Consultores, from ENMNV-2001 and PRAF-2002
Levels of significance: * = p<0.1; ** = p<0.05; *** = p<0.01

Few of the community-levels variables are individually significant, and they are so only in the Honduras sample. The level of agricultural wages, in a rural population where a large proportion of active individuals are paid field labourers, would clearly contribute to raise the overall household income and thus impact the child's nutritional status. The proportion of household with tap water within the house or within the compound reflects the progress of sanitary infrastructure. It usually contributes to the content of another individual variable, that is, the incidence of diarrhea, which in turns affects the nutritional status. Unfortunately, we could not observe the behaviour of this variable in the Honduras sample, as it was not included for all children under five. In Nicaragua, where the impact of diarrheal incidence on nutritional status is significant, that of the community-level water supply variable is not, and the intermediate factor in this case could be the existence of appropriate hygienic practices.

From the results obtained in the two surveys, direct health/nutrition interventions seem to have little impact on the child's nutritional status. Indeed, when those variables take a statistically significant value, as is the case for targeting children at health centre for food or vitamin supplements in Nicaragua or the mother and child binomial unit for MCH coupons in Nicaragua, the apparent relationship is negative in sign and thus, could reflect an issue of placement of the interventions rather than the actual results of these interventions (Rosenzweig and Wolpin, 1986).

While it may be satisfying to see that beneficiaries are indeed children with a poor nutritional status, this does not contribute much in terms of impact evaluation. Other factors that may be involved in the apparent lack of effect could be the insufficient level of the intervention (from an individual household point of view, that is, for instance, the fact that the value of the coupon could be too low to actually generate a significant change in the feeding patterns of the child), or some sampling problems related to the fit between the complex design of the intervention and the survey results currently available to us, as may be the case for the PRAF sample: the study sample was taken from 70 of the poorest municipalities (in terms of stunting for school age children), but the scope of the MCH component of the PRAF program was only 30 municipalities in which four modalities of support were designed: demand subsidy only (coupons), supply subsidies only (improvement in quality of health services), demand and supply subsidies, and control. The preliminary results of the longitudinal ex-ante/ex-post survey conducted by the International Food Policy Research Institute (IFPRI) on behalf on the PRAF/IDB Phase II Project actually showed significant increases in attendance to health services, as mandated by the coupons policy (proportions of women with five prenatal controls, of children weighed, of children with complete immunization schedule), but no impact on the HAZ scores for children under five years old (IFPRI, 2003).

Using the (community) fixed effect model allows to better qualify the intra-community variations in individual and household variables, independently of the impact of inter-community variability. While few of the community-level variables are individually significant in both samples, the insertion of the fixed-effect factor makes a significant difference for all three indicators in the Honduras sample, but only for the weight-for-age variable in Nicaragua. As seen in the regressions of the fitted values of these community fixed effects on the available, observed community variables, a large number of these variables contribute to the definition, the configuration of these fixed effects. However, the facts that the coefficients for those variables may acquire a sign that is not intuitively consistent with the expected effect of the individual variable on the nutritional status makes the interpretation of these individual values more difficult. From the Honduras sample, it would seem that in equations 5(b) and 7(b), the absolute values of both the intercepts and the coefficients of most of the main variables are reduced as compared to equations 5(a) and 7(a). If a bidimensional analogy of a multidimensional model is valid, our interpretation is that the community fixed effects (i.e., the inter-community variability) would tend to increase the impact of intra-community variability, that is, that differences between individual and households would be synergically increased by improvements in community well-being[6]. As the overall profile of communities in the Honduras sample is more homogeneous than in the Nicaragua study, the deviance in community characteristics would be felt more strongly, resulting in higher levels of significance for all three dependent variables.

9. Conclusions

The model proposed by the Research Network was applied and adapted to the two data sets for Nicaragua (at national level) and for the western regions of Honduras. We found that the model was quite robust, yielding consistent results in a variety of specification changes. In both countries, apart from child's age, per capita household expenditures, household size and age difference with an older sibling are the factors most constantly encountered that determine the child's nutritional status. In the Honduras sample, where data on maternal height were available,

[6] However, this general statement may not be valid for the education variables, as seen above.

a strong relation of this variable with height- and weight-for-age indicators has been established, showing the role of prenatal – genetic and nutritional - factors. Discrimination by sex of the child was not found in either country, a seemingly common finding to Central American countries. In Honduras, the age difference with a younger brother is also a related variable, explained by the natural history of child feeding and malnutrition; we hypothesize that an accrued sensitivity to shorter birth intervals with the upcoming child may exist in poorer, marginal populations. Incidence of diarrhea is also a key determinant in Nicaragua, where this variable was available.

While the education levels in Nicaragua did not reach levels of significance, in Honduras, the education level of the household woman and – to a lesser extent – of the household head, is also related to the child's nutritional status, though overall characteristics of better of communities may hide this impact.

The importance of individual, community-level observed variables, related to stunting and wasting, is relatively lower when compared to the household and child variables; only the proportion of dwellings with tap water and the level of agricultural wages in the Honduras sample are significant. The inclusion of community fixed effects in the model does not drastically change the parameters of the other variables, although overall community well being (as measured through these fixed effects) tends to have a small but significant synergic effect on the impact of individual and household variables.

While the impact of sector-specific interventions (food/vitamin supplements) or programs linked to the strategy of poverty reduction (MCH coupons, food for work) seem to have little impact, we consider that problems in the identification of intervention/control areas, the complex design of some interventions and the lack of ex-ante/ex-post information in the data available to us prevents a reliable evaluation of the impact of this type of program, which would warrant a longitudinal study. However, the available results of such a study done to evaluate the 1998-2001 period of the program, did not show any significant result of the interventions on the nutritional status of children. The findings of this paper, however, would point out at the need to improve intra-community (household and individual) targeting rather than inter-community targeting, as the former parameters seem to have a major role as determinants in child health and nutrition. The trilogy of improved socio-economic situation, sound population and family planning policies and appropriate preventive public health care (maternal nutrition, hygiene and child feeding practices) are still a safe – although longer term - investment towards improved health and productivity of today's children.

Bibliography

Abelin T., Brzezinski Z.J., Carstairs V.D.L. 1987. Measurement in Health Promotion and Protection. World Health Organization.

Alderman H. 1990. Nutritional status in Ghana and its determinants. SDA Working Paper No. 3, Policy Analysis, The World Bank.

Barrera A. The role of maternal Schooling and its interaction with public health programs in child health production. Journal of Development Economics - 1990, 34(1-2): 81-98 or 32: 69-91

Becker G. 1981. *A treatise on the Family*. Cambridge: Harvard University Press.

Biswas M., Pinstrup-Andersen P. 1985. *Nutrition and Development*, Oxford Medical Publications.

Christiaensen L., Alderman H. 2001. Child malnutrition in Ethiopia: Can maternal knowledge augment the role of income? Africa Region Working Paper Series Number 22. The World Bank.

Collier P., Dercon S., Mackinnon J. 2002. Density vs Quality in Health Care Provision: Using household data to make budgetary choices in Ethiopia. The World Bank Economic Review, Vol. 16, No. 3, 425-448.

Encuesta Nacional de Epidemiología y Salud Familiar (ENESF) – National Epidemiology and Family Health Survey, Honduras, 2001.

Encuesta Nicaraguense de Demografía y Salud Familiar (ENDESA) – Nicaraguan Demography and Health Survey, Nicaragua, 1998.

