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SOCIAL DIMENSIONS OF ADJUSTMENT IN SUB-SAHARAN AFRICA

WORKING PAPER NO. 4

POLICY ANALYSIS

Malnutrition in Côte d'Ivoire

Prevalence and Determinants

David E. Sahn

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David E. Sahn is senior research associate and deputy director at the Cornell University Food and Nutrition Policy Program.

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SDA Working Paper Series Foreword

Integration of social and poverty concerns in the structural adjustment process in Sub-Saharan Africa is a major driving force behind the design of the World Bank's adjustment lending program in the Region. To further the goal, the Social Dimensions of Adjustment (SDA) Project was launched in 1987, with the United Nations Development Programme and the African Development Bank as partners. Since then many other multilateral and bilateral agencies have supported the project financially as well as with advice. The task presents a formidable challenge because of the severity of economic and social constraints in Africa and the intrinsic difficulty of tracing the links between economic policies and social conditions and poverty. It is essential to have a continuous professional dialogue between all concerned parties, so that the best ideas get discussed by the best minds, and become, as quickly as possible, available for implementation by policymakers. This is the aim of the SDA working paper series.

To fulfill its mission, the SDA Project operates on different levels. Conceptually, contributions need to be made which advance our understanding of how the economic crisis in Africa on the one hand and the adjustment response on the other hand affect the living conditions of people. Empirically, major improvements are needed in our knowledge of the social dimensions of life in Africa, how they change, and whether all groups in society participate effectively in the process of economic development. Gaining this knowledge will demand new efforts in data collection and policy oriented analysis of these data. Most importantly, policy actions are needed in the short term to absorb undesirable side-shocks stemming from the adjustment process so that the poor and disadvantaged are not unduly hurt, and in the long term to ensure that these groups fully participate in the newly generated growth. The SDA Project's mandate is to operate, in a concerted way, in all three domains: concepts, data, actions. This working paper series will report progress and experience in all three areas. I encourage every reader's active participation in the series and the work it reports on. It is meant to be a forum not only for exchange of ideas but even more importantly to advance the cause of sustainable and equitable growth in Africa.

Edward V.K. Jaycox
Vice President, Africa Region

The Social Dimensions of Adjustment (SDA) Project Working Paper Series

The SDA Project has been launched by the UNDP Regional Programme for Africa, the African Development Bank, and the World Bank in collaboration with other multilateral and bilateral agencies. The objective is to strengthen the capacity of governments in the Sub-Saharan African Region to integrate social dimensions in the design of their structural adjustment programs. The World Bank is the executing agency for the Project. Since the Project was launched in July 1987, 30 countries have formally requested to participate in the Project.

The Project aims to respond to the dual concern in countries for immediate action and for long-term institutional development. In particular, priority action programs are being implemented in parallel with efforts to strengthen the capacity of participating governments (a) to develop and maintain statistical data bases on the social dimensions of adjustment, (b) to carry out policy studies on the social dimensions of adjustment, and (c) to design and follow up social policies and poverty alleviation programs and projects in conjunction with future structural adjustment operations.

The working paper series "Social Dimensions of Adjustment in Sub-Saharan Africa" aims to disseminate in a quick and informal way the results and findings from the Project to policymakers in the countries and the international academic community of economists, statisticians, and planners, as well as the staff of the international agencies and donors associated with the Project. In the light of the three terrains of action of the Project, the working paper series consists of three subseries dealing with (a) surveys and statistics, (b) policy analysis, and (c) program design and implementation.

The Surveys and Statistics subseries focuses on the data collection efforts undertaken by the SDA Project. As such, it will report on experiences gained and methodological advances made in the undertaking of household and community surveys in the participating countries to ensure an effective cross-fertilization in the participating countries. The subseries would also include "model" working documents to aid in the implementation of surveys, such as manuals for interviewers, supervisors, data processors, and the like, as well as guidelines for the production of statistical abstracts and reports.

The Policy Analysis subseries will report on the analytical studies undertaken on the basis of both existing and newly collected data, on topics such as poverty, the labor market, health, education, nutrition and food security, the position of women, and other issues that are relevant for assessing the social dimensions of adjustment. The subseries will also contain papers that develop analytical methodologies suitable for use in African countries.

Another subseries, Program Design and Implementation, will report on the development of the conceptual framework and the policy agenda for the project. It will contain papers on issues pertaining to policy actions designed and undertaken in the context of the SDA Project in order to integrate the social dimensions into structural adjustment programs. This includes the priority action programs implemented in participating countries, as well as medium- and long-term poverty alleviation programs and efforts to integrate disadvantaged groups into the growth process. The focus will be on those design issues and experiences which have a wide relevance for other countries as well, such as issues of cost-effectiveness and ability to reach target groups.

Table of Contents

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Executive Summary

Sixteen percent of the preschool-aged children in Côte d'Ivoire are stunted, an indicator of long-term (or chronic) malnutrition. Regionally, the problem is most serious in the Savannah where 23 percent of the children are stunted, in contrast to only 11 percent being stunted in the urban areas. Wasting, an indicator of current and acute episodes of malnutrition, was prevalent among 7 percent of the preschool-aged children.

In order to explore the causes of malnutrition, this paper estimates reduced-form nutritional status functions that include a linear combination of independent variables, which explain the household's per capita consumption expenditures. Instrumented consumption expenditures are considered a good proxy for permanent income, and the findings indicate that they are an important determinant of long-term (or chronic) malnutrition. Income, however, does not have a significant effect on current (or acute) malnutrition. Children from households that allocate a larger share of their land to producing export crops than food crops did not display more stunting or wasting. Mothers with more education will be less likely to have children who suffer from acute malnutrition, when controlling for income levels. The education of the father, however, does not confer the same positive benefits upon his children's nutritional welfare, except as mediated through higher earnings. Parental height, especially of women, also has an important impact on long-term nutritional status. The characteristics of the village in which the household resides also plays an important role in determining levels of malnutrition. In particular, the presence of a nurse and the proximity to a doctor are important determinants of malnutrition. Likewise, children suffer less malnutrition if they reside in villages where dysentery and malaria are not serious health problems.

1. Introduction

Malnutrition is considered to be a problem approaching epidemic proportions in developing countries. This is an especially serious problem in Sub-Saharan Africa where recent statistics indicate that the prevalence of malnutrition is worsening in many countries (FAO, 1985).

Reducing malnutrition, both in order to eliminate the human suffering that it causes and protect the quality of human resources, clearly represents a pillar of any development policy. However, the elemental information required to formulate enlightened policy and projects includes understanding the levels, characteristics, and determinants of malnutrition, the subject of this paper for Côte d'Ivoire. Therefore, the focus of this paper is to explore, descriptively and econometrically, these issues employing data from the Côte d'Ivoire Living Standards Survey.

The most important issue to be addressed is whether raising household consumption expenditures (a proxy for income) reduces childhood malnutrition? It is hypothesized that raising household incomes will increase household caloric intake as well as expenditures on other goods and services, thereby contributing to better nutritional status.

To amplify, there are two hypothesized pathways that link income and nutritional status. The first is simply that more income leads to higher calorie intake and perforce, better nutrition. The second is that income improves nutrition through its effect on other inputs, such as health care and practices.

While the biological literature is clear that raising calorie intake improves nutrition as indicated by anthropometric indicators, new doubts have recently been raised as to the responsiveness of calorie intake (and consequently nutrition) to changes in incomes. This has led some to question whether raising incomes will lead to improved nutrition, as measured through anthropometric outcomes. More specifically, it has been argued that bias in estimation due to measurement error[1] and the exclusion of variables correlated with both income and consumption[2] have led to overstating the response of calories, and consequently nutrition, to changes in income.[3]

Even if there is considerable ambiguity as to the effectiveness of raising incomes to improve nutritional status, as mediated through raising calorie intake, a second pathway that links income to nutrition is that more income raises the demand for other goods and services that are inputs into health (Kennedy, 1989). Consequently, income-augmenting and related wage and employment policies can be hypothesized to improve nutritional outcomes even if income elasticities of demand for calories are low.

In an attempt to cast further light on this important debate, this paper will focus on the role of income as a determinant of preschool-aged malnutrition in Côte d'Ivoire. In order to avoid the potential bias that could be introduced if income is jointly determined with nutritional outcomes, instrumented, rather than reported, income is employed. In addition, by regressing anthropometric indicators directly on instrumented income, the potential of income-augmenting measures in improving nutritional status is directly explored. However, the issue of the relative importance of the mediating role of nutrient demand versus demand for other goods and services in bringing about improved anthropometric growth performance is not addressed.

This paper, furthermore, focuses on the role of a variety of other individual- and household-level characteristics in determining preschool-aged malnutrition. Among the potential household characteristics that one can include in the reduced-form function is household size and other household structure variables.[4] Doing so will also allow us to examine the contention that children of larger households are more vulnerable to malnutrition. Studies from Nigeria, Thailand, and India (World Bank, 1975), for example, suggest a negative correlation between family size and nutrition. In contrast, Sahn (1988) and Behrman and Wolfe (1984) show that there are economies of scale of nutrient intake in terms of household size, which would tend to favor the nutritional status of children from larger families. Therefore, the effect of household size, standardized with respect to its composition, is explored.

Several other hypotheses related to household structure and composition are explored. The first is that older siblings (that is, six years old and above) who do not directly compete for nurturing time with a preschool-aged child and who are also able to provide some child care assistance, will result in better current nutritional status for the young child. Second is that the greater the number of adult women, holding constant household size and age composition of the household, the better the nutritional status of the young child. This latter issue arises out of the literature from Africa on conflicts between males and females on the choice of consumption expenditures (Jones, 1984).

In order to further explore gender issues, the finding of Kennedy and Cogill (1987) that children living in households headed by women are better nourished is also examined. However, this is done in urban areas only, given the absence of women-headed households in rural areas of Côte d'Ivoire.

The other gender-specific issue included in this study is determining whether malnutrition and growth retardation is worse among boys or girls. Despite the arguments often heard that male children are favored, both in terms of the intrahousehold allocation of food and other health and nutrition inputs, recent studies in the Philippines by Haddad (1987) and Horton (1986) indicate to the contrary.

The effect of a child's birth order on nutritional outcomes is also addressed in this paper. The literature suggests that younger siblings are nutritionally disadvantaged, especially when measured in terms of long-term malnutrition (Horton, 1988). This is often explained in terms of an additional child straining household resources—that is, the per capita availability of food and other nutrition inputs are less for the children of higher birth order. However, this issue of more children spreading household resources more thinly is implicitly addressed in the models presented in this paper through defining household expenditures in per capita terms and controlling for the age structure of household members. Nonetheless, other reasons have also been posited for an earlier sibling position presenting an advantage. These include biological explanations (for example, less maternal depletion), cultural reasons (for example, the oldest son is important in funeral rites), and socioeconomic reasons (for example, parents are more dependent upon first born children for their security in old age) (Horton, 1988).

