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Poverty and nutrition: A case study of rural households in Thailand and Viet Nam

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POVERTY AND NUTRITION: A CASE STUDY OF RURAL HOUSEHOLDS IN THAILAND AND VIET NAM

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Abstract

In this paper, we analyze the link between nutrition and poverty in two Asian countries where monetary-based poverty reduction was especially successful. Thailand and Viet Nam are two emerging market economies where poverty rates are now below 10% and are declining further. Despite this success, it is not clear to what extent this success has translated into similar improvements in the nutritional situation of the people and especially of children. We find that undernutrition continues to be a problem in Viet Nam with child underweight rates of 27% and therefore higher than headcount rates of the \$1.25 poverty line. Also, Thailand, after the economic crisis, with 19% of children underweight, is still above the World Health Organization's threshold. We investigate the factors that influence nutrition outcomes, measured as Z-scores of the weight-for-age indicator, by using Tobit regressions for four different groups of children, based on income (poor vs. non-poor) and nutrition (underweight vs. non-underweight). We find that poverty and income influence nutrition outcomes, but other factors such as mother's height, education, migration and sanitation also affect nutrition. Coefficients of respective variables differ by poverty status. Our conclusion that non-monetary factors matter to reduce undernutrition, and, therefore, monetary poverty reduction is not a sufficient condition, is further underlined by a prediction of future undernutrition rates based on regressions. Also, we find that, even under the assumption of high growth, income growth alone will not be able to reduce undernutrition to a level of low severity until the year 2030.

JEL Classification: I31, I32, O10

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1. INTRODUCTION

Asian countries have made significant progress in poverty reduction in the past twenty years. This has been largely due to economic growth and direct measures for poverty reduction. The optimistic view is that poverty in Asia may soon come to an end. There are at least two reasons to be more careful in this prediction. First, the headcount ratio as a static poverty measure does not allow any conclusion about the risk of people falling back into poverty, i.e., their vulnerability to poverty (Klasen and Waibel 2013). In the past, economic, ecological and political shocks have been responsible for many people falling back into poverty. Examples are the financial, economic and food-price crisis that hit Asian countries in 2008. Second, it is perhaps much too early to declare victory on the poverty front in Asia because monetary poverty is only one of the several dimensions of poverty. Education, health and nutrition, e.g., are other poverty dimensions that need to be taken into account (Carter and Barrett 2006; Clark and Hulme 2010; Sen 2000; Tsui 2002). Several studies have demonstrated that the correlation between monetary and non-monetary poverty is low (Baulch and Masset 2003; Günther and Klasen 2009; McKay and Lawson 2003).

Clearly one of these dimensions is nutrition. The global food-price crisis reminded the development community that food security remains a global concern. The number of undernourished people in the world recently passed beyond one billion, the majority of whom belong to Asia. In this paper, we analyze the link between nutrition and poverty in two Asian countries where monetary-based poverty reduction was especially successful, namely Thailand and Viet Nam, two emerging market economies where poverty rates are now below 10% and are declining further. Despite this success, it is not so clear to what extent this success has translated into similar improvements in the nutritional situation of the people, especially of children. The analysis in this paper is concentrated on the rural population in these two countries. We have panel data on basically all aspects of household livelihoods including food consumption and we have a set of anthropometric data for all household members including mothers and their children.

Specifically, we address the following questions:

1. Is there still a nutrition problem in Thailand and Viet Nam in spite of the progress made in poverty reduction?
2. What are the factors that condition the nutritional status of children and adults in rural areas of these two countries?
3. What are the factors that influence nutrition outcomes as households depart from the monetary poverty line?
4. What is the time horizon to reach the end of malnutrition under different income growth scenarios?

The paper proceeds as follows. In Section 2, the conceptual framework is introduced which outlines the measures and the econometric model used in this paper. In Section 3, a description of the data is presented. In Section 4, the empirical results and a prediction of nutrition outcomes are shown. Finally, Section 5 summarizes and concludes.