Flores R., Morris S., Olinto P. & al. 2003. Evaluation of the Family Allowance Program (PRAF) in Honduras: Health and Nutrition Impact. Social Policy Monitoring Network, Web site.

Glewwe P., Koch S., Nguyen B.L. 2002. Child Nutrition, Economic Growth and the provision of health care services in Vietnam in the 1990s. World Bank.

Maine D. 1981. Family Planning: its impact on the Health of Women and Children. The Center for Population and Family Health, Faculty of Medicine, Columbia University, New York.

Murray C.J.L., Lopez A.D. 1997. The utility of DALYs for public health policy and research: a reply. Bulletin of the World Health Organization, 75:377-381.

Noorali R., Luby S., Rahbar M.H. 1999. Does use of government service depend on distance from health facility? Health Policy and Planning, Vol. 14, No. 2:191-197.

Pan American Health Organization. 2001.Fact Sheet of the Program on Women, Health and Development.

Pelletier D.L., Frongillo E.A. 2003. Changes in child survival are strongly associated with changes in malnutrition in developing countries. J. Nutr. 133:107-119.

Rosenzweig M., Wolpin K. 1986. Evaluating the effects of optimally distributed public programs: Child health and family planning interventions. American Economic Review – 76(3).

Schmidt M.K, Muslimatun S., West C.E. & al. 2002. Nutritional status and linear growth of Indonesian infants in West Java determined more by prenatal environment than by post natal factors. J. Nutr.132:2202-2207.

Thomas D., Strauss J., Henriques M.H. 1990. Child survival, Height for Age and Household Characteristics in Brazil. Journal of Development Economics – 33: 197-234

Wolfe BL., Behrman JR. 1982. Determinants of child mortality, health and nutrition in a developing country. Journal of Development Economics – 11 (2): 163-193.

World Bank. 1993. World Development Report.

World Health Organization. WHO Global Database on Child Growth and Nutrition (http://www.who.int/nutgrowthdb).

Annexes

Annex 1. Tables for Nicaragua

Table N1. Anthropometric indicators by age group, sex and location - Nicaragua

Nicaragua	Rural				Urban			
	Boys		Girls		Boys		Girls	
Height-for-Age Z-score	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
0-5 months	-0.06	0.9946	-0.12	1.3370	0.15	1.0726	0.06	0.7425
6-11months	-0.73	1.4643	-0.75	1.3772	-0.60	0.9066	-0.60	0.9345
12-17 months	-1.48	1.3124	-0.92	1.0585	-0.78	1.1769	-0.93	1.3060
18-23 months	-1.39	1.2700	-1.18	1.4036	-0.59	1.6192	-0.61	0.9854
24-35 months	-1.10	1.1358	-1.04	1.3934	-0.27	1.3361	-0.70	1.2006
36-47months	-1.31	1.2945	-1.34	1.2511	-0.87	1.1984	-0.62	1.2403
48-59 months	-1.69	1.0827	-1.36	1.2115	-1.16	1.1404	-0.88	1.1392
Total	**-1.19**	1.2984	**-1.07**	1.3270	**-0.68**	1.2792	**-0.66**	1.1472
Number of obs.	739		699		624		614	

Nicaragua	Rural				Urban			
	Boys		Girls		Boys		Girls	
Weight-for-Height Z-score	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
0-5 months	1.00	1.6945	0.89	2.2642	1.02	1.7099	1.16	1.8507
6-11months	0.21	1.2034	0.32	1.1811	0.43	1.0342	0.38	0.8866
12-17 months	-0.07	1.2331	-0.14	1.0073	0.19	1.0444	0.07	0.8909
18-23 months	-0.13	1.1197	0.10	1.3174	0.17	1.0237	0.08	1.0250
24-35 months	-0.02	0.846	-0.09	0.8524	-0.08	1.0078	0.03	0.8516
36-47months	0.02	0.8483	0.06	0.808	0.01	0.9631	0.13	1.0865
48-59 months	-0.01	0.7873	0.07	0.8264	0.11	1.1374	0.22	0.9785
Total	**0.10**	1.1024	**0.10**	1.1249	**0.17**	1.1303	**0.23**	1.1112
Number of obs.	739		699		624		614	

Nicaragua	Rural				Urban			
	Boys		Girls		Boys		Girls	
Weight-for-Age Z-score	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
0-5 months	0.62	0.9168	0.48	1.2696	0.90	1.0289	0.86	0.9107
6-11months	-0.40	1.2107	-0.41	1.2029	-0.07	0.9696	-0.24	1.0598
12-17 months	-1.04	1.0893	-0.73	1.0972	-0.38	1.0452	-0.60	0.9512
18-23 months	-0.88	0.9239	-0.59	1.1714	-0.21	1.2370	-0.29	0.9682
24-35 months	-0.72	1.0126	-0.78	1.1728	-0.34	1.2791	-0.49	0.9988
36-47months	-0.79	1.0423	-0.85	0.9753	-0.55	1.0900	-0.39	1.2353
48-59 months	-1.05	0.8611	-0.80	0.9484	-0.64	1.2656	-0.42	1.0979
Total	**-0.68**	1.1038	**-0.64**	1.1377	**-0.32**	1.2187	**-0.30**	1.1196
Number of obs.	739		699		624		614	

Source: ESA Consultores, from ENMNV-2001

Table N2. Proportion of undernourished children (<-2SD) according to selected characteristics - Nicaragua

	Height/ Age	Weight/ Height	Weight/ Age	N
Age difference with older brother				
Less than 18 months	27	0.7	10.6	397
18 months or more	17.5	1.0	7.9	1,613
Age difference with younger brother				
Less than 15 months	26.6	2.4	11.8	169
15 months or more	24.3	0.4	10.3	564
Presence of diarrhoea or respiratory problems in last 15 days				
Diarrhoea or respiratory problems	15.8	1.2	7.9	1,078
Diarrhoea and respiratory problems	23.2	1.1	8.5	148
Education level of household head				
None/preschool/adult education	22.8	1.0	9.2	998
Primary	16.7	1.1	8.6	1,201
Secondary or more	8.8	0.8	3.8	477
Education level of woman of the household				
None/preschool/adult education	23.8	0.9	8.9	1,013
Primary	15.7	1.3	8.9	1,185
Secondary or more	9.2	0.6	3.6	478
Household size Up to 4 members				
Up to 4 members	11.7	0.7	6.1	538
More than 8 members	22.1	2.2	9.2	791
Per capita household expenditure (quintiles1)				
Q1(lowest expenditures)	31.3	1.1	12.3	796
Q5 (highest)	4.7	0.7	2.4	295
Type of water supply				
Tap inside house or compound	12.3	1.0	5.6	1,206
Other sources	22.0	1.0	9.9	1,470
Type of sanitary system				
Toilet or washable latrine	4.6	0.9	2.5	326
Latrines	16.9	1	8	1,717
Other systems	26.2	0.9	10.6	633
Time (in mn) from health center				
Less than 30 mn	15	0.8	7	1,438
60 mn and more	25.9	1.5	9.7	526

1. Based on location of household in corresponding quintiles from national distribution of per capita household expenditures