There are two final important areas of inquiry in this study. The first is the role of the combined effects of genotype and phenotype as captured by parental stature in affecting growth performance of the offspring. This study will expand upon the growing evidence that parental height is an important determinant of nutritional status (Strauss, 1987; Thomas, Strauss, and Henriques, 1987; Horton, 1988; Kennedy and Cogill, 1987).

The second area is the role of parental education, above and beyond the expected impact of schooling on the productivity of market activities. Concerning this issue, previous research has provided ample evidence that education is an important determinant of nutritional status (Horton, 1988; Behrman and Deolalikar, 1988; Haddad, 1987). However, as a consequence of relying on the conventional reduced-form model, previous studies were not able to distinguish whether education improves nutrition as mediated through the effects of increased productivity in market activities, and perforce, incomes, or through other independent channels. For example, these non-income channels through which education could improve nutrition may include altering the household preference function, increasing productivity of household activities, and adopting improved methods of child care.[5] In terms of the issue of preferences, Behrman and Wolfe (1984) also hypothesize that the education of the mother is especially vital. This might be explained by the mother's preference ordering being more oriented toward child nutrition. By employing a linear combination of independent variables to explain income, which is included as a regressor in the reduced-form nutrition function along with education, this paper explores explicitly the effects of education on nutrition, independent of increased productivity leading to higher earnings and profits.

The remainder of this paper is organized as follows. First, a brief discussion of the data is presented in Chapter 2. This is followed in Chapter 3 by a discussion of the choice of nutritional indicators. Information on the extent of current (that is, acute) and long-term (that is, chronic) malnutrition is presented in Chapter 4. These descriptive data are also disaggregated by some important characteristics such as region, income levels, and various other individual-, household-, and community-level characteristics. Chapter 5 expands upon the insights gained in doing the descriptive statistics, and models the long-term and current nutritional status of preschool-aged children living in urban and rural areas of Côte d'Ivoire. The importance of going beyond these descriptive statistics is well-illustrated in this paper, as simple correlations (or the lack thereof) are not always supported by the econometric analysis that controls for confounding variables. The paper concludes with a discussion of the most salient findings and their policy implications in Chapter 6.

Notes

1. See the discussion of Bouis and Haddad (1989) about the problems of the positive correlation between measurement errors in the dependent and independent variables, as well as for a discussion of the large differences in parameter estimates when the model employs 24-hour food recall rather than food expenditures.

2. See, for example, Behrman and Wolfe (1984), who stress the importance of including education in estimating equations; in contrast, see Alderman (1987) who finds that using fixed effects does not change markedly parameter estimates, thereby indicating that no serious bias is introduced as a result of missing variable bias.

3. See, for example, Bouis and Haddad (1989) and Alderman (1986) who survey the range of estimates found in the literature. Also, see Alderman (1989) for a critical discussion of the issues regarding this emerging debate.

4. The problem of doing so is that family size may be endogenous, as the literature on the tradeoffs between the quality and quantity of children has shown (Becker, 1975). Failure to account for such endogeneity may result in biased estimators. However, identifying suitable instruments for household size is considerably more difficult than for income. This, coupled with the fact that its exclusion introduces a potential bias in the income coefficient, which is the focus of this study, suggests that it is reasonable to include household size, acknowledging the possible bias.

5. Rosenzweig and Schultz (1983) argue the importance of education of women in their responsibilities for nurturing and caring for children.

2. Data

The data used in this survey are from the Côte d'Ivoire Living Standards Survey (CILSS). The data were collected by the Côte d'Ivoire Direction de la Statistique in collaboration with the World Bank Living Standards Measurement Study. The data, described in detail by Grootaert (1986) and Ainsworth and Muñoz (1986), are from two survey rounds. The first round of data were collected between February 1985 and February 1986. It included approximately 1,500 households, selected on the basis of a national probability sample, representative of the general population. Since the survey did not begin gathering anthropometric data until the seventh month of the first round, only 1,008 children under the age of six were measured.

The sample for the second round of data, collected from March 1986 to March 1987, also consisted of approximately 1,500 households. A little less than half of those households were drawn randomly from the set of households that were sampled during the first round; the remainder were drawn randomly from the larger national probability sample. Measurements on 2,315 children were available from the second round since the anthropometry was collected throughout. Pooling the two rounds of data resulted in anthropometric data from 3,323 children.

3. Choice of Nutritional Indicators

This paper employs anthropometric indicators to measure nutritional status. Anthropometry is recognized as the technique of choice for determining deficits in food energy and protein that manifest themselves in stunting (that is, slow linear growth) and wasting (that is, being emaciated). In combination, inadequate food energy and protein intake have been shown to be the most widespread and debilitating nutritional problem in developing countries.

The assessment of nutritional status is based on two indicators, in keeping with the conventional standards of classification (WHO, 1983). The first, height-for-age, measures the degree to which linear growth is retarded due to inadequate nutrient intake and poor health. The stunting of growth is a physiological response to nutrient deficits, and likely represents an attempt to maintain vital bodily functions, a normal level of physical activity, and a proportionate weight for a given stature or length. When a child is stunted, it is an indicator of chronic, long-term, and/or previous malnutrition.[6] The implication, of course, is that identifying the socioeconomic determinants of stunting or previous malnutrition is difficult in the absence of lagged information on the circumstances of the child in the preceding months or years. It is necessary, therefore, to resort to the reasonable assumption that there is high correlation between the present socioeconomic environment and that which prevailed in previous periods, in order to assess the determinants of long-term malnutrition.

A child's weight for a given height is an indicator of leanness, or wasting. When a child's weight-for-height is below the normative standard, it is a sign of acute malnutrition and physiological stress. Wasting is a reflection of the current nutritional status of a child, in contrast to stunting that measures long-term nutritional well-being.[7,8]

Of course, nutritional indicators such as height-for-age and weight-for-height of children only find meaning in terms of comparisons with normative standards. Once again in keeping with convention, the National Center for Health Statistics (NCHS) reference population is used as the benchmark (U.S. Public Health Service, 1976).[9] In addition, it is necessary to select a cutoff point, below which a child is classified as being previously or currently malnourished. The convention for doing so is to employ a value -2 Z-scores below the median value for the three indicators discussed above.[10] The -2 Z-score cutoff point is constructed by taking the median value of a reference population's weight-for-height or height-for-age of a given age cohort. Fifty percent of the children in the reference population have measures greater than this value, and half of the children will be below this value. Then a range, plus and minus two standard deviation units, is set around that median. This includes 97.6 percent of the children in the population. A child whose weight-for-height or height-for-age falls within this range is classified as being normally nourished. If a child falls two standard deviation units, alternatively referred to as -2 Z-scores below the median, then the child is classified as undernourished. In essence, using Z-scores allows the analyst to make a probability statement based on a comparison of the measurements of a child from Côte d'Ivoire with the healthy reference population. Specifically, there is less than a 0.023 probability that a child with a height-for-age or weight-for-height of less than -2 Z-scores would be found in the healthy reference population.

Notes

6. For the remainder of this paper, chronic malnutrition, long-term malnutrition, previous malnutrition, and stunting are used interchangeably.

7. For the remainder of the paper, acute malnutrition, current malnutrition, and wasting are used interchangeably.

8. A third classification of malnutrition, being concurrently stunted and wasted, is not employed, given that only around one percent of the population falls in this category.

9. Martorell and Habicht (1986) and WHO (1983) discuss the appropriateness of employing the NCHS growth standards, based on the measurement of children from the United States, to assess nutritional status among developing country populations. The basic argument is that the NCHS standards are based on a heterogenous population, randomly selected from different economic and ethnic groups; and that there is no strong evidence to suggest that the genetic growth potential is different among children from different ethnic and racial groups. Thus, healthy preschool-aged children in Africa should grow at the same rate as those in the U.S.

10. A Z-score is the standard deviation of a given indicator for an individual. Children with Z-scores less than -2 are classified as malnourished. Z-scores are calculated as follows:

$$Z = (M_o - M_e)/SD_e$$

where M_o is the observed height or weight of individuals in a given age or height group, M_e is the expected median height or weight of that group of the reference population, and SD_e is the standard deviation of the measurements for that group of the reference population.

4. *Prevalence of Malnutrition and Associations with Socioeconomic Characteristics*

At a national level, 16.2 percent of the preschool-aged population in Côte d'Ivoire are stunted, indicating long-term or previous malnutrition; and 7.1 percent of the preschoolers suffer from wasting, a measure of current malnutrition (Table 1). This low incidence, *relative* to those found in other poor African and Asian countries, is an initial indicator of a combination of a relatively high level of household food security (that is, adequate access to food) and/or low levels of morbidity.

Regionally, stunting (that is, previous or long-term malnutrition) is most prevalent in the poorest region of Côte d'Ivoire, the Savannah. The probability of being stunted is lowest in Abidjan and other cities. The same regional pattern does not hold for acute (that is, current) malnutrition. In Abidjan, 9.4 percent of the children are classified as suffering from acute malnutrition, a figure that is as low as 3.4 percent in the West Forest.

Wasting, which indicates a current episode of acute malnutrition, is primarily a problem among children 12 to 23 months of age, with 14.6 percent of the children being wasted in this cohort. The vulnerability of children during this weaning period has been documented extensively in other developing countries. Also as observed elsewhere, the incidence of stunting, which indicates previous or long-term malnutrition, increases from 7.9 percent among children less than one year of age to 20.2 percent among children three years of age. Thereafter the level of chronic, long-term undernutrition declines to 15.6 percent among those children 48 to 60 months of age.[11]

Examining the anthropometric data by gender revealed no evidence that either boys or girls are better nourished. This applies even when the gender comparisons are further disaggregated by age cohorts, and the regions for which data are presented in Table 1.

Identifying the sociodemographic characteristics of malnourished children and the households in which they reside is a prerequisite to any targeted effort to improve nutritional well-being. Table 2 indicates that as per capita expenditures rise, there is a decline in the percentage of children who suffer from long-term malnutrition. Nationally, 19.3 percent of the children in the lowest expenditure group are chronically malnourished, 17.0 percent in the second quintile, and only 12.5 percent among the highest 20 percent of the expenditure distribution.[12] Across these expenditures groups, the percentage of acutely malnourished children declines modestly from 8.7 percent in the lowest quintile to 5.3 percent among the upper 20 percent of the expenditure distribution.

In order to examine the percent of malnourished children by expenditure group, two sets of quintiles were constructed—one for urban areas and the other for rural areas. This was necessitated by virtue of the fact that in the Savannah and Forest regions, 8.3 and 11.1 percent, respectively, of the children reside in households falling in the highest two quintiles of the national expenditure ranking; while in Abidjan less than 4.0 percent of the children fall in the lowest quintile of the national expenditure ranking. Thus, if the national expenditure quintiles are employed, the cell sizes in the upper groups are too small to infer anything meaningful in rural areas, while the same is true of the cell sizes in the urban areas in the lowest expenditure groups.