2. CONCEPTUAL FRAMEWORK

In this section, we establish the conceptual basis for this study. We introduce three aspects necessary to analyze the relationship between nutrition and poverty. First, we define the most common measures of nutrition to identify the nutrition outcome variables. Second, we discuss the direction of influence between wealth and nutrition by reviewing relevant literature. Third, we identify the main variables that have been used in models that aim to explain the change in the nutritional status of people in developing countries.

The nutritional status of a population is often measured using anthropometric indicators, mostly for children below the age of five. For example, in the Millennium Development Goals underweight of children is one of the indicators for hunger. Stunting and wasting of children are indicators for the World Health Organization's (WHO) Global Targets 2025. Also, the largest share of scientific publications on malnutrition concentrates on children below five years of age. There are several reasons for this choice of indicators. First, for children, even short periods of undernutrition can cause long-lasting and irreversible damage. Child malnutrition can lead to low cognitive outcomes and, therefore, to lower productivity even when they become adults. Second, children's bodies react faster to changes in the food supply and food shortages manifest faster in their weight and height than for adults. Therefore, the nutritional status of children below five years is a good proxy for the current nutritional situation of a population. However, only a share of households has children below five years. For a complete picture of the nutritional status of a population, indicators for adults should be included even if adults are less vulnerable to short-term food shortages.

The most commonly-used anthropometric measures to describe the nutritional status of a population are weight and height. For children, the parameters are related to age [see (a)–(d)] whereas, for adults, the body mass index (e) is the only measure of those listed below:

- (a) Weight-for-age (WFA);
- (b) Height-for-age (HFA);
- (c) Weight-for-height (WFH);
- (d) Body Mass Index (BMI) for age (for children); and
- (e) Body Mass Index (BMI) for adults.

WFA is an indicator of *underweight*; HFA is an expression of *stunting*; WFH is called *wasting*; and the BMI is a measure for *underweight*, generally used for adults, but also for children. All five indicators are used as proxies of undernutrition relative to defined threshold values. The most commonly-used measure is weight-for-age (WHO Working Group 1986), which is used, e.g., in the Millennium Development Goals, because it reveals both, acute and chronic, malnutrition (de Onis and Blössner 2003). Stunted growth, which means low height relative to age (HFA), is an indicator for chronic malnutrition and early childhood illnesses. WFH is regarded as an indicator for acute undernutrition because weight can drop rapidly in cases of acute food shortages whereas height is unaffected by short-time changes in food supply. For adults, BMI is the most widely-used indicator, measuring the current nutritional status; for children, reference standards and cut-offs for BMI-for-age have only recently been developed and are not yet that widely used (Cole, et al. 2007).

Statistically, child undernutrition is measured using growth data in comparison with an international healthy reference population of the same age (height), based on WHO standards (de Onis et al. 2009). Malnutrition of populations using the indicators (a) to (d) is usually done by calculating Z-scores, defined as: “observed value minus the median value of a reference population divided by the standard deviation of that reference population” (WHO 2015). For indicators (a) to (d) a Z-score of -2 is used, i.e. for WFA if children are more than two standard deviations below the median (or mean) of their reference group they would be called underweight. The body-mass-index (BMI) is calculated as weight in kg divided by the square of height, measured in meters. For children, Z-scores for BMI for age are used whereas for adults, a fixed BMI cut-off value of below 18.5 is considered as underweight.

The second issue that must be dealt with when analyzing undernutrition problems in developing countries is how to integrate nutrition into economic models. The theoretical foundation to establish causality between nutrition outcomes and the physical and socio-economic conditions of a target population in developing countries is household theory (Becker 1965; Strauss and Thomas 1995). Aside from income, health and nutrition can be considered as components of a household’s utility function, given its production choices and resource constraints. However, as pointed out by Alderman (2012), the explanatory power of income-based indicators is poor and, referring to Almond and Currie (2011), it is increasingly recognized that the health and nutritional status of children is not only subject to postnatal but to prenatal conditions as well. This suggests that information about the mother’s health prior to childbirth is important to assess the nutritional status of children. Modelling nutrition outcomes (N) therefore can be formulated as a function of household income, household and village characteristics, and the child’s and the mother’s characteristics. Following Kabubo-Mariara, Ndenge and Mwabu (2009), we specify a model for the nutritional status of children below the age of five as follows:

$$N_{it} = f(Y_{jt}, C_{it}, M_{it}, X_{jt}, Z_{kt}, \varepsilon_{it}) \quad (1)$$

where N_{it} is the nutritional outcome of child i at time t ; Y is income of household j ; C includes child, mother and adult characteristics of person i ; X describes household characteristics; and Z is a vector of characteristics of village k ; all variables being measured at time t ; and ε is a randomly distributed error term. In our models, we use Z-scores of nutrition outcomes, i.e., WFA as dependent variable.

The choice of explanatory variables follows the general framework developed by UNICEF (Menon 2012). The framework distinguishes between immediate, underlying and basic causes of undernutrition, whereby immediate causes are (a) lack of food and nutrition intake; and (b) poor health status. Underlying factors are the sanitary conditions of a household and the provision of basic health services. Food and nutrition intakes are subject to food access which is determined by the market infrastructure and the general state of agricultural development. As a basic cause of undernutrition, maternal and child care practices are hypothesized to influence the health and nutrition of children. In the following, we describe the choice of variables in detail.

Most of the literature suggests that higher income and reduction in poverty have positive effects on nutrition and health (e.g., Anand and Ravallion 1993; Strauss and Thomas 1998) but this relationship can vary across countries and within households (Haddad, et al. 2003). This difference can be attributed to inequality and the extent to which public goods are directed towards nutrition (Anand and Ravallion 1993).

Further, we include for child characteristics, the three variables, age, gender and a dummy variable to reflect whether the child was sick in the reference period. Because the risk of malnutrition has been shown to differ with the age of children (Alderman, Hoogeveen, and Rossi 2006; Menon 2012), we include age dummies. A slower growth of girls/boys might occur if intra-household allocation discriminates for gender (Belitz, Hübner, and Klasen 2010). The nutritional status of a child will suffer in times of illness, but with good health care, effects will be less strong (Menon 2012). For mother characteristics, her height is generally believed to predetermine the child's nutritional status, which underlines intergenerational transmission of undernutrition through genes and economic status (Belitz, Hübner, and Klasen 2010). Mother's education (Smith et al. 2003) is used as a proxy for child care practices and mothers who migrated might have more child care knowledge, in addition to the remittances that may benefit a child's nutritional status. Adult characteristics include similar variables: gender, education, age and a dummy variable for sickness. For household characteristics, we include household size and dependency ratio which may influence the resource situation of the household and the degree of child care (Belitz, Hübner, and Klasen 2010). Migration of other household members, measured in months absent per year, is included as a proxy for the amount of remittances sent to the rural household. To measure the influence of sanitation facilities in the household, we include dummy variables on having running water and whether the household has a private water toilet. For village characteristics, health infrastructure is included, proxied by the percentage of households with sanitation, and availability of public water (Haddad et al. 2003). We control for the relative wealth of the village by including the average income of the village. In Viet Nam, we also include a dummy variable for ethnic minorities and control for different agro-ecological zones, i.e., whether the household is located in a mountainous region.

Most studies on child undernutrition use Demographic and Health Survey data (e.g., Kabubo-Mariara, Ndenge and Mwabu 2009), which are rich in terms of health information on child and mother, but do not always provide income or consumption data. In our panel data set which is described in more detail in the next section we have available direct measures, therefore we include (log) income per capita as Y . We take WFA as the nutrition-outcome indicator (N) as a continuous variable in Z-scores for children below five years of age. First, we estimate the model of equation (1) using ordinary least-squares (OLS) regression over the entire sample. In accordance with our objective to explore the relationship between poverty reduction and nutritional status of the rural population in Viet Nam and Thailand, we establish four groups, namely: (a) children who live in poor households based on a poverty line of \$2 income per capita and are underweight based on a Z-score cut-off of -2 for WFA; (b) children who live in poor households but are not underweight; (c) children who are from non-poor households but are underweight; and (d) children who are from non-poor households but are not underweight (as expected).