Source: ESA Consultores, from ENMNV-2001

Table 3. Descriptive statistics on main variables - Nicaragua

	Mean/ proportion	Standard Desviation	**No. Children**
Child variables			
Age (months)	30.02	17.25	2,676
Sex (female child)	0.49	0.50	2,676
Age difference with older brother (months)	42.57	34.9	1,317
Dummy variable: 1= no suitable older brother	0.51	0.50	2,676
Age difference with younger brother (months)	24.72	10.17	424
Dummy variable: 1= no suitable younger brother	0.84	0.37	2,676
Diarrhoea in last 30 days	0.25	0.44	2,676
Household variables			**No. Households**
Education level of household head:			
None/adult learning	0.33	0.47	4,191
Primary	0.44	0.50	4,191
Secondary or more	0.23	0.42	4,191
Education of the "women" of the household:			
None/adult learning	0.33	0.47	4,019
Primary	0.44	0.50	4,019
Secondary or more	0.23	0.42	4,019
Female head of household	0.28	0.45	4,191
Age of household head (years)	46.75	15.71	4,191
Age of the woman of the household (years)	42.39	15.57	4,019
Age difference (years) between household head and spouse / companion	5.38	7.53	2,600
Dummy variable: 1 = women is household head or has other relationship with household head	0.35	0.48	4,019
Household size	5.44	2.72	4,191
Household receives food for work or free food	0.06	0.24	4,191
Household includes child receiving food/vitamin supplements in health center	0.14	0.35	4,191
Income variable			
Natural logarithm of household monthly per capita expenditures (Córdovas)	8.74	0.76	4,191
Index of household goods (11 items)	3.60	2.20	2,676
Natural logarithm of predicted household monthly per capita expenditures (Córdovas), on the basis of possession of household goods	8.51	0.51	4,191
Community variables			**No. Segments**
Proportion of households with water tab within house or compound	0.582	0.393	228
Proportion of households with toilet or washable latrine	0.240	0.331	228
Proportion of women delivered within last two years who had an institutional delivery	0.728	0.294	226
Proportion of children with immunization schedule up-to-date for their age	0.478	0.232	228
Average distance (mn) from nearest health centre	37.84	0.491	228
Proportion of households where someone received food for work or free food distribution	0.042	0.091	228
Proportion of households where a child received food or vitamin supplements at health center	0.286	0.220	228
Average price (Córdobas) of:			
Beans	4.52	0.73	225
Corn	1.64	0.46	165
Rice	3.63	0.32	228
Powdered milk	178.57	146.1	174
Average daily wage (Córdobas) for:			
Agricultural worker	38.94	29.57	49
Non-agricultural worker	42.25	21.04	222
Dummy variable: Data on agricultural daily wage not available, community assigned average wage	0.79	0.41	228

Source: ESA Consultores, from ENMNV-2001

Table N4 Step-by-step Inclusion of Independent Variables in Equation (5) - Height-for-age - Nicaragua

Independent variable	1	2	3	4	5	6	7
Child variables							
Age in months	-.0164 ***	-.0156 ***	-.0152 ***	-.0157 ***	-.0158 ***	-.0158 ***	-.0162 ***
Sex (1 = girl)	0.0415	.0414	0.0427	0.0432	0.0407	0.0409	0.0422
Age difference with older sibling		.0448 ***	.0047 ***	.0047 ***	.0044 ***	.0044 ***	.0045 ***
Dummy (1 = no suitable older sibling)		.1015 *	.0981 *	.1010 *	.1240 **	.1247 **	.1254 **
Age difference with younger sibling			-.0051	-.0049	-.0061	-.0062	-.0060
Dummy (1 = no suitable younger sibling)			0.0355	0.0372	0.0433	0.0423	0.0306
Incidence of diarrhea				-.1524 **	-.1534 ***	-.1527 ***	-.1506 **
Household variables							
Education of hhld head (1 = primary)	0.0456	.0624	0.065	0.0683	0.0461	0.0451	0.049
Education of hhld head (1 = secondary)	0.1437	.1669	0.1697	0.1732	0.1332	0.1347	0.1413
Education of woman of hhld (1 = primary)	0.1161 *	.1202 *	.1211 *	.1202 *	0.081	0.0785	0.0847
Education of woman of hhld (1 = secondary)	0.0982	.0998	0.1015	0.0997	0.015	0.0141	0.0154
Sex of hhld head (1 = woman)	-.0161	-.0474	-.0485	-.0472	-.0410	-.0421	-.0427
Household size					-.0354 ***	-.0353 ***	-.0345 ***
Ln predicted expenditures	.7862 ***	.7292 ***	.7266 ***	.7094 ***	.7267 ***	.7278 ***	.7229 ***
Hhld receives food for work/donations						0.072	0.0909
Hhld child receives food/vitamin suppl.							-.1147 *
Observations	2,298	2,298	2,298	2,298	2,298	2,298	2,298
Adjusted R-square	0.1380	0.1461	0.1457	0.1478	0.1536	0.1534	0.1544
F-statistic	27.26 ***	25.57 ***	22.76 ***	21.97 ***	21.84 ***	20.82 ***	20.06 ***

Source: ESA Consultores, from ENMNV-2001

Standards errors in parentheses - Levels of significance: * = p<0.1; ** = p<0.05; *** = p<0.01