In Abidjan, one finds a marked decline in the percent of stunted children between the lowest 60 and upper 40 percent of the expenditure distribution. In other urban centers, there is also a drop in the level of long-term malnutrition that is pronounced between the fourth and fifth quintile. Wasting, reflecting current malnutrition, also shows a marked decline over the expenditure distribution in Abidjan, falling from 19.3 in the lowest quintile to 4.0 percent in the highest quintile. In the rural areas, there is no clear pattern between expenditures and child malnutrition. This is the case for both stunting and wasting, in the Forest and Savannah regions.

One limitation of the use of Z-score cutoff points is that simply reporting the percentage of children that

Table 1. Mean Z-scores and percent malnourished, by region and age

Age Group	Indicator	Abidjan	Other Cities	West Forest	East Forest	Savannah	All
(months)				*(percent)*			
0-11	Stunted	6.3	4.9	13.0	8.4	8.7	7.9
	Wasted	12.5	11.3	5.9	12.9	9.5	10.7
	N	96.0	142.0	85.0	155.0	127.0	605.0
12-23	Stunted	16.9	13.4	19.8	20.6	24.8	19.0
	Wasted	18.1	12.4	7.0	17.9	17.3	14.6
	N	83.0	5.0	86.0	112.0	93.0	479.0
24-35	Stunted	10.8	15.9	20.5	17.9	28.7	18.7
	Wasted	5.9	6.1	1.2	10.6	5.2	6.1
	N	102.0	132.0	83.0	123.0	115.0	555.0
36-47	Stunted	14.4	10.7	26.4	18.0	29.5	19.1
	Wasted	7.8	3.1	1.4	3.7	0.9	3.4
	N	90.0	131.0	72.0	161.0	112.0	566.0
48-60	Stunted	7.9	11.7	16.9	17.3	20.3	15.1
	Wasted	3.7	1.9	2.3	4.3	0.9	2.7
	N	164.0	265.0	172.0	300.0	217.0	1,118.0
ALL	Stunted	11.4	11.3	18.7	16.9	23.2	16.2
	Wasted	9.4	6.0	3.4	9.0	7.1	7.1
	N	535.0	775.0	498.0	851.0	664.0	3,323.0

Notes: Stunted, or previously malnourished, is defined as height-for-age Z-score ≤ -2
Wasted, or currently malnourished, is defined as weight-for-age Z-score ≤ -2

Table 2. Percent malnourished, by per capita expenditure category and by region

Per Capita Expenditure Category		Urban Areas: Abidjan	Urban Areas: Other Cities	Rural Areas: West Forest	Rural Areas: East Forest	Rural Areas: Savannah	National
				(percent)			
1	Stunted	12.5	12.6	14.6	17.5	31.3	19.3
	Wasted	19.3	7.8	2.9	18.2	6.9	8.7
	N	88.0	167.0	103.0	137.0	160.0	657.0
2	Stunted	17.1	10.7	23.9	16.4	19.1	17.0
	Wasted	11.7	7.4	1.1	8.6	8.6	8.2
	N	111.0	149.0	88.0	152.0	162.0	886.0
3	Stunted	16.0	11.8	12.4	16.9	17.6	15.3
	Wasted	9.4	3.9	1.0	9.6	5.9	8.3
	N	106.0	152.0	105.0	177.0	119.0	659.0
4	Stunted	7.5	13.9	21.4	15.2	22.1	17.5
	Wasted	4.7	4.6	5.4	7.6	4.8	5.2
	N	106.0	151.0	112.0	184.0	104.0	659.0
5	Stunted	4.8	6.7	22.2	19.4	24.4	12.5
	Wasted	4.0	5.2	6.7	4.2	8.4	5.3
	N	124.0	134.0	90.0	191.0	119.0	656.0
ALL	Stunted	11.4	11.3	18.7	17.1	23.2	16.3
	Wasted	9.3	5.8	3.4	9.2	7.1	7.1
	N	535.0	753.0	498.0	841.0	664.0	3,291.0

Notes: Per capita expenditure categories in this table are different for urban and rural areas, and for the national figures as well. The quintiles for the urban areas were determined by ranking all children living in Abidjan and other cities, according to their per capita expenditures, deflated by a price index based on food prices. Therefore, 20 percent of the children in urban areas fall in each of the quintiles. In a similar vein, the quintiles for the rural areas were determined by ranking all children living in the East and West Forest, and Savannah, according to their per capital expenditures, deflated by a price index based on food prices. Twenty percent of the children in rural areas fall in each quintile. The national quintiles are based on ranking all the children measured, and ranking them according to the deflated per capita expenditures. The actual cutoff points employed, in terms of deflated annual per capita expenditures (in CFA) are as follows:

Urban: (1) Less than 100,799; (2) 100,800-144,799; (3) 144,800-201,829; (4) 201,830-315,373; (5) greater than 315,374.
Rural: (1) Less than 67,837; (2) 67,838-92,179; (3) 92,180-121,682; (4) 121,683-175,029; (5) greater than 175,030.
National: (1) Less than 77,135; (2) 77,136-107,143; (3) 107,144-145,984; (4) 145,985-226,429; (5) greater than 226,430.

are malnourished does not provide any insight into the severity of wasting and stunting.[13] Therefore, in Table 3, additional measures of malnutrition that take into account the severity of the problem are presented.

To amplify, two further indicators are employed. The first and third columns measure the depth or severity of malnutrition, conditional upon being categorized as such. The national data suggest that the average gap between the cutoff point (that is, -2 Z-scores) defining normal height-for-age or weight-for-height and the actual mean height-for-age or weight-for-height among the currently malnourished population is stable throughout the expenditure groups.

In the second and fourth columns, a measure that combines the concern over the numbers of malnourished, with the severity of malnutrition, according a greater sensitivity to those who are more severely malnourished, is presented (that is, M_2). Following from Foster, Greer, and Thorbecke (1984), who developed such a concept for measuring poverty, and Kanbur (1987), who employed the measure for income-determined poverty lines in Côte d'Ivoire, this indicator essentially raises the extent to which an individual's weight-for-height or height-for-age fall short of the cutoff point to the second power, summing these squared deviations over the malnourished children, and thereafter normalizes in terms of the numbers of the entire population of well- and malnourished children.

Results at the national level once again do not indicate any clear relationship between the value of this composite index for chronic or acute malnutrition and expenditure quintile. When these same variables are examined by urban and rural areas, one finds that in rural areas, none show any association with per capita expenditures. In urban, however, all the variables show a marked decline with the level of expenditures. This indicates that among those children suffering from long-term and current malnutrition, the severity is worse the lower the expenditure group. And likewise, the composite index of the prevalence and sever-

Table 3. Indexes of depth of malnutrition and combined depth and head count measures of malnutrition, by per capita expenditure category

Per Capita Expenditure Category	*Height-for-Age*		*Weight-for-Height*	
	M_1	M_2	M_1	M_2
All Regions				
1	0.493	0.782	0.322	0.152
2	0.516	0.919	0.368	0.205
3	0.382	0.442	0.390	0.282
4	0.398	0.511	0.261	0.092
5	0.432	0.448	0.377	0.159
Urban				
1	0.487	0.468	0.383	0.315
2	0.406	0.518	0.293	0.146
3	0.352	0.305	0.255	0.168
4	0.367	0.316	0.262	0.044
5	0.245	0.069	0.249	0.046
Rural				
1	0.494	0.907	0.313	0.160
2	0.521	0.996	0.339	0.143
3	0.444	0.622	0.423	0.216
4	0.402	0.588	0.438	0.240
5	0.478	0.908	0.407	0.228

Note:

$$M_1 = \frac{-2-\bar{z}}{-2}$$

$$M_2 = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{-2-z_i}{-2}\right)^2 * 10$$

where:

$\bar{z}$ = the mean Z-score among those classified as being currently or previously malnourished;
z_i = the Z-score of individual i;
q = the number of children classified as being currently or previously malnourished;
n = the total number of children in the population.

ity of currently and chronically malnourished children shows a strong negative correlation with the per capita expenditure level of the child's household.

A variety of other household-level factors that may be related to nutritional outcomes were explored. First, the nutritional status of children residing in rural areas was examined by both farmsize and farmsize per capita (the latter is found in Table 4). There is no evidence that landholdings of the household is related to nutritional status of children, even when normalized by the size of the household. In addition to examining the effects of the quantity of landholdings on nutritional status, the relationship between the share of the total land in cultivation devoted to the traditional export cash crops, coffee, cocoa, and cotton, and nutrition was also explored. One can see that for the sample of all households that reported cultivating land, there is no association between the share of land devoted to cash crops and nutritional status (see Table 4). When these shares are examined stratified by total land cultivated per capita, there is likewise no relationship between land use and the level of stunting and wasting. Not shown in Table 4, although also noteworthy, is that no association was observed between preschool-aged nutrition and the share of land in cash crops, when disaggregated by the per capita expenditure categories.

The probability of being malnourished is also examined in terms of the educational achievement of the mother and father (see Table 5). In rural areas, 12.9 percent of the children of mothers who have received some education are stunted or previously malnourished, as opposed to 21.1 percent for mothers having no education. The level of wasting or current malnutrition is not significantly lower among children of mothers with some education. In rural areas, there is no significant difference in the long-term and current nutritional status of children of fathers with no, versus some, education.

Education is a major determinant of household expenditures.[14] Among children from urban households that fall in the lowest expenditure group, 71.5 percent of their fathers had not completed the first grade; the comparable figure in the highest expenditure quintile is less than 20.0 percent. Therefore, it is important to examine the effects of education on nutritional status, disaggregated by expenditure class, in order to determine whether there are any independent effects of education, not mediated by returns to labor.

The data suggest that a child will be less likely to be chronically undernourished if her/his mother has received some level of education. This relationship is strongest for the lower three expenditure quintiles. Note, for example, that in the rural areas within the

Table 4. Percent malnourished, by share of land devoted to cash crops[a]

Per Capita Land Category[b]		*Percent of Land Cultivated Devoted to Cash Crops*					
		< 5.6	*5.7–25.91*	*25.92–42.02*	*42.03–58.30*	*> 58.3*	*ALL*
				(percent)			
1	Stunted	21.4	17.9	20.3	11.8	30.0	20.2
	Wasted	7.5	9.0	7.2	8.8	15.0	8.3
	N	187.0	67.0	69.0	34.0	20.0	377.0
2	Stunted	22.1	25.8	19.5	14.6	18.7	20.6
	Wasted	9.1	7.7	8.3	6.1	10.4	8.1
	N	77.0	105.0	72.0	82.0	48.0	384.0
3	Stunted	25.6	10.9	20.2	17.8	20.5	18.9
	Wasted	2.3	7.3	4.0	5.6	9.0	5.8
	N	43.0	55.0	99.0	107.0	78.0	382.0
4	Stunted	25.0	21.0	17.9	10.7	15.6	17.2
	Wasted	8.4	7.4	10.2	4.0	8.2	7.7
	N	36.0	81.0	78.0	75.0	109.0	379.0
5	Stunted	22.5	25.3	12.7	25.3	23.5	22.2
	Wasted	7.5	4.2	8.4	6.6	7.3	6.9
	N	40.0	71.0	71.0	75.0	136.0	393.0
ALL	Stunted	22.4	21.1	18.3	16.6	20.5	19.8
	Wasted	7.3	7.1	7.5	5.9	8.7	7.3
	N	383.0	379.0	389.0	373.0	391.0	1,915.0

a. Cash crops refer to the traditional export crops of coffee, cocoa, and cotton.
b. Per capita land category corresponds to the following size landholdings (hectares): (1) 0.010–0.384; (2) 0.385–0.599; (3) 0.600–0.874; (4) 0.875–1.329; (5) > 1.330.