As the dependent variable, we use Z-scores of WFA. The dependent variable is truncated at the respective cut off points for per capita income and WFA. With this approach, we are able to identify whether the factors that condition nutritional status of rural children in the two emerging market economies change as households move away from the poverty line. The comparison also shows the importance of income as a factor for undernutrition because we look at those households which are income poor but do not have underweight children. Because households tend to shift income shares to food when resources become scarce, an increase in income might have different influences for households below than above the poverty line. With our methodology, we therefore identify different influencing factors on nutritional outcome below and above income and nutrition thresholds. To correct for the thresholds, we use a truncated Tobit

model (Wooldridge 2010) with an underlying latent variable. Because we have pooled panel data, we use cluster robust standard errors.

We estimate two kinds of models on the four groups of children as explained above. First we pool data for both countries in order to see the overall pattern of nutrition poverty. Second we estimate the model for the Viet Nam data set separately.¹ As pointed out by several authors (e.g., Alderman, Hoozevee, and Rossi 2006; Haddad et al. 2003) income measures can be subject to endogeneity, e.g., due to measurement errors. A possible solution is to use asset value as an instrumental variable. We tested for endogeneity using the Durbin-Wu-Hausman test for the OLS models and the Smith-Blundell test for the Tobit models (Wooldridge, 2010). In most of our models, we cannot reject exogeneity of the income measure and, therefore, prefer OLS and Tobit variants to instrumental variable approaches. Where we detected endogeneity (Viet Nam data, full model on all groups), we additionally reported an instrumental variables, two-stage least-squares regression.

3. DESCRIPTIVE ANALYSIS

In this section, we describe the background of our data which were collected among some rural 4,000 households in both countries in 2007, 2008 and 2010. The data originate from a household and village survey administered in the context of a research project on vulnerability to poverty.² In this project a comprehensive survey with four panel waves was carried out in six provinces of the two countries. The provinces were selected purposively based on criteria such as low per capita income, importance of agriculture, generally risky conditions because of remoteness and poor infrastructure. In Thailand, the three provinces are Nakhon Phanom, Ubon Ratchathani and Buri Ram; all belonging to the northeastern part of the country which has a long history of poverty and underdevelopment. In Vietnam, the three provinces involved include two that belong to the Central Highlands, namely, Hat Tinh and Dak Lak, both bordering the South China Sea, and the land-locked province of Dak Lak in the Southern part of the country. The sampling procedure differed between the two countries due to difference in ecological conditions (see Hardeweg, Klasen and Waibel 2013). In Thailand, the primary sampling unit was the sub-districts of the selected provinces and systematic random sampling was applied. In the second stage, two villages per sub-district were sampled with probability proportional to size of the population. At the third stage, ten households per village were selected systematically from a list of households ordered by household size. In Viet Nam, the sampling procedure was different at the first sampling stage due to high diversity in natural conditions of the three provinces. Here provincial agroecological zones were defined with a minimum of 160 households per strata. Within these strata two communes (equivalent to a sub-district in Thailand) were sampled according to population density and subsequently the procedure followed the one from Thailand. For the analysis in Viet Nam, the use of sample weights was necessary whereas the sample in Thailand was self-weighting by design.

Summary statistics for all variables included in the model are presented in Table 1 showing their means and standard deviation over the entire sample by country.

¹ We also estimated a separate model for Thailand but the results were not very conclusive. This is perhaps because the food security situation is much better in Thailand and the extent of both poverty and malnutrition is less severe. Therefore, the number of cases in the group of poor households with undernourished children is too small for estimating meaningful nutrition equations. However, we estimated an OLS and IV model for the full sample (and across different income intervals) which gave some plausible results. These results are reported in the appendix.

² See <http://www.vulnerability-asia.uni-hannover.de/overview.html>

Table 1: Definition and Summary Statistics of Panel Data for Thailand and Viet Nam, Children below 5 Years

	Nutrition Outcome	Thailand		Viet