Table N5: Regression Coefficients for Equation (5) - Nicaragua

	Height-for-age		Weight-for-age		Weight-for-height	
Independent variable	**No CFE**	**With CFE**	**No CFE**	**With CFE**	**No CFE**	**With CFE**
Child variables						
Age in months	-.0162 (.0016) ***	-.0157 (.0015) ***	-.0157 (.0014) ***	-.0156 (.0014) ***	-.0099 (.0015) ***	-.0098 (.0014) ***
Sex (1 = girl)	.0422 (.0507)	.0699 (.0478)	.0097 (.0456)	.0391 (.0432)	.0320 (.0473)	.0431 (.0449)
Age difference with older sibling	.0045 (.0011) ***	.0049 (.0010) ***	.0034 (.0009) ***	.0039 (.0009) ***	.0013 (.0010)	.0016 (.0009) *
Dummy (1 = no suitable older sibling)	.1254 (.0547) **	.0986 (.0522) *	.1240 (.0492) **	.0877 (.0471) *	.0623 (.0510)	.0275 (.0489)
Age difference with younger sibling	-.0057 (.0063)	-.0065 (.0059)	-.0003 (.0056)	-.0005 (0053)	.0043 (.0058)	.0048 (.0055)
Dummy (1 = no suitable younger sibling)	.0306 (.0762)	.0629 (.0718)	-.0428 (.0685)	-.0471 (.0648)	-.0906 (.0711)	-.1243 (.0673) *
Incidence of diarrhea	-.1506 (.0587) **	-.1721 (.0563) ***	-.2097 (.0528) ***	-.1984 (.0508) ***	-.1848 (.0548) ***	-.1607 (.0528) ***
Household variables						
Education of hhld head (1 = primary)	.0490 (.0657)	.0778 (.0654)	.0297 (.0591)	.0208 (.0591)	.0167 (.0613)	-.0334 (.0614)
Education of hhld head (1 = secondary)	.1413 (.1089)	.1745 (.1011) *	.1136 (.0980)	.1181 (.0913)	.0073 (.1016)	-.0254 (.0948)
Education of woman of hhld (1 = primary)	.0847 (.0654)	.0996 (.0646)	-.0155 (.0589)	.0274 (.0583)	-.0329 (.0610)	.0183 (.0606)
Education of woman of hhld (1 = secondary)	.0154 (.1059)	.0364 (.1014)	-.0607 (.0953)	-.0293 (.0916)	-.0643 (.0988)	-.0311 (.0951)
Sex of hhld head (1 = woman)	-.0427 (.0634)	-.0479 (.0627)	.0142 (.0571)	.0005 (.0566)	.0783 (.0592)	.0686 (.0588)
Household size	-.0345 (.0087) ***	-.0324 (.0086) ***	-.0325 (.0079) ***	-.0290 (.0078) ***	-.0104 (.0081)	-.0099 (.0081)
Ln predicted expenditures	.7229 (.0749) ***	.6321 (.0776) ***	.5666 (.0674) ***	.5073 (.0701) ***	.1273 (.0699) *	.1309 (.0728) *
Hhld receives food for work/donations	.0909 (0955)	.0936 (.1026)	.0029 (.0860)	.0174 (.0927)	-.1414 (.0892)	-.1621 (.0962) *
Hhld child receives food/vitamin suppl.	-.1147 (.0601) *	-.1431 (.0558) **	-.1020 (.0541) *	-.1113 (.0504) **	-.0608 (.0561)	-.0492 (.0524)
Community variables						
% hhlds with piped water in house/yard	-.0001 (.0011)		-.0004 (.0010)		.0002 (.0010)	
Distance in time to health center	-.0009 (.0010)		-.0008 (.0009)		-.0001 (.0009)	
Daily agricultural wages (córdobas)	.0025 (.0023)		.0009 (.0020)		.0026 (.0021)	
Dummy (1 = wages figure not available)	-.1479 (.0552) ***		-.0831 (.0496) *		-.0665 (.0515)	
Price of corn (córdobas)	-.0281 (0644)		-.0263 (.0579)		.0515 (.0601)	
% hhlds with children receiving supplements	-.0014 (.0016)		-.0024 (.0014) *		-.0012 (.0015)	
Observations	2,298	2,668	2,298	2,668	2,298	2,668
Adjusted R-square	0.1544	0.1703	0.1340	0.1434	0.0255	0.0303
F-statistic (for the model)	20.06 ***	21.55 ***	17.16 ***	18.89 ***	3.73 ***	4.53 ***
Rho (fraction of variance due to ui		0.1555		0.1975		0.1586
F-statistic (for ui = 0)		1.12		1.31 ***		1.07

Source: ESA Consultores, from ENMNV-2001

Standards errors in parentheses - Levels of significance: * = p<0.1; ** = p<0.05; *** = p<0.01

Table N6: Regression of Fitted Values of Community Fixed Effects on Individual Community

Independent variable	Height-for-age	Weight-for-age	Weight-for-height
% hhlds with piped water in house/yard	-.0013 (.0004) ***	-.0007 (.0004) *	.0008 (.0004) **
% hhlds with flush toilet or latrine	.0047 (.0005) ***	.0026 (.0005) ***	-.0001 (.0004)
Distance in time to health center	.0001 (.0003)	.0003 (.0003)	.0005 (.0003)
% children with up-to-date immunizations	.0013 (.0005) **	.0030 (.0005) ***	.0019 (.0005) ***
% intitutional delivery	-.0004 (.0005)	-.0025 (.0005) ***	-.0036 (.0004) ***
Daily agricultural wages (córdobas)	.0023 (.0007) ***	.0012 (.0007) *	.0035 (.0006) ***
Dummy (1 = wages figure not available)	-.1810 (.0176) ***	-.0833 (.0172) ***	-.0210 (.0151)
Daily non- gricultural wages (córdobas)	.0002 (.0007)	.0051 (.0007) ***	.0064 (.0006) ***
Price of beans (córdobas)	.0002 (.0127)	.0151 (.0124)	.0290 (.0108) ***
Price of corn (córdobas)	-.0238 (.0219)	-.1235 (.0213) ***	-.1039 (.0187) ***
Price of rice (córdobas)	.0113 (.0250)	.0026 (.0244)	.0370 (.0214) *
Price of powdered milk (córdobas)	-.0001 (.0001)	.0002 (.0001) ***	.0005 (.0001) ***
% hhlds receiving food for work/donations	.0025 (.0009) ***	-.0019 (.0009) **	.0025 (.0008) ***
% hhlds with children receiving supplements	-.0012 (.0005) **	-.0024 (.0005) ***	-.0016 (.0004) ***
Observations	1,784	1,784	1,784
Adjusted R-square	0.102	0.1078	0.1469
F statistic	15.47 ***	16.39 ***	22.93 ***

Source: ESA Consultores, from ENMNV-2001

Standards errors in parentheses - Levels of significance: * = p<0.1; ** = p<0.05; *** = p<0.01

Table N7: Regression Coefficients for Equation (7) with interaction terms - Nicaragua

	Height-for-age		Weight-for-age		Weight-for-height	
Independent variable	**No CFE**	**With CFE**	**No CFE**	**With CFE**	**No CFE**	**With CFE**
Child variables						
Age in months	-.0162 (.0016) ***	-.0166 (.0017) ***	-.0158 (.0014) ***	-.0161 (.0015) ***	-.0099 (.0015) ***	-.0104 (.0016) ***
Sex (1 = girl)	.0402 (.0507)	.0626 (.0525)	.0058 (.0456)	.0220 (.0468)	.0312 (.0473)	.0331 (.0491)
Age difference with older sibling	.0044 (.0011) ***	.0049 (.0011) ***	.0034 (.0009) ***	.0038 (.0010) ***	.0012 (.0010)	.0014 (.0010)
Dummy (1 = no suitable older sibling)	.1281 (.0546) **	.1121 (.0572) *	.1250 (.0491) **	.1121 (.0511) **	.0677 (.0510)	.0455 (.0535)
Age difference with younger sibling	-.0062 (.0063)	-.0053 (.0064)	-.0009 (.0056)	-.0011 (.0057)	.0040 (0058)	.0033 (0060)
Dummy (1 = no suitable younger sibling)	.0279 (.0761)	.0324 (.0782)	-.0470 (.0685)	-.0551 (.0698)	-.0911 (.0710)	-.1167 (.0732)
Incidence of diarrhea	-.1500 (.0587) **	-.1746 (.0618) ***	-.2088 (.0528) ***	-.2048 (.0552) ***	-.1834 (.0548) ***	-.1674 (.0578) ***
Household variables						
Education of hhld head (1 = primary)	.0570 (.0652)	.0757 (.0708)	.0374 (.0586)	.0404 (.0632)	.0333 (.0608)	-.0025 (.0663)
Education of hhld head (1 = secondary)	.2048 (.3216)	-.0036 (.3621)	.0665 (.2894)	-.0417 (.3231)	-.0991 (.3002)	-.2369 (.3387)
Education of woman of hhld (1 = primary)	.0467 (.2011)	.0451 (.2235)	-.0367 (.1810)	-.0383 (.1994)	-.0325 (.1877)	-.0306 (.2090)
Education of woman of hhld (1 = secondary)	.0294 (.1086)	.0343 (.1159)	-.0522 (.0978)	-.0481 (.1034)	-.0563 (.1014)	-.0588 (.1084)
Sex of hhld head (1 = woman)	-.0337 (.0627)	-.0432 (.0689)	.0264 (.0565)	.0063 (.0614)	.0930 (.0585)	.0823 (.0644)
Household size	-.0335 (.0087) ***	-.0345 (.0094) ***	-.0318 (.0078) ***	-.0328 (.0084) ***	-.0092 (.0081)	-.0140 (.0088)
Ln predicted expenditures	.7272 (.0735) ***	.6803 (.0866) ***	.5789 (.0662) ***	.5357 (.0772) ***	.1395 (.0686) **	.1263 (.0810)
Hhld receives food for work/donations	.0842 (.0944)	.1051 (.1058)	-.0121 (.0850)	.0332 (.0944)	-.1471 (.0882) *	-.1506 (.0990)
Hhld child receives food/vitamin suppl.	-.1315 (.0574) **	-.1510 (.0613) **	-.1265 (.0517) **	-.1349 (.0547) **	-.0778 (.0536)	-.0766 (.0573)
Community variables						
Index of community characteristics	.0011 (.0044)		-.0012 (.0039)		-.0011 (.0041)	
Interactions						
Hhld head has 2ry schooling & Community Index	-.0015 (.0078)	.0032 (.0088)	.0013 (.0070)	.0038 (.0079)	.0034 (.0073)	.0059 (.0082)
Woman of hhld has 1ry schooling & community index	.0013 (.0058)	.0012 (.0064)	.0008 (.0052)	.0010 (.0057)	.0001 (.0054)	.0008 (.0060)
Observations	2,298	2,298	2,298	2,298	2,298	2,298
Adjusted R-square	0.1541	0.1586	0.1335	0.1396	0.0249	0.0321
F-statistic (for the model)	21.91 ***	16.63 ***	18.69 ***	15.08 ***	3.94 ***	3.76 ***
Rho (fraction of variance due to ui		0.1255		0.1521		0.1125
F-statistic (for ui = 0)		1.10		1.33 ***		1.02