Table 5. Percent malnourished, by parents' education categories, per capita expenditures, and urban/rural

Per Capita Expenditure Class[a]		*Father's Education*					*Mother's Education*				
		Urban			*Rural*		*Urban*			*Rural*	
		None[b]	*Some Elementary*	*Elementary*	*None*	*Some Elementary*	*None*	*Some Elementary*	*Elementary*	*None*	*Some Elementary*
						(percent)					
1	Stunted	14.2	8.6	8.6	24.1	15.9	12.9	7.4	18.2	24.1	10.7
	Wasted	10.8	11.4	20.0	10.0	7.3	9.2	22.2	36.4	9.3	12.5
	N	176.0	35.0	35.0	311.0	82.0	217.0	27.0	11.0	344.0	56.0
2	Stunted	9.6	13.9	24.5	17.9	22.0	10.1	14.7	34.8	20.7	10.90
	Wasted	7.0	5.6	18.9	7.8	4.6	9.5	7.4	13.0	7.1	6.32
	N	157.0	36.0	53.0	268.0	132.0	168.0	68.0	23.0	338.0	64.0
3	Stunted	13.0	11.6	16.5	17.8	11.9	10.1	16.0	29.2	17.6	8.3
	Wasted	6.9	7.0	5.0	5.2	7.9	7.6	4.0	4.2	6.4	5.6
	N	131.0	43.0	79.0	270.0	126.0	158.0	75.0	24.0	329.0	72.0
4	Stunted	6.7	16.7	12.0	19.5	17.6	11.9	14.5	4.4	19.4	16.8
	Wasted	11.2	0.0	1.0	6.1	6.9	6.7	2.9	2.2	6.3	6.3
	N	89.0	48.0	100.0	261.0	131.0	134.0	69.0	45.0	304.0	95.0
5	Stunted	11.1	3.2	5.3	22.4	19.3	11.2	4.5	2.1	23.3	15.1
	Wasted	13.3	3.2	3.3	6.6	5.2	9.0	0.0	4.1	7.6	0.0
	N	45.0	31.0	152.0	259.0	135.0	89.0	67.0	97.0	314.0	86.0
ALL	Stunted	11.4	11.4	11.7	20.5	17.5	11.4	12.1	10.5	21.1	12.9
	Wasted	9.2	5.2	6.5	7.2	6.3	8.5	5.2	6.5	7.4	5.6
	N	598.0	193.0	419.0	1,369.0	606.0	766.0	306.0	200.0	1,629.0	373.0

a. Per capita expenditure classes for urban and rural areas correspond to the figures in Table 2.
b. None refers to persons who have failed to complete the first year of school.

first expenditure group, 24.1 percent of the children of mothers with no education are previously malnourished; the comparable figure for children of mothers who have at least completed one year of schooling is 10.7 percent. There is much less convincing evidence of a relationship between the father having attended school, and the probability of the child living in rural areas being previously malnourished. For mothers and fathers, there is no relationship between their education and wasting or current nutritional status of the child across all expenditure groups. And within expenditure groups, it is only in the fifth quintile that the child is less likely to be wasted if the mother has some education.

In urban areas, it is possible to distinguish between children of parents who have not completed the first year of schooling, those whose parents have attended (although not necessarily completed) elementary school, and those whose parents have gone beyond elementary schooling. Across all expenditure groups, educational achievement among mothers and fathers shows no statistically significant relationship to the percentage of children who are stunted or wasted. Within a given expenditure quintile, there is likewise no clear pattern to support that previous (that is, long-term) or current malnutrition is associated with educational achievement. Some surprises, such as those in the second expenditure group in the urban areas where children of fathers who have gone beyond elementary school have a higher probability of being stunted, are hard to explain; they likely represent a structural problem with the data. More in keeping with expectations, among the highest expenditure quintile, 11.2 percent of the children are previously malnourished if the mother has no education, while the figures are only 4.5 and 2.1 percent if the mother has attended secondary school, and exceeded secondary school, respectively.

The association between nutrition status and the educational achievement of the head of the household (when different from the father or mother), as well as the senior wife in polygamous families was also examined. No clear patterns emerged.

The role of parental height, in relation to long-term nutritional status, is of considerable importance. In Table 6, one can see that if both of a child's parents were in the lowest height quintile, the probability of being previously malnourished is 38 percent, as opposed to 9 percent if both the child's parents are in the tallest 20 percent of the population.

One would expect the genetic influence on stature from the father and mother to be the same. Additionally, for the mother, the environmental impact on genetic potential, the phenotype, is also expected to affect the offspring. This would, in theory, suggest that the mother's stature should be more influential on the

Table 6. Percent malnourished, by father's and mother's height

Father's Height Category		*Mother's Height Category*					
		1	*2*	*3*	*4*	*5*	*ALL*
				(percent)			
1	Stunted	37.8	25.3	13.7	20.3	15.9	25.0
	Wasted	8.9	8.5	8.2	2.9	11.1	8.1
	N	135.0	95.0	73.0	69.0	63.0	435.0
2	Stunted	26.4	12.6	16.5	13.1	7.9	15.3
	Wasted	1.4	3.4	4.1	7.9	2.6	4.0
	N	72.0	87.0	121.0	76.0	76.0	432.0
3	Stunted	23.3	26.3	23.3	17.0	11.2	20.7
	Wasted	6.5	6.1	3.5	3.0	14.6	6.9
	N	107.0	99.0	86.0	69.0	89.0	450.0
4	Stunted	18.2	22.1	22.0	15.3	14.6	18.6
	Wasted	11.7	9.3	20.0	8.2	3.7	10.9
	N	77.0	86.0	100.0	85.0	82.0	430.0
5	Stunted	10.9	25.7	8.9	7.8	9.0	11.7
	Wasted	8.1	13.6	6.9	3.9	8.2	7.8
	N	37.0	74.0	101.0	103.0	122.0	437.0
ALL	Stunted	26.4	22.4	16.9	14.1	11.3	18.2
	Wasted	7.5	7.9	8.6	5.2	8.1	7.5
	N	428.0	441.0	481.0	402.0	432.0	2,184.0

Notes: Father's height categories are (in meters):
1. less than 1.634; 2. 1.634–1.670; 3. 1.671–1.702; 4. 1.703–1.745; 5. greater than 1.745.
Mother's height categories are (in meters):
1. less than 1.539; 2. 1.539–1.572; 3. 1.573–1.600; 4. 1.601–1.636; 5. greater than 1.636.

child's height-for-age than that of the father, an issue explored in greater detail in the next section of this paper.

Household size showed no relationship with nutritional indicators. Given that households are often comprised of more than two adults, and offspring from more than one set of parents, this absence of correlation between the nutritional status of the child and the size of her/his family was not surprising.

The relationship between the number of children and the number of adults was explored to determine whether children from households with higher dependency ratios had a higher probability of being malnourished. There is little strong evidence that the probability of being chronically or currently malnourished is related to the dependency ratio even when disaggregated by expenditure group (see Table 7). Likewise, a variety of other potential associations between nutrition and a variety of other socioeconomic factors were examined employing descriptive statistics. Most are not reported given that no relationship was observed. One such avenue of exploration was the issue of whether the source of income in rural areas was associated with levels of malnutrition. In particular, this involved determining whether the share of agricultural production that is consumed at home, the proportion of food expenditures that is from own production, and the share of income that is received from the production of cash crops, are related to nutritional outcomes. No statistically significant association was observed between such derived variables and nutritional status, even when disaggregating by a variety of factors, including expenditure groups, farm size, and region.

The lack of such associations, however, are difficult to interpret. First, the observed behavior of households (for example, the share of income from consumption of own production) is strongly associated with other factors that affect nutrition; these cannot be captured employing descriptive statistics. Second, outcomes such as the share of income from consumption of own production is a manifestation of household choices concerning factors such as how much time the household members work in their own fields versus hiring themselves out as wage labor; which crops to grow; and the share of farm output to market for cash income versus the share to store on the farm for future consumption, which is partly determined by the efficiency and competitiveness of local markets.

But most important is that the same exogenous factors that may result in a high proportion of household income from home consumption, may also contribute to a high prevalence rate for malnutrition. For example, consider the farm household in a remote area of Côte d'Ivoire that is less likely to market their farm output due to the thin and noncompetitive commodity market. It is also likely that the opportunities for off-farm employment will be minimal. Consequently, the share of income from home consumption may be quite high. These same remote spatial characteristics may portend a lack of health infrastructure and environmental sanitation facilities leading to high levels of malnutrition. Such a circumstance may result in a positive correlation between the share of income from

Table 7. Percent malnourished, by dependency ratio and per capita expenditure class

Per Capita Expenditure Class[a]		*Ratio of Household Members 14 to Household Members > 14*					
		0.6 <	*0.61–0.8*	*0.81–1.0*	*1.1–1.5*	*> 1.5*	*ALL*
				(percent)			
1	Stunted	19.3	23.1	19.1	18.6	14.9	19.3
	Wasted	8.4	10.8	11.0	4.0	8.1	8.7
	N	166.0	130.0	163.0	124.0	74.0	657.0
2	Stunted	17.2	17.5	15.7	14.7	22.4	17.0
	Wasted	12.7	6.4	6.4	10.5	3.5	8.2
	N	134.0	126.0	172.0	143.0	85.0	660.0
3	Stunted	14.6	17.2	11.5	15.8	16.5	15.3
	Wasted	8.8	10.3	8.9	5.8	7.0	8.4
	N	137.0	174.0	113.0	120.0	115.0	659.0
4	Stunted	14.9	22.2	14.1	21.2	18.0	17.5
	Wasted	5.6	3.7	4.3	6.1	6.3	5.2
	N	161.0	108.0	163.0	99.0	128.0	659.0
5	Stunted	9.2	8.7	13.3	10.6	17.1	12.5
	Wasted	4.1	5.4	5.6	5.6	5.5	5.3
	N	98.0	92.0	143.0	142.0	181.0	656.0
ALL	Stunted	15.5	18.1	15.0	15.8	17.7	16.3
	Wasted	8.0	7.8	7.2	6.5	6.0	7.2
	N	696.0	630.0	754.0	628.0	583.0	3,291.0

a. Per capita expenditure classes correspond to the national figures in Table 2.

home consumption and malnutrition. This, however, is obviously not causal.