Source: ESA Consultores, from ENMNV-2001

Standards errors in parentheses - Levels of significance: * = p<0.1; ** = p<0.05; *** = p<0.01

Annex 2 Tables for Honduras

Table H1. Anthropometric indicators by age group, sex and location - Honduras

Honduras	Rural				Urban			
	Boys		Girls		Boys		Girls	
Height-for-Age Z-score	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
0-5 months	-1.10	1.0050	-1.02	0.9842	-0.64	0.7750	-0.77	1.2505
6-11months	-1.77	1.1004	-1.47	0.9753	-1.39	0.9416	-1.12	0.9636
12-17 months	-2.31	1.0822	-2.05	1.1212	-1.54	0.9806	-1.50	1.2596
18-23 months	-2.33	1.0436	-2.29	1.0864	-1.49	1.1282	-1.56	1.1481
24-35 months	-2.23	1.0981	-2.28	1.1026	-1.45	1.2472	-1.46	1.3120
36-47months	-2.40	1.0366	-2.53	1.1748	-1.69	1.0485	-1.90	1.1007
48-59 months	-2.52	1.0150	-2.55	1.1182	-1.91	1.0289	-1.98	1.1765
Total	**-2.19**	1.1247	**-2.18**	1.2003	**-1.55**	1.1021	**-1.59**	1.2233
Number of obs.	2,294		2,252		392		384	

Honduras	Rural				Urban			
	Boys		Girls		Boys		Girls	
Weight-for-Height Z-score	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
0-5 months	0.63	0.9201	0.64	0.9839	0.78	0.7956	0.49	1.1783
6-11months	0.15	1.0013	0.22	1.0007	0.09	1.0729	0.21	1.0097
12-17 months	-0.59	0.8772	-0.59	0.7569	-0.41	0.7398	-0.39	1.1000
18-23 months	-0.76	0.8577	-0.60	0.8875	-0.54	1.0901	-0.57	0.7687
24-35 months	-0.36	0.7281	-0.46	0.7135	-0.17	0.8751	-0.14	0.7835
36-47months	-0.22	0.6901	-0.22	0.7569	-0.09	0.8240	-0.09	0.8466
48-59 months	-0.20	0.7651	-0.12	0.8052	-0.16	0.6821	0.04	0.9733
Total	**-0.23**	0.8738	**-0.21**	0.8881	**-0.13**	0.8997	**-0.09**	0.9543
Number of obs.	2,273		2,227		391		379	

Honduras	Rural				Urban			
	Boys		Girls		Boys		Girls	
Weight-for-Age Z-score	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
0-5 months	-0.38	0.9218	-0.27	1.1085	0.14	0.8046	-0.21	0.9013
6-11months	-1.19	1.0716	-1.02	1.0954	-0.95	1.1232	-0.76	1.1067
12-17 months	-1.90	0.9812	-1.75	0.9298	-1.26	0.7436	-1.26	0.9902
18-23 months	-1.81	0.9433	-1.67	0.9313	-1.21	1.0754	-1.26	0.9931
24-35 months	-1.66	0.9073	-1.77	0.9357	-1.05	1.1251	-1.06	1.0835
36-47months	-1.56	0.7703	-1.71	0.8860	-1.08	0.9192	-1.28	0.9572
48-59 months	-1.64	0.7804	-1.61	0.8960	-1.29	0.7883	-1.18	0.9004
Total	**-1.51**	0.9694	**-1.51**	1.0478	**-1.06**	1.0078	**-1.08**	1.0332
Number of obs.	2,288		2,246		391		382	

Source: ESA Consultores, from PRAF-2002

Table H2. Proportion of undernourished children (<-2SD) according to selected characteristics

	Height/age	Weight/Height	Weight/age	N
Maternal height	75.2	1.6	45.0	1,000
Less than 143.6 cms.	60.1	1.4	33.5	1,978
>143.6 to 149.8 cms.	43.8	1.6	25.6	978
>149.8 to 153 cms.	29.2	1.7	15.7	981
>153 cms.				
Age difference with older brother				
Less than 18 months	61.3	1.7	34.8	664
18 months or more	55.0	1.6	31.1	3,493
Age difference with younger brother				
Less than 15 months	55.3	2.5	31.7	199
15 months or more	70.1	0.9	35.7	1,628
Presence of diarrhoea or respiratory problems in last 15 days				
Diarrhoea or respiratory problems	48.6	2.0	31.9	1,480
Diarrhoea and respiratory problems	44.6	3.2	33.8	500
Education level of household head				
None/preschool/adult education	57.8	2.3	35.0	1,103
Primary	54.2	1.4	30.1	3,992
Secondary or more	20.8	0.5	11.3	221
Education level of woman of the household				
None/preschool/adult education	60.1	1.8	36.7	1,190
Primary	53.5	1.5	29.4	3,928
Secondary or more	17.3	0.0	9.6	197
Education level of women when household heads				
None/preschool/adult education	51.6	1.9	27.2	213
Primary	46.5	1.5	26.5	533
Secondary or more	10.9	0.0	8.7	46
Household size				
Up to 4 members	41.7	1.1	25.1	1,044
5 to 8 members	54.7	1.7	30.1	2,945
More than 8 members	60.5	1.6	35.0	1,333
Per capita household expenditure (quintiles1) and education level of household woman				
Q1 (lowest expenditures)	67.6			1,063
Q2	60.3			1,063
Q3	54.6			1,063
Q4	53.2			1,063
Q5 (highest)	31.2			1,063
Type of water supply				
Tap inside house or compound	52.2	1.6	28.3	3,430
Other sources	59.7	1.3	33.9	1,892
Type of sanitary system				
Toilet or washable latrine	47.2	1.4	25.6	2,491
Other systems	59.2	1.6	34.4	2,831
Time (in mn) from health center				
Less than 30 mn	43.4	1.7	24.9	1,670
30-59 mn	57.6	1.3	31.7	2,021
60 mn and more	59.1	1.6	34.1	1,631
Child up-to-date for immunizations				
Yes	42.0	1.7	26.2	652
No	47.7	2.2	30.5	2,232

Source: ESA Consultores, from PRAF-2002

Table H3. Descriptive statistics on main variables - Honduras

Mean, Standard deviation for each variable and the No. of children taken in the sample			
Variable	**Mean**	**Standard Deviation**	**No. Children**
Child Variables			
Age (in months)	30.5	16.80	5,322
Age (square)	1,210.30	1,037.00	5,322
% of females	0.5	0.50	5,322
Maternal height (centimetres)	148.4	5.70	4,937
Age difference with older brother (months)	31.4	20.1	3,408
Dummy variable: 1= no suitable older brother	0.36	0.48	5,322
Age difference with younger brother (months)	25.7	8.80	1,479
Dummy variable: 1= no suitable younger brother	0.72	0.45	5,322
Diarrhea in last 15 days	0.34	0.47	3,114
Household Variables			**No.**
			Households
Household head education level-			
Adult or no education	0.24	0.43	5681
Primary	0.70	0.46	5681
Secondary or higher	0.06	0.23	5681
Household woman education level-			
Adult or no education	0.26	0.44	5521
Primary	0.69	0.46	5521
Secondary or higher	0.05	0.22	5521
Household head is female	0.20	0.40	5,681
Age of household head (years)	45.28	15.5	5,679
Age of woman of the household (years)	40.92	15.42	5,521
Age difference between household head and companion woman (years)	4.84	6.80	4,193
Dummy variable: 1 = women is household head or has other relationship with	0.24	0.43	5,521
household head			
Household size	5.62	2.57	5,681
Household receives food from organization in the community	0.21	0.41	5,673
Household includes recipient of Mother/Child or Health/Nutrition coupons	0.09	0.29	5,659
Income variable			
Natural Logarithm of annual per capita consumption (Lempiras)	8.34	0.67	5,315*
Index of household goods (13 items)	2.90	1.70	5,322*
Natural Logarithm of predicted annual per capita consumption, on the basis	8.34	0.37	5,322*
of possession of household goods (Lempiras)			
Community level variables			**No. segments**
% Of households with tap water in the house or in the compound	0.669	0.372	767
% Of households with toilets or washable latrines	0.500	0.368	767
% of women delivered within last two years who had an institutinal delivery	0.369	0.422	486
% Of children younger than 3 years who have had diarrhoea in the last 15 days	0.318	0.291	673
% Of children with immunization schedule up-to-date for their age	0.228	0.275	662
Average time to reach a health centre (walking distance)	50.96	46.77	767
% of households having received food or health support from organization in the	0.195	0.266	767
community			
% of households with beneficiaries of "Food and Health Coupons" or "Mother	0.099	0.218	767
& Child Coupons"			
Community where Community Integrated Child Care program (AIN-C) was	0.060	0.240	767
implemented			
Prices (for 1 pound)			
Beans (Lempiras)	5.03	0.74	697
Corn	1.63	0.30	648
Rice	4.09	0.36	746
Powdered milk	35.4	12.59	436
Wages			
Agricultural workers daily wage (Lempiras)	35.03	9.57	575
Agricultural workers daily wage (Lempiras)	48.96	33.76	430

* Statistics based upon number of children, as the full household database was not available to us.

Source: ESA Consultores, from PRAF-2002

Table H4 Step-by-step Inclusion of Independent Variables in Equation (5) - Height-for-age - Honduras

Independent variable	1	2	3	4	5	6
Child variables						
Age in months	-.0224 (.0009) ***	-.0214 (.0009) ***	-.0199 (.0011) ***	-.0199 (.0011) ***	-.0200 (.0011) ***	-.0200 (.0011) ***
Sex (1 = girl)	-.0219 (.0311)	-.0196 (.0308)	-.0228 (.0307)	-.0217 (.0306)	-.0205 (.0306)	-.0204 (..0306)
Maternal height	.0677 (.0029) ***	.0675 (.0028) ***	.0674 (.0028) ***	.0661 (.0028) ***	.0662 (.0028) ***	.0661 (.0028) ***
Age difference with older sibling		.0057 (.0010) ***	.0055 (.0010) ***	.0050 (.0010) ***	.0049 (.0010) ***	.0049 (.0010) ***
Dummy (1 = no suitable older sibling)		.1986 (.0345) ***	.1971 (.0346) ***	.1794 (.0346) ***	.1808 (.0346) ***	.1796 (.0346) ***
Age difference with younger sibling			.0144 (.0032) ***	.0143 (.0032) ***	.0143 (.0032) ***	.0141 (.0032) ***
Dummy (1 = no suitable younger sibling)			.1423 (.0410) ***	.1409 (.0408) ***	.1404 (.0408) ***	.1370 (.0409) ***
Household variables						
Education of hhld head (1 = primary)	-.0144 (.0413)	.0027 (.0410)	.0101 (.0409)	-.0029 (.0408)	-.0046 (.0409)	-.0050 (.0410)
Education of hhld head (1 = secondary)	.0793 (.1127)	.1083 (.1119)	.1181 (.1115)	.0737 (.1114)	.0713 (.1114)	.0644 (.1116)
Education of woman of hhld (1 = primary)	.1002 (.0403) **	.1150 (.0401) ***	.1215 (.0399) ***	.0951 (.0401) **	.0943 (.0401) **	.0955 (.0401) **
Education of woman of hhld (1 = secondary)	.2158 (.1128) *	.2090 (.1119) *	.2073 (.1115) *	.1269 (.1120)	.1242 (.1121)	.1331 (.1122)
Sex of hhld head (1 = woman)	.1711 (.0450) ***	.1099 (.0454) **	.0877 (.0455) *	.0703 (.0455)	.0685 (.0455)	.0669 (.0455)
Household size				-.0335 (.0061) ***	-.0342 (.0061) ***	-.0346 (.0061) ***
Ln predicted expenditures	.6350 (.0535) ***	.5690 (.0537) ***	.5546 (.0537) ***	.5967 (.0541) ***	.5983 (.0541) ***	.5995 (.0541) ***
Hhld receives food donations					.0348 (.0356)	.0346 (.0356)
Hhld has beneficiary of coupons						-.0880 (.0622)
Community variables						
% hhlds with piped water in house/yard	.0019 (.0005) ***	.0018 (.0005) ***	.0018 (.0005) ***	.0018 (.0005) ***	.0019 (.0005) ***	.0019 (.0005) ***
Distance in time to health center	-.0001 (.0004)	-.0000 (.0004)	.0001 (.0004)	.0002 (.0004)	.0001 (.0004)	.0001 (.0004)
Daily agricultural wages (lempiras)	.0056 (.0018) ***	.0056 (.0018) ***	.0057 (.0018) ***	.0054 (.0018) ***	.0054 (.0018) ***	.0055 (.0018) ***
Price of corn (lempiras)	.0128 (.0560)	.0043 (.0556)	.0003 (.0555)	.0091 (.0553)	.0104 (.0553)	.0098 (.0553)
% hhlds with beneficiaries of coupons	-.0008 (.0008)	-.0008 (.0008)	-.0009 (.0008)	-.0009 (.0008)	-.0009 (.0008)	.0004 (.0012)
Observations	4,070	4,070	4,070	4,070	4,070	4,068
Adjusted R-square	0.3046	0.3152	0.3205	0.3253	0.3253	0.3255
F-statistic	128.31 ***	118.03 ***	107.61 ***	104.27 ***	99.1 ***	94.44 ***