These problems of simultaneity and choice are especially severe concerning the discussion of income sources. However, the limitations of the descriptive analysis presented throughout this section revolves around the fact that correlation, or the lack thereof, is difficult to interpret. One should be careful not to draw any causal inferences from these relationships. Simply, the direction and degree of causation is not determinable without resorting to econometric analysis. Thus, the descriptive statistics provide only limited guidance into the consequences of various policies on nutritional status. The need for integrating these concerns into a more coherent model is manifest.

Notes

11. The fact that nutritional status varies markedly with the age of the child admonishes the analyst to examine the age structure of the population before presenting descriptive statistics such as nutritional status by region or by expenditures group. Doing so is necessary to ensure that the age composition of the populations are roughly comparable, and do not bias the results.

12. Per capita expenditures were deflated across communities and across survey rounds to account for spatial and temporal price differences. See Appendix A for a discussion of how the deflators were constructed.

13. This issue has been discussed at some length in terms of income-determined poverty measures by Sen (1976), Foster, Greer, and Thorbecke (1984), and most recently in context of Côte d'Ivoire, by Kanbur (1987).

14. The role of education in determining household expenditures is presented more precisely in the models in Appendix B.

5. Determinants of Nutritional Status

This section of the paper presents the econometric analysis of the determinants of nutritional status. Models are estimated separately for urban and rural areas, as well for the causation of previous and current malnutrition.

The model of nutritional status can be derived from the maximization of the following household utility function:

$$U = u(X, L, Q) \tag{1}$$

where X and L are the household's consumption of a composite good and leisure, respectively, and Q is the quality of children, to be represented by their nutritional status. The composite consumption good is derived from the vectors of the consumption expenditures of individual household members.[15] The assumption is that good nutrition, as represented by the vector of nutritional status of preschool-aged children, is desirable in its own right; and it is likewise assumed that households make consumption decisions on the basis of reasons other than nutrition (Pitt and Rosenzweig, 1985).

The utility function is maximized subject to several technology constraints. In addition, the reduced form functions, conditional on per capita expenditures, for each individual in the household can be represented as follows:

$$L_i = L(X, A_i, Z_i, C_i, e_i) \tag{2}$$

$$W_i = W(X, A_i, Z_i, C_i, e_i) \tag{3}$$

where L_i is long-term nutritional status of child i, W_i is short-term nutrition status, X is the household's per capita consumption expenditures, A_i is the vector of the individual's i's personal attributes that may influence his/her nutrition, Z_i and C_i are the vector of observable household and community characteristics, respectively, that may influence child i's nutrition, and e_i is the child-specific random disturbance term.[16]

In (2) and (3), we therefore estimate a reduced-form nutrition function conditional upon expenditures.[17] A problem with this formulation, however, is that consumption expenditures is endogenous to the model. In addition, it is a function of many of the same characteristics that simultaneously determine child growth. Therefore, this paper includes a linear combination of independent variables to explain household consumption expenditures. This procedure circumvents the potential problem of joint endogeneity of expenditures and nutritional outcomes. By instrumenting per capita consumption expenditures, one ensures that the expenditure parameter estimates and the standard errors are unbiased.

Results

The results are presented separately for the determinants of long-term (that is, chronic) malnutrition, and current (that is, acute) malnutrition. For each, a base model is presented for urban and rural areas. Then, a second set of models are shown that examine explicitly the non-linearities of education on nutrition and the interactions of education and income on nutritional status, as well as the effect of community characteristics in affecting levels of malnutrition. In addition, a third set of models is presented for rural areas only that looks at the impact of landholding and export cropping on nutritional status.

Long-Term/Chronic Malnutrition

The results of the nutritional status functions are reported in Table 8 for urban and rural areas with variable definitions, means, and standard deviation in Appendix Table B. The reduced-form models for consumption expenditures (that is, reduced-form human and physical capital functions) are reported in Appendix C.

First, and of greatest importance, is that in both rural and urban areas, Model I indicates that income is an

Table 8. Long-term/chronic nutrition functions

Independent Variables	Dependent Variable: Height-for-Age Z-Score									
	Urban – I		*Rural – I*		*Urban – II*		*Rural – II*		*Rural – III*	
	Parameter Estimate	*Standard Error*	*Parameter Estimate*	*Standard Error*	*Parameter Estimate*	*Standard Error*	*Parameter Estimate*	*Standard Error*	*Parameter Estimate*	*Standard Error*
Intercept	-18.665	2.244	-9.736	2.026	-18.464	2.690	-8.795	2.254	-8.440	2.377
Mother's height	5.899	0.996	3.761	0.866	5.724	1.001	3.645	0.889	3.157	0.921
Father's height	2.672	0.877	0.331	0.790	2.606	0.881	0.208	0.816	0.494	0.842
Female head dummy	0.666	0.712			0.659	0.712				
Child 0–6 month dummy	1.235	0.215	0.764	0.203	1.219	0.215	0.749	0.209	0.724	0.216
Child 7–12 month dummy	1.051	0.247	0.450	0.207	1.049	0.248	0.436	0.211	0.406	0.217
Child 25–36 month dummy	-0.307	0.194	-0.321	0.176	-0.325	0.194	-0.407	0.182	-0.441	0.188
Child 37–48 month dummy	-0.025	0.197	-0.107	0.181	-0.025	0.197	-0.130	0.186	-0.170	0.191
Child 49–60 month dummy	0.157	0.186	0.083	0.165	0.151	0.187	0.039	0.170	-0.027	0.175
January-March dummy	-0.383	0.179	-0.027	0.142	-0.401	0.180	-0.339	0.167	-0.353	0.169
April-June dummy	-0.239	0.188	0.150	0.166	-0.280	0.192	-0.074	0.174	-0.069	0.177
July-September dummy	-0.026	0.144	0.236	0.139	-0.044	0.144	-0.014	0.156	0.045	0.159
No. children 0–5 yrs	-0.053	0.050	0.122	0.048	-0.050	0.050	0.142	0.049	0.158	0.051
No. children 6–14 yrs	0.105	0.057	0.083	0.056	0.111	0.057	0.106	0.058	0.115	0.059
No. female > 14 yrs	0.076	0.047	0.001	0.053	0.070	0.047	0.024	0.054	0.008	0.055
Ln expenditures per capita	0.387	0.107	0.189	0.089	0.408	0.153	0.218	0.112	0.220	0.122
Child gender dummy var.	-0.237	0.111	-0.089	0.098	-0.249	0.111	-0.128	0.101	-0.142	0.104
Abidjan dummy var.	0.124	0.117			0.121	0.118				
1985 dummy var.	0.215	0.137	-0.129	0.119	0.230	0.138	-0.167	0.133	-0.164	0.139
Household size	-0.005	0.033	0.012	0.036	-0.005	0.033	0.002	0.037	0.015	0.038
Mother's age	-0.005	0.006	-0.001	0.004	-0.005	0.006	-0.003	0.004	-0.004	0.004
Birth order	-0.072	0.049	-0.050	0.044	-0.070	0.049	-0.059	0.046	-0.070	0.047
West Forest dummy var.			0.064	0.128			-0.142	0.132	-0.211	0.137
East Forest dummy var.			-0.051	0.135			-0.017	0.142	-0.151	0.160
Mother's education	0.009	0.018	0.036	0.031	-0.566	0.312	0.061	0.709	-0.413	0.806
Father's education	-0.026	0.015	-0.016	0.017	0.311	0.276	0.280	0.369	0.572	0.395
Mother's ed x Ln exp per capita					0.048	0.026	-0.021	0.060	0.021	0.067
Father's ed x Ln exp per capita					-0.031	0.024	-0.031	0.032	-0.059	0.034
$(\text{Mother's ed})^2$					-0.003	0.003	0.030	0.015	0.030	0.019
$(\text{Father's ed})^2$					0.004	0.003	0.008	0.005	0.011	0.005
Malaria									-0.350	0.228
Dysentery									-0.551	0.239
Chicken/smallpox/measles									0.406	0.152
Distance to doctor									-0.221	0.080
Nurse dummy									4.856	2.832
Nurse x Ln per capita exp.									-0.368	0.246
Land per capita									0.037	0.077
Export crop share									-0.002	0.003
	$R^2 = 0.1842$		$R^2 = 0.0697$		$R^2 = 0.1897$		$R^2 = 0.0991$		$R^2 = 0.1070$	

important determinant of long-term nutritional status. This is shown by the positive and significant parameter estimate indicating that as the expenditures of the household increase, so do the height-for-age Z-scores of the preschool-aged children. In rural areas, the magnitude of the significant expenditure coefficient is approximately half that in the urban areas. This indicates that expenditures play a less important role in rural areas in affecting nutritional outcomes. Among the bottom quintile of the income distribution, elasticities of height-for-age Z-scores with respect to income are 1.07 and 0.28 for children in urban and rural areas, respectively.

A second feature of these models is that once one controls for household income, mother's education has no measurably significant impact on the nutritional status of the child, although the sign of the coefficient is positive. In urban areas, increased schooling of the father exerts a negative influence on child nutrition, once again, controlling for the mediating role of income. These findings suggest that the schooling of the mother does not have an independent effect on long-term nutritional status, either through changing preferences or improving the productivity of household activities. Meanwhile, there is evidence of a deleterious impact of raising father's education, controlling for income. One plausible explanation for this finding is that education proxies for income control and bargaining power within the household, which determines how resources are spent and allocated. If male preferences tend toward expenditures on goods and services that are less beneficial to child nutrition (e.g., entertainment, clothing), in contrast to the choices that would be made by women, then it follows that increased male education, controlling for income, may adversely affect child nutrition. Of course, these findings on the relative benefits of male and female education do not imply that male education should not be promoted. The increased household income that accompanies paternal education will result in improved child nutrition.

Another noteworthy finding of the urban equations found in Table 8 is that the height of both the mother and father affect the stature of their preschool-aged offspring. While both parental stature coefficients are significant, the parameter estimate for the mother's height is more than twice the magnitude of the coefficient for the father's height. This suggests that the intergeneration link of stature is stronger for the mother than the father. This could be attributable to the fact that the maternal influence incorporates factors relating to phenotype (for example, the environment within the womb before birth), as well as genotype, while only the father's genotype has any influence on his offspring. In rural areas, the mother's height coefficient is smaller than that observed in the cities, but nonetheless highly significant. In contrast, in rural areas, the height of the father has no explanatory power in predicting a child's stature.