Source: ESA Consultores, from PRAF-2002

Standards errors in parentheses - Levels of significance: * = p<0.1; ** = p<0.05; *** = p<0.01

Table H5: Regression Coefficients for Equation (5) - Honduras

	Height-for-age		Weight-for-age		Weight-for-height	
Independent variable	**No CFE**	**With CFE**	**No CFE**	**With CFE**	**No CFE**	**With CFE**
Child variables						
	-.0200	-.0216	-.0145	-.0161	-.0075	-.0083
	(.0011)	(.0010)	(.0011)	(.0010)	(.0010)	(.0010)
Age in months	***	***	***	***	***	***
	-.0204	-.0021	-.0234	-.0135	.0059	.0037
Sex (1 = girl)	(.0306)	(.0283)	(.0295)	(.0278)	(.0281)	(.0268)
	.0661	.0548	.0432	.0375	.0044	.0053
	(.0028)	(.0030)	(.0027)	(.0029)	(.0026)	(.0028)
Maternal height	***	***	***	***	*	*
	.0049	.0036	.0034	.0025	.0012	.0010
	(.0010)	(.0009)	(.0009)	(.0009)	(.0009)	(.0009)
Age difference with older sibling	***	***	***	***		
	.1796	.1645	.1253	.1007	.0409	.0237
	(.0346)	(.0326)	(.0333)	(.0320)	(.0318)	(.0309)
Dummy (1 = no suitable older sibling)	***	***	***	***		
	.0141	.0140	.0125	.0125	.0077	.0070
	(.0032)	(.0030)	(.0031)	(.0029)	(.0030)	(.0028)
Age difference with younger sibling	***	***	***	***	***	**
	.1370	.0665	-0435	-.1075	-.1589	-.1897
	(.0409)	(.0380)	(.0393)	(.0372)	(.0375)	(.0358)
Dummy (1 = no suitable younger sibling)	***	*		***	***	***
Household variables						
	-.0050	.0045	.0333	-0300	.0559	-.0455
Education of hhld head (1 = primary)	(.0409)	(.0421)	(.0393)	(.0412)	(.0375)	(.0398)
	.0644	.0066	.0896	-.0406	.1024	-.0590
Education of hhld head (1 = secondary)	(.1116)	(.1043)	(.1072)	(.1022)	(.1023)	(.0986)
	.0955	.0495	.0886	.0683	.0449	.0536
	(.0401)	(.0401)	(.0386)	(.0393)	(.0368)	(.0380)
Education of woman of hhld (1 = primary)	**		**	*		
	.1331	.1495	.1800	.2708	.1379	.2526
	(.1122)	(.1100)	(.1078)	(.1077)	(.1029)	(.1039)
Education of woman of hhld (1 = secondary)			*	**		**
	.0669	.0535	.0841	.0784	.0590	.0645
	(.0455)	(.0459)	(.0438)	(.0450)	(.0418)	(.0434)
Sex of hhld head (1 = woman)			*	*		
	-.0346	-.0293	-.0221	-.0222	.0003	-.0040
	(.0061)	(.0062)	(.0059)	(.0061)	(.0056)	(.0059)
Household size	***	***	***	***		
	.5995	.6588	.4171	.5110	.0584	.1439
	(.0541)	(.0588)	(.0520)	(.0577)	(.0497)	(.0557)
Ln predicted expenditures	***	***	***	***		**
	.0346	-.0036	.0903	-.0128	.1000	-.0141
	(.0356)	(.0407)	(.0342)	(.0400)	(.0327)	(.0386)
Hhld receives food donations			***		***	
	-.0880	-.1428	-.1190	-.1432	-.0944	-.0767
	(.0622)	(.0606)	(.0597)	(.0593)	(.0569)	(.0571)
Hhld has beneficiary of coupons		**	**	**	*	
Community variables						
	.0019		.0011		.0002	
	(.0005)		(.0005)		(.0004)	
% hhlds with piped water in house/yard	***		**			
	.0001		.0001		.0001	
Distance in time to health center	(.0004)		(.0004)		(.0003)	
	.0055		.0007		-.0038	
	(.0018)		(.0017)		(.0017)	
Daily agricultural wages (lempiras)	***				**	
	.0098		-.0284		-.0384	
Price of corn (lempiras)	(.0553)		(.0532)		(.0507)	
	.0004		.0018		.0023	
	(.0012)		(.0012)		(.0011)	
% hhlds with beneficiaries of coupons					**	
Observations	4,068	4,928	4,057	4,914	4,029	4,877
Adjusted R-square	0.3255	0.3347	0.1782	0.1886	0.0186	0.0168
	94.44	94.09	42.89	45.87	4.63	6.54
F-statistic (for the model)	***	***	***	***	***	***
Rho (fraction of variance due to ui		0.2743		0.2562		0.2525
		1.79		1.50		1.43
F-statistic (for ui = 0)		***		***		***

Source: ESA Consultores, from PRAF-2002

Standards errors in parentheses - Levels of significance: * = p<0.1; ** = p<0.05; *** = p<0.01

Table H6: Regression of Fitted Values of Community Fixed Effects on Individual Community

Independent variable	Height-for-age	Weight-for-age	Weight-for-height
% hhlds with piped water in house/yard	.0014 (.0004) ***	-.0007 (.0004) *	-.0019 (.0004) ***
% hhlds with flush toilet or latrine	-.0004 (.0004)	.0017 (.0004) ***	.0024 (.0004) ***
% children <3yrs with diarrhea	-.0005 (.0005)	-.0016 (.0005) ***	-.0019 (.0005) ***
Distance in time to health center	.0010 (.0003) ***	.0009 (.0003) ***	.0003 (.0003)
% children with up-to-date immunizations	.0005 (.0006)	-.0001 (.0005)	.0001 (.0005)
% intitutional delivery	.0009 (.0003) ***	.0007 (.0003) **	.0001 (.0003)
Daily agricultural wages (lempiras)	.0073 (.0014) ***	.0034 (.0013) **	-.0016 (.0013)
Daily non- gricultural wages (lempiras)	-.0008 (.0004) **	-.0015 (.0004) ***	-.0014 (.0004) ***
Price of beans (lempiras)	-.0283 (.0159) *	-.0465 (.0153) ***	-.0540 (.0145) ***
Price of corn (lempiras)	-.1024 (.0402) **	-.0687 (.0386) *	-.0018 (.0365)
Price of rice (lempiras)	.0968 (.0292) ***	.0577 (.0280) **	.0281 (.0265)
Price of powdered milk (lempiras)	.0003 (.0007)	-.0003 (.0007)	-.0009 (.0007)
% hhlds receiving food donations	-.0008 (.0004) *	.0014 (.0004) ***	.0026 (.0004) ***
% hhlds with beneficiary of coupons	.0026 (.0005) ***	.0020 (.0005) ***	.0004 (.0005)
Community Integrated Child care program	-.0427 (.0420)	.0325 (.0402)	.0189 (.0381)
Observations	1,561	1,557	1,544
Adjusted R-square	0.0801	0.0662	0.1017
F statistic	10.06 ***	8.35 ***	12.64 ***