The household size variable was not significant in either the urban or rural areas. This suggests the absence of any economies-of-scale effect. It is interesting, however, that some of the household composition variables proved significant. Specifically, the rural model shows that the greater the number of children less than five years of age for a household of a given size and number of adults, the higher the height-for-age Z-score. This finding may seem counter-intuitive, given the expectation that there might be some competition for child care and attention between, say, a one-year-old and a three-year-old child, or vice versa. A plausible explanation for this finding is, however, that the greater the number of young children in any given size household, the greater the value of expenditures per adult equivalent unit. This would imply a greater availability of food and nonfood goods per child, and may contribute to improved long-term nutritional status.

In both urban and rural areas, there is a positive coefficient for the number of children 6–14 years of age; although it is not significant at $P < 0.1$ in rural areas. This finding likely reflects the fact that the presence of older siblings that are capable of providing some level of child care and nurturing but are too young to be working extensively in the labor market affords a degree of benefit to the preschoolers' long-term nutritional well-being.

In urban areas, but not rural areas, one finds that the greater the number of adult females for a household of a given size and composition, the greater the child's linear growth. It is hypothesized that this finding is partially a reflection of women exerting more control over expenditures, and that the child's nutritional welfare is more important in the preference ordering of urban women than men. Alternatively, however, this may simply reflect that women (like young children) "cost" less than men in terms of their consumption of food, clothing, and so on. It is noteworthy that the gender of the head of the household has no effect on the linear growth of children in urban areas.

The age of the mother serves as a proxy for experience in caring for a child. Maternal age is also expected to affect the birth outcome and birth weight, which is correlated with a young child's length-for-age. In both urban and rural areas, however, the coefficient proved insignificant.

Concerning the effect of the child's age, in both urban and rural areas, the coefficients on the dummy variables for children less than or equal to 6 months of age and 7–12 months are positive and significant. This can be explained by the fact that the accumulation of episodes of nutritional and health stress are less likely to manifest themselves in terms of stunting during a child's first year of life than between the ages of 13 and 24 months. The negative coefficient found on the dummy variable for children aged 25–36 months indicates that Z-scores for height-for-age are lowest among this age group. This reflects the acute periods of malnutrition suffered previously during the weaning period of 13–24 months of age, when infection and diarrheal disease are known to be most debilitating.

In urban and rural equations, the male dummy variable (that equals 1 if the child is a boy, and 0 if a girl), has a negative coefficient. It is, however, only significant in the urban equation. The fact that the height-for-age Z-score, and thus the long-term nutritional status, is lower for boys when controlling for other socioeconomic variables, supports the conclusions of Svedberg's (1988) recent review of the literature that finds little evidence of discrimination against female children in Africa, unlike in Southeast Asia.[18]

The effect of birth order on previous malnutrition as measured in terms of linear growth was also examined. In both rural and urban areas, the parameter estimate is negative, but only significant at the 10 percent level in urban areas. Seasons also play a role in terms of predicting height-for-age Z-scores. This is in accordance with the evidence that linear growth does display seasonal cycles (Payne, 1989).

The basic model described above was expanded in our search for non-linearities and interactions between variables, as well as the effect of community-level variables on child nutrition. More specifically, a quadratic term for education and an interaction term between education and income were included in a second model.[19] Concerning the impact of community variables, these data were taken from a separate community-level questionnaire administered only in the rural areas. They assist in providing some insight into the effect of regional factors and community services on nutrition.

The results of Model II indicate that the income terms in urban and rural areas remain significant. In fact, the parameter estimates are slightly higher, yielding elasticities of height-for-age Z-score with respect to income of 1.12 and 0.33 for urban and rural households, respectively, in the bottom income quintile. In urban areas the interaction term between income and mother's education is significant and positive, implying that income brings higher returns in terms of improved nutrition when the mother has more education, and/or that the positive impact of education is greater among households with more income. The fact that the coefficient for mother's schooling changes sign from Model I, and is significant should not be interpreted as more education leading to worse nutrition. Rather, this switch simply reflects the inclusion of the interaction term. When the total derivative is taken, it is positive over most of the relevant range of urban households, although the positive effect of education becomes negligible among households at the bottom end of the income distribution. These female education and education interaction terms, however, are not jointly significant at standard levels, although the male education variables are jointly significant at the 0.15 level (F equal to 1.91).

In rural areas, the fit of the expanded model is an improvement. Among the community-level characteristics, the negative and significant malaria and dysentery variables indicate that children are likely to suffer less stunting in villages where these diseases were not reported to be serious health problems.[20] The surprising positive coefficient for the smallpox/chickenpox/measles variable is difficult to explain. One potential reason may revolve around the fact that since the variable included smallpox, it may be that those villages with greater health awareness are cognizant of the potential threat that smallpox used to represent. An alternative explanation is that if chickenpox/smallpox/measles are among the most serious health problems, by implication others are not. Compared with the chronic episodes of dysentery and malaria, one-off episodes of smallpox/chickenpox/measles may be less likely to affect the long-term nutritional status of preschool-aged children.

Also in keeping with expectations, the negative and significant result for the distance to the doctor variable indicates that the more distant such medical services, the lower the height-for-age Z-score. Similarly, the dummy variable for whether there is a nurse in the village has a positive coefficient, indicating that a nurse's presence might be expected to improve long-term child nutrition. Interestingly, the negative interaction term between nurse and expenditures also suggests that for wealthier households, the presence of a nurse in the village is not as important as for households in the lower end of the income distribution. The nurse and nurse multiplicative interaction term with expenditures are jointly significant with a p-value less than 0.0001, as are all the community-level variables combined.

The addition of the quadratic schooling and interaction terms with education resulted in the quadratic term for mother's education being positive and significant at the 0.05 level. This suggests a non-linear relationship between mother's education and long-term malnutrition in rural areas where there is an increasingly positive return to mother's school with more education. However, the education and education interaction terms for both mothers and fathers were not jointly significant at standard levels.

Next, a third model is run for rural areas only, adding two more variables: per capita landholdings and the share of land devoted to the production of the major export crops—coffee, cocoa, and tobacco—as well as the less important cola nut and tobacco. In the case of perennial crops, such as coffee and cocoa, the land allocated to these crops is not subject to year-to-year changes such as for field crops. Consequently, the land use variable is considered exogenous. With the inclusion of the per capita landholding variable, which controls for farm size, it is possible to test whether there is a deleterious impact on nutritional status of producing export, rather than domestically consumed food crops.

The results indicate that neither the landholding per capita nor the share of the household's land devoted to the production of the major export crops are significant in the long-term nutrition functions. This supports the descriptive data presented above, indicating that the use of land for producing export crops, rather than food crops, will not affect the long-term nutritional status of preschool-aged children.[21]

Current Malnutrition

The determinants of current nutritional status, or wasting, among preschool-aged children are expected to be more difficult to capture in a model because of the stochastic nature of episodes of stress and disease that precipitate acute malnutrition. Nevertheless, current nutritional status functions are presented in Table 9.

The results indicate that the income parameter, although positive, is not statistically significant in either the urban or rural areas. The variable for mother's schooling is positive and significant, indicating that unlike for long-term or previous malnutrition, the education of the mother enhances the nature of preferences and decisions in such a way as to raise the child's current nutritional status in urban and rural areas. This supports the hypothesis that the education of women has a greater positive effect on the nutrition of children as mediated through their greater efficiency in household productive activities.[22]

The higher parameter value in the rural equations indicates that mother's education will have a stronger effect in rural than in urban areas. At the same time, the education of the father shows no effect on child nutrition in either urban or rural areas.

Among other noteworthy findings is the influence of mother's height, which is negative and significant in urban areas, and father's height, which is negative and significant in rural areas. The indication that children of taller mothers/fathers will be more lean and at greater likelihood of being characterized as currently malnourished needs to be carefully assessed. The question arises as to whether children are misclassified as currently malnourished because of their genetic propensity for being tall and lean, and in fact do not suffer some functional impairment because of their relatively low proportionate weight-for-height. This issue needs to be the focus for further research.

As with the height-for-age regressions in both urban and rural areas, household size plays no role in affecting current nutritional status when controlling for the household structure. There is also some tentative support for the hypothesis that as with the height-for-age equations for a given household size, the greater the number of women over the age of 14, and perforce the fewer men, the higher the weight-for-age Z-score of the child. In addition, there is a positive and significant coefficient in rural areas for the number of children between 6 and 14 years of age. This corresponds to what was observed in the long-term nutrition production functions, further reinforcing the notion that older siblings provide valuable child care for preschool-aged children.

Concerning other household structure and demographic variables, as with long-term nutrition, the age of the mother has no effect on a child's current nutrition. And likewise, the dummy variable for female-headed households is not significant in the urban current nutrition functions.

The age of a child is an important determinant of the weight-for-height Z-score. In both urban and rural areas, children 0–6 months and 2–4 years of age have better current nutritional status than children between 13 and 24 months, the vulnerable weaning period.

Unlike for chronic malnutrition, the gender of the child does not play a role in affecting the level of wasting. The child's birth order variable is negative in both urban and rural areas, although not significant in urban areas. As in the case of long-term nutrition, this reinforces that children in earlier sibling positions are advantaged, relative to brothers and sisters that are born later.

As with the long-term nutrition function, the expanded models of current malnutrition are presented. The community-level variables indicate once again the importance of malaria in the village as a determinant of preschool-aged malnutrition. The chickenpox/smallpox/measles indicator takes on the expected statistically significant negative sign, reflecting how the occurrence of such a disease in the community may have deleterious short-term nutritional impacts. The insignificant dysentery variable is difficult to explain. Once again the distance to the doctor