Source: ESA Consultores, from PRAF-2002

Standards errors in parentheses - Levels of significance: * = p<0.1; ** = p<0.05; *** = p<0.01

Table H7: Regression Coefficients for Equation (7) with interaction terms - Honduras

	Height-for-age		Weight-for-age		Weight-for-height	
Independent variable	**No CFE**	**With CFE**	**No CFE**	**With CFE**	**No CFE**	**With CFE**
Child variables						
	-.0200	-.0216	-.0145	-.0160	-.0075	-.0081
	(.0011)	(.0011)	(.0011)	(.0011)	(.0010)	(.0011)
Age in months	***	***	***	***	***	***
	-.0212	-.0290	-.0239	-.0405	.0058	-.0081
Sex (1 = girl)	(.0306)	(.0310)	(.0294)	(.0304)	(.0281)	(.0293)
	.0664	.0530	.0429	.0375	.0037	.0070
	(.0028)	(.0032)	(.0027)	(.0032)	(.0026)	(.0031)
Maternal height	***	***	***	***		**
	.0049	.0037	.0035	.0024	.0013	.0010
	(.0010)	(.0010)	(.0009)	(.0010)	(.0009)	(.0009)
Age difference with older sibling	***	***	***	**		
	.1782	.1448	.1208	.0793	.0363	.0102
	(.0347)	(.0358)	(.0333)	(.0352)	(.0319)	(.0340)
Dummy (1 = no suitable older sibling)	***	***	***	**		
	.0137	.0141	.0126	.0124	.0082	.0072
	(.0032)	(.0033)	(.0031)	(.0032)	(.0029)	(.0031)
Age difference with younger sibling	***	***	***	***	***	**
	.1355	.0810	-.0453	-.1021	-.1594	-.1943
	(.0408)	(.0415)	(.0392)	(.0406)	(.0374)	(.0391)
Dummy (1 = no suitable younger sibling)	***	*		**	***	***
Household variables						
	-.0115	-.0264	.0281	-.0510	.0550	-.0407
Education of hhld head (1 = primary)	(.0408)	(.0454)	(.0392)	(.0445)	(.0375)	(.0429)
	1.1306	.7087	1.1516	.7617	.5667	.3388
	(.4750)	(.4987)	(.4556)	(.4888)	(.4404)	(.4768)
Education of hhld head (1 = secondary)	**		**			
	.3519	.4721	.4291	.5278	.3148	.3742
	(.1403)	(.1527)	(.1348)	(.1497)	(.1292)	(.1450)
Education of woman of hhld (1 = primary)	**	***	***	***	**	**
	.1516	.1251	.1666	.2043	.0962	.1777
	(.1158)	(.1260)	(.1111)	(.1235)	(.1063)	(.1192)
Education of woman of hhld (1 = secondary)				*		
	.0668	.0542	.0838	.0811	.0594	.0688
	(.0454)	(.0498)	(.0436)	(.0488)	(.0417)	(.0471)
Sex of hhld head (1 = woman)			*	*		
	-.0350	-.0280	-.0219	-.0239	.0011	-.0067
	(.0061)	(.0067)	(.0059)	(.0065)	(.0056)	(.0063)
Household size	***	***	***	***		
	.6121	.6386	.4164	.5025	.0456	.1328
	(.0534)	(.0645)	(.0513)	(.0633)	(.0491)	(.0610)
Ln predicted expenditures	***	***	***	***		**
	.0334	-.0059	.0933	-.0025	.1054	-.0019
	(.0353)	(.0447)	(.0339)	(.0438)	(.0324)	(.0423)
Hhld receives food donations			***		***	
	-.1357	-.1220	-.0896	-.1159	-.0147	-.0572
	(.0435)	(.0645)	(.0418)	(.0631)	(.0399)	.0608
Hhld has beneficiary of coupons	***	*	**	*		
Community variables						
	.0148		.0128		.0063	
	(.0034)		(.0033)		(.0032)	
Index of community characteristics	***		***		**	
Interactions						
	-.0284	-.0173	-.0283	-.0200	-.0121	-.0098
	(.0123)	(.0129)	(.0118)	(.0127)	(.0114)	(.0124)
Hhld head has 2ry schooling & Community Index	**		**			
	-.0074	-.0120	-.0099	-.0133	-.0079	-.0093
	(.0039)	(.0043)	(.0038)	(.0042)	(.0036)	(.0041)
Woman of hhld has 1ry schooling & community index	*	***	***	***	**	**
Observations	4,068	4,068	4,057	4,057	4,029	4,029
Adjusted R-square	0.3260	0.3055	0.1808	0.1629	0.0178	0.0138
	104.52	70.57	48.1	34.7	4.85	5.1
F-statistic (for the model)	***	***	***	***	***	***
Rho (fraction of variance due to ui		0.2587		0.2212		0.2039
		2.00		1.63		1.46
F-statistic (for ui = 0)		***		***		***

Source: ESA Consultores, from PRAF-2002

Standards errors in parentheses - Levels of significance: * = p<0.1; ** = p<0.05; *** = p<0.01

Table H8: Regression of Fitted Values of Community Fixed Effects (with interaction terms) on Individual

Independent variable	Height-for-age	Weight-for-age	Weight-for-height
% hhlds with piped water in house/yard	.0032 (.0004) ***	.0013 (.0004) ***	-.0004 (.0004)
% hhlds with flush toilet or latrine	-.0003 (.0004)	.0017 (.0004) ***	.0024 (.0004) ***
% children <3yrs with diarrhea	-.0003 (.0005)	-.0014 (.0005) ***	-.0018 (.0005) ***
Distance in time to health center	.0008 (.0003) ***	.0006 (.0003) **	.0001 (.0003)
% children with up-to-date immunizations	.0007 (.0006)	.0001 (.0005)	.0001 (.0005)
% intitutional delivery	.0010 (.0003) ***	.0009 (.0003) ***	.0002 (.0003)
Daily agricultural wages (lempiras)	.0083 (.0014) ***	.0045 (.0013) ***	-.0009 (.0013)
Daily non- gricultural wages (lempiras)	-.0008 (.0004) **	-.0014 (.0004) ***	-.0013 (.0004) ***
Price of beans (lempiras)	-.0347 (.0160) **	-.0530 (.0154) ***	-.0576 (.0145) ***
.0014	-.1826 (.0404) ***	-.1525 (.0388) ***	-.0586 (.0366)
Price of rice (lempiras)	.1070 (.0293) ***	.0640 (.0281) **	.0309 (.0266)
Price of powdered milk (lempiras)	.0003 (.0007)	-.0002 (.0007)	-.0008 (.0007)
% hhlds receiving food donations	-.0008 (.0004) *	.0014 (.0004) ***	.0025 (.0004) ***
% hhlds with beneficiary of coupons	.0040 (.0005) ***	.0034 (.0005) ***	.0014 (.0005) ***
Community Integrated Child care program	-.0216 (0421)	.0630 (.0404)	.0436 (.0383)
Observations	1,561	1,557	1,544
Adjusted R-square	0.1688	0.1258	0.0948
F statistic	22.12 ***	15.93 ***	11.77 ***

Source: ESA Consultores, from PRAF-2002

Standards errors in parentheses - Levels of significance: * = p<0.1; ** = p<0.05; *** = p<0.01