Table 9. Current nutrition functions

Independent Variables	Dependent Variable: *Weight-for-Height Z-Score*									
	Urban – I		*Rural – I*		*Urban – II*		*Rural – II*		*Rural – III*	
	Parameter Estimate	*Standard Error*	*Parameter Estimate*	*Standard Error*	*Parameter Estimate*	*Standard Error*	*Parameter Estimate*	*Standard Error*	*Parameter Estimate*	*Standard Error*
Intercept	0.838	1.639	0.900	1.432	1.081	1.966	1.245	1.615	1.693	1.701
Mother's height	-1.277	0.727	0.100	0.612	-1.225	0.732	0.021	0.638	-0.153	0.660
Father's height	-0.082	0.644	-1.093	0.559	-0.049	0.648	-0.905	0.585	-1.013	0.603
Female head dummy	-0.244	0.519			-0.259	0.520				
Child 0–6 months dummy	0.598	0.159	0.759	0.145	0.609	0.159	0.761	0.152	0.795	0.157
Child 7–12 months dummy	0.221	0.180	-0.143	0.146	0.214	0.181	-0.147	0.151	-0.144	0.155
Child 25–36 months dummy	0.272	0.142	0.571	0.124	0.283	0.142	0.547	0.130	0.586	0.135
Child 37–48 months dummy	0.400	0.143	0.551	0.128	0.402	0.144	0.539	0.133	0.569	0.137
Child 49–60 months dummy	0.292	0.136	0.482	0.117	0.292	0.136	0.475	0.122	0.497	0.125
January-March dummy	0.289	0.131	-0.063	0.100	0.281	0.132	-0.032	0.119	-0.019	0.121
April-June dummy	0.074	0.137	-0.066	0.117	0.096	0.140	-0.006	0.124	0.048	0.127
July-September dummy	-0.003	0.105	-0.007	0.098	0.008	0.106	0.062	0.111	0.079	0.114
No. children 0–5 yrs	-0.010	0.037	0.032	0.034	-0.014	0.037	0.034	0.035	0.023	0.036
No. children 5–14 yrs	-0.004	0.042	0.103	0.039	-0.009	0.042	0.101	0.041	0.114	0.042
No. female > 14 yrs	0.051	0.035	0.054	0.038	0.054	0.035	0.074	0.039	0.075	0.039
Ln expenditures per capita	0.073	0.078	0.029	0.063	0.036	0.112	0.023	0.080	0.025	0.087
Child gender dummy var.	0.119	0.081	-0.066	0.069	0.123	0.081	-0.099	0.072	-0.125	0.074
Abidjan dummy var.	-0.296	0.086			-0.290	0.086				
1985 dummy var.	-0.136	0.100	0.395	0.084	-0.142	0.101	0.343	0.095	0.321	0.100
Household size	-0.003	0.024	-0.031	0.026	-0.002	0.024	-0.031	0.027	-0.034	0.027
Mother's age	-0.002	0.004	0.000	0.003	-0.002	0.004	0.002	0.003	0.003	0.003
Birth order	-0.026	0.036	-0.063	0.031	-0.025	0.036	-0.068	0.033	-0.072	0.034
West Forest dummy var.			-0.429	0.090			-0.473	0.095	-0.412	0.098
East Forest dummy var.			-0.412	0.095			-0.386	0.102	-0.284	0.115
Mother's education	0.028	0.013	0.039	0.022	0.070	0.228	0.539	0.508	0.431	0.593
Father's education	-0.005	0.011	0.003	0.012	-0.098	0.202	-0.185	0.264	-0.383	0.284
Mother's ed x Ln exp per capita					-0.003	0.019	-0.032	0.043	-0.021	0.049
Father's ed x Ln exp per capita					0.011	0.017	0.013	0.023	0.029	0.025
$(\text{Mother's ed})^2$					-0.000	0.002	-0.020	0.011	-0.023	0.013
$(\text{Father's ed})^2$					-0.003	0.002	0.004	0.004	0.005	0.004
Malaria									-0.569	0.164
Dysentery									0.238	0.171
Chicken/smallpox/measles									-0.285	0.109
Distance to doctor									-0.149	0.057
Nurse dummy									1.136	2.041
Nurse x Ln per capita exp.									-0.082	0.177
Land per capita									-0.120	0.055
Export crop share									0.002	0.002
	$R^2 = 0.0621$		$R^2 = 0.1046$		$R^2 = 0.0665$		$R^2 = 0.1347$		$R^2 = 0.1440$	

is negative and significant, indicating the importance of access to medical care as a determinant of current nutritional status. The nurse dummy variable and interaction term with income, although not significant, have the same signs as they did for the height-for-age equation. They are jointly significant at the 0.15 level. In total, the community level variables are jointly significant at the 0.0001 level with an F-statistic equal to 6.93.

The interaction terms between education and income prove insignificant. The significant and negative quadratic term for mother's education in rural areas implies that in contrast to the long-term nutrition functions, the positive effect of mother's schooling on nutrition diminishes as the level of educational achievement rises. The mother's education and education interaction terms are jointly significant for weight-for-height at the 0.15 level (F equal to 1.89), although this was not the case for the male education variables.

In rural areas, Model III, which includes landholding variables, indicates that the share of cash crops in total hectarage cultivated will not have any impact on nutritional status. However, the per capita landholding variable was significant and negative in this model of current malnutrition. This suggests that among households with comparable income, the more land under cultivation, the worse the current nutritional status of the child. While at first glance this may be considered counterintuitive, one can formulate a reasonable hypothesis explaining the negative parameter estimate. A larger amount of land under cultivation undoubtedly involves more time spent in agricultural activities, especially among women, and perforce, less time for child nurturing and related household production activities such as food preparation. This may result in less or poorer quality child care, thereby leading to more current malnutrition. An alternative explanation for this finding is that, controlling for income, households with a higher share from agriculture may be at greater nutritional risk as a consequence of the lumpy nature of agricultural incomes and the difficulties in intertemporal savings.

Notes

15. Consumption expenditures are defined as the sum of food and nonfood expenditures, the value of goods produced and consumed by the household, the imputed value of durable goods owned by the household, and the actual or imputed rents of urban residents. In addition, consumption expenditures are in real terms, with nominal values deflated by the cluster-specific price index. Consumption expenditures are considered the best possible measure of household permanent income, and similarly, the household's unobservable utility.

16. The model does not include commodity prices, which could cause a bias if the omitted prices are associated with any of the included variables. This is because many of the prices used to deflate expenditures were predicted, or derived from cell means, and not observed. While using such information as the basis for constructing deflators for the cross tabulations presented earlier is reasonable, the use of these predicted prices as regressors in an econometric model was not considered to be justified. Furthermore, the effect of prices on nutrition would be limited to differences in relative prices inducing different patterns of expenditures. Given that rural and urban models are estimated separately, and both include seasonal, regional, and round dummy variables, it is likely that most of the relative price differences have been captured. In addition, the price of leisure or the imputed wage rate is not included in the models. This despite that it was included in the community-level questionnaire. However, it was felt asking one person in a village, at one season, for the prevailing agricultural wage, results in a suspect representation of the opportunity cost of time. Furthermore, only a couple percent of the rural working age population reported performing wage labor, precluding estimating a wage function, and suggesting that rural wage labor markets, if they exist, are extremely thin.

17. The theory of conditional demand functions in consumer behavior is discussed in Pollack (1969), where he shows that conditional demand functions meet all the requirements satisfied by ordinary demand functions.

18. To the extent that the NCHS standards are wrong (that is, if there is a systematic gender bias in the reference population but not in the observations), this finding would not be valid. However, the evidence as put forth in Habicht (1974) and Martorell and Habicht (1986) provides some confidence in the use of the NCHS standards for comparisons across ethnic groups.

19. It is noteworthy that an attempt was made to introduce a quadratic and cubic income term into Models I and II. In both cases, it only resulted in increased multicollinearity and insignificant parameter estimates.

20. The community-level questionnaire asked for a listing of the four major health problems. If malaria was given as the most serious, or second most serious health problem in the village, it was coded as a 1, and otherwise 0. The same procedure was employed for dysentery and smallpox/chickenpox/measles, the latter group of diseases that were all coded together.

21. A similar model was estimated including an interaction term between the share of land devoted to export crops and per capita expenditures. The variable proved insignificant.

22. An alternative explanation for such a finding is that women are able to exert more influence in the household decision making process since better education improves their intrahousehold bargaining power. Of course, this is predicated on women having a different preference ordering from their spouse, one which tends to favor the current nutrition of their children. As indicated by Rosenzweig and Schultz (1983), it is difficult to distinguish between the alternative hypotheses. A recent paper by Thomas (1989) attempts to look upon this issue by examining whether the effect of income under the control of different households members is the same in terms of nutrient intakes, fertility, child survival, weight-for-height, and height-for-age. While his results reject the suggestion that all income is pooled or allocated by a dictator, for all but height-for-age, the results need to be interpreted with caution since there is a strong assumption that current unearned income does not reflect past labor supply decisions.

6. Conclusions

This paper has examined the extent of malnutrition in Côte d'Ivoire and the determinants of long-term and current nutritional status among preschool-aged children. The most important finding of this work is that the levels of both long-term and current malnutrition are low relative to survey data from other Sub-Saharan African nations. This is indicative of a combination of relatively good access to food (that is, household food security) and low levels of debilitating disease. Nonetheless, there remains ample opportunity to improve the nutritional status of the 16.2 percent of the children that are stunted and 7.1 percent of the children that are wasted.

Raising expenditure levels is the key element to any effort to reduce chronic malnutrition. In the longer term, expenditure levels will be raised by increasing the assets of the household (for example, land, equipment, business assets), and raising their productivity through education. In the shorter term, whether it be through income transfer schemes or employment generation projects, targeted efforts to increase incomes of poor households will also go a long way toward alleviating chronic nutritional problems.

While income is of considerable importance in reducing long-term malnutrition, a number of other factors contribute to the problem. In particular, the results suggest that the education of women plays an important role in improving a child's long-term nutritional status, as well as in equipping mothers to avoid and/or cope with crises that may precipitate acute periods of nutritional stress (that is, current malnutrition). These influences are over and above the fact that better-educated women (like men) have higher earnings that tend to raise incomes and nutritional status.

Controlling for household incomes, the observed positive effect of the education of women on current nutritional status was not observed for men. This likely reflects that the mother is the key household member concerned with health-related decisions and implementation. More education will consequently improve the mother's knowledge and health practices and have a greater impact on child nutrition (e.g., because they are more likely to use oral rehydration techniques, or prepare more nutritious weaning foods [Behrman, 1988]). In addition, to the extent that education is a proxy for income control, and that women's preferences are more oriented toward purchasing goods and services that are inputs into good nutrition, this too could explain both the positive effect of maternal education on current nutrition, and the fact that father's education appears to be a risk factor for long-term malnutrition in urban areas, controlling for household incomes.

Exploring non-linearities in the role of education and the interactions between education and expenditures provided no generalizable patterns. For example, increasing returns to education of women in rural areas were noted for long-term nutrition, while just the opposite was found for current nutrition. Similarly, for long-term nutritional status, evidence that mothers' education is more important for households with higher income was noted only in urban areas.

In sum, it is therefore inferred that a higher educational attainment of the mother improves the productivity of household activities, such as child care, and improves the quality of decisions that fall in the women's domain concerning the choice of food and other inputs that contribute to good nutrition. Since men do not assume primary responsibility for child care, improving their knowledge does not contribute directly to better nutritional outcomes. A related potential explanation for the positive effect of the mother's, but not the father's, education is that education proxies for authority over the expenditure of household resources. Consequently, if a woman is better educated, she may exert more control over decisions in such a way as to favor nutrition, assuming her preference function differs from that of her spouse. This latter explanation finds some additional support in the fact that many of the nutrition production functions indicate that the larger the proportion of women in a household (of a given size and age composition), the better the nutritional status of the child.

This being said, the evidence does indicate that there are positive effects of the father's and mother's education as mediated through income. In addition, the observation that women's education is more beneficial than men's education when controlling for expenditure levels must be tempered by the fact that the gross returns to education among men are higher than for women (see Appendix B). Therefore, the vital role of raising the education of men in order to increase household income levels must not be overlooked.

It is also important to emphasize that nonformal education, especially for women, will also likely contribute to improved child nutrition. Experiences from other countries especially in Asia illustrate the benefits of nutrition education messages, targeted to the poor and designed to elicit a response to a carefully crafted and delivered message (Griffiths, 1985; Berg, 1987). This paper also amply illustrated the importance of community characteristics as determinants of malnutrition. For example, both height-for-age and weight-for-height Z-scores are lower in communities where malaria is a serious health problem, where doctors are a greater distance from the community, and where nurses are absent. Therefore, investments in health infrastructure that reduce the prevalence of diseases such as malaria and dysentery, and similarly improve the availability of health care personnel offers a fruitful avenue for improving child nutrition.

While household size showed no effect on nutritional status, birth order was an important causal element of malnutrition. The results reinforce the need for family planning programs and fertility reduction measures, such as breastfeeding, to address the nutritional problems associated with later-born siblings. And these positive effects do not include the fact that higher per capita expenditure levels will likely also follow from fewer children.

The role of intergenerational influences in determining nutritional status was also highlighted. The observation that mother's height has a greater impact on child nutrition indicates that it is not just genetics but also the mother's phenotype and/or human capital accumulation that condition nutritional outcomes. These intergenerational determinants of malnutrition focus attention on the long-term consequences of neglecting human resources in the short term.

This paper also explored whether allocating land to export crops, rather than food crops that may either be marketing or consumed at home, has a deleterious impact on nutritional status of preschool-aged children. Doing so has important implications of a strategy of agricultural development based on exploiting comparative advantage through increasing incentives for producing the dominant export crops. Controlling for the total value of household income in cash and in-kind, and per capita landholding, there was no indication that the household's decision to allocate land to the production of major export crops, as an alternative to producing food crops for domestic consumption, represents a short-term nutritional risk factor. This suggests that liberalizing prices and removing distortions that will encourage agricultural growth will improve nutritional status, even though such a move implies favoring the production of highly taxed export rather than food crops. While the objective of food self-sufficiency is still within the grasp of Côte d'Ivoire, any effort to achieve that objective must be carefully weighed against the economic costs of the sub-optimal use of valuable resources. Given that households who choose to grow export crops do not manifest a higher probability of their children being malnourished, there is a strong argument for Côte d'Ivoire's following a development strategy that focuses on growth in incomes and improving returns to factors, even if it be at the cost of food self-sufficiency.

The fact that the survey data did not include any information on consumption and that the commodity price data were limited and of suspect quality, detracts from exploring the impact of price policy on nutrition, either directly through effecting commodity choice, or indirectly through the effect on real earnings. Likewise, the potential benefits of improving the efficiency of commodity markets cannot be examined. Thus, the role of a variety of policy instruments on nutrition, such as real exchange rate depreciation that alters relative prices, cannot be determined. Likewise, the absence of consumption data precludes relating nutritional status to household food security concerns that revolve around access to adequate food.

Despite these drawbacks, this paper generally supports the contention that malnutrition is a problem of poverty; and any policies that either reduce the incomes of the poor or result in less availability of social services, especially in the areas of primary health care and primary school, will have immediate and long-term deleterious impacts on the nutritional welfare of children.

This being said, waiting for economic growth to reduce malnutrition likely represents an unacceptably long time horizon. Experiences from other countries indicate that targeted programs, whether they be in the domain of food distribution, income augmenting measures, and/or primary health care, can raise nutrition levels of children even in the face of a stagnant economic environment. Therefore, more immediate targeted action is necessary. This, of course, requires expanding institutional capacity to plan projects and deliver services, a costly challenge in its own right. But if such development is possible anywhere in Africa, the circumstances in Côte d'Ivoire are most amenable to such institution building.

Appendix A
Price Index

In order to address the problem of comparing household expenditures across survey rounds (that is, years) and regions, a price index was formulated. The deflators were constructed from price data collected by enumerators in the form of a community questionnaire that was administered in the clusters in which the household survey was undertaken. The index took the following form:

$$I_{ijk} = \frac{\Sigma_{ijk} \; (P_{ijk} * W_i)}{\Sigma_i \; (P_i * W_i)}$$

where P_i corresponds to the mean price of commodity i across all clusters and both survey rounds, W_i represents the mean food share expended on that commodity across clusters and survey rounds, and P_{ijk} is the price paid for commodity i, in region j in round k.

The community questionnaire included a list of 18 food commodities and 4 nonfood commodities on which the surveyor was instructed to seek three representative retail prices. In many instances, however, none, one, or two prices were recorded for a commodity in a given community. When only one price was available from the community questionnaire for a given commodity, it was used in constructing a price index. When two or three prices were recorded, the mean value was employed.

For a number of commodities, in a number of clusters in any given round, there were no prices reported in the community questionnaire. In order to arrive at the most accurate index numbers, an econometric model was employed to predict commodity prices based on a variety of community-level and temporal characteristics. Included as regressors were the following: population size; the level of concentration of hamlets; and a series of dummy variables that equaled 1 if (a) the community was served by a paved road, (b) there was a market place, (c) there was public transportation, (d) there was a passable road, (e) people migrate out of the community in search of work, and (f) people migrate into the village in search of work. In addition, seasonal and yearly dummy variables were included, as well as dummy variables for agricultural zones. In combination, these variables reflected the level of market integration and sectoral and temporal factors that are expected to affect commodity prices.

This model was run for all the commodities included in the index, both by individual year and across the two rounds. In the latter case, an additional dummy variable for round was included. When the models were significant, predicted values were compared with actual prices in those clusters in which prices were recorded in the community questionnaire. If the predictions were accurate, and the correlation between predicted and actual prices high, the prices predicted from the model were used to fill in missing prices, although reported prices were used when available.

In some cases, however, the prediction equations were not significant and/or the comparison of predicted and actual values raised some suspicion as to the accuracy of the model. In such a case, the mean price for the region and round (that is, Abidjan, Other Cities, West Forest, East Forest, and Savannah) was inserted to fill in missing values.

Owing to the small number of nonfood items (that is, cloth, enamel bowl, menthol, and sandals) included in the community questionnaire, coupled with the large number of missing values and large variance in reported values likely due to the nonhomogeneity of the product, the deflators employed were based on food prices only. Food makes up approximately 55 percent of the average household expenditures. The absence of any reliable nonfood price data in the survey has the obvious disadvantage of running the risk of the deflators for urban areas being too high. However, food prices, in general, are not markedly higher in the urban market—that is likely because the flow of goods produced in rural areas is often into market centers, and then once again out to thinner rural markets.

To determine whether the use of the deflators affected the results, sensitivity analysis was employed using non-deflated values. The descriptive data changed slightly, especially when comparing results across sectors where deflators are most variable. Most important were the changes in the Savannah where food prices are markedly below the national average. The econometric results presented in the paper were unaffected by the use of the deflated values.

Appendix B
Variable Means and Standard Deviation

Appendix Table B. Variable means and standard deviation

	Urban		*Rural*	
Independent Variables	*Mean*	*Standard Deviation*	*Mean*	*Standard Deviation*
Weight-for-height	-0.38	1.15	-0.22	1.31
Height-for-age	-0.16	1.66	-0.51	1.83
Ln of per capita expenditure	12.11	0.67	11.60	0.59
Father's education	5.26	5.84	2.45	4.08
Mother's education	3.21	4.44	1.13	2.53
Father's height (meters)	1.70	0.06	1.68	0.07
Mother's height (meters)	1.60	0.06	1.59	0.06
Household size	11.83	6.50	11.79	5.39
No. children 0-5 yrs	2.97	1.86	3.29	1.73
No. children 6-14 yrs	3.28	2.60	3.14	2.22
No. females > 14 yrs	3.03	2.10	3.15	1.86
Birth order	6.18	3.95	5.99	3.29
Mother's age	28.48	10.75	29.29	13.39
Father's age	31.95	13.57	35.61	15.54
Ln of value of housing (CFA)	6.91	7.33		
Ln of business assets (CFA)	7.20	6.35	3.13	5.07
Ln of value of land (CFA)			13.52	3.21
Ln of value of tools (CFA)			10.40	2.12
Ln of value of equipment (CFA)			2.98	4.88
Malaria			0.07	0.27
Dysentery			0.05	0.22
Chicken/smallpox/measles			0.19	0.22
Ln distance to doctor			3.08	0.74
Nurse			0.26	0.44

Appendix C
Reduced-form Human and Physical Capital Models

Appendix Table C contains the results of the second stage estimates of the reduced-form human and physical capital functions where the dependent variable is the natural log of expenditures. They represent the second stage of a two-staged least squares procedure used to generate the results found in Tables 1 and 2. The reduced-form models are similar in parameters to the human welfare functions estimated for Côte d'Ivoire by Glewwe (1987).

Despite the fact that the purpose of this paper is not to address issues regarding the returns to physical assets and human capital, a few highlights are worth emphasizing. First, the gross returns to education are positive for men and women in urban areas, and they increase with more schooling. Second, the returns are greater for men than women in urban areas, and the rate of increase in the marginal returns is also higher. In rural areas, there is no evidence of positive returns to women's education, and once again the returns to education for men increase with additional schooling. For men with only a couple of years of schooling, the marginal effect on income appears to be negative, although this likely reflects the limited curvature in the function estimated.

Another point is that the age coefficient, a proxy for experience, was not significant. And finally concerning assets, the returns to business assets are positive in both urban and rural areas, with their being greater in rural areas; and there are positive returns to assets in the form of equipment and land in rural areas, but not tools.

Appendix Table C. Second stage reduced-form consumption expenditure function

	Dependent Variable: Log of Expenditures			
	Urban		*Rural*	
Independent Variables	*Parameter Estimate*	*Standard Error*	*Parameter Estimate*	*Standard Error*
Intercept	12.044	0.091	11.848	0.103
Mother's age	0.002	0.002	-0.002	0.001
Father's age	0.001	0.001	-0.000	0.001
Household size	-0.050	0.058	0.068	0.059
Ivorian dummy	-0.247	0.046	-0.073	0.046
Abidjan dummy	-0.001	0.039		
East Forest dummy			-0.019	0.039
West Forest dummy			-0.080	0.048
Mother's education	0.017	0.012	0.004	0.032
Father's education	0.031	0.010	-0.029	0.015
(Mother's ed)^2	0.001	0.001	0.000	0.005
(Father's ed)^2	0.002	0.001	0.004	0.001
Ln of value of housing	0.008	0.003		
Ln of value of tools			-0.057	0.014
Ln of business assets	0.014	0.003	0.026	0.003
Ln of value of equipment			0.017	0.003
Ln of value of land			0.045	0.010
No. children 0-5 yrs	0.008	0.059	-0.130	0.058
No. children 6-14 yrs	0.031	0.060	-0.078	0.059
No. males > 15 yrs	0.045	0.060	-0.086	0.061
No. females > 15 yrs	0.025	0.061	-0.079	0.062
1985 dummy	-0.177	0.040	-0.051	0.037
	$R^2 = 0.4744$		$R^2 = 0.1633$	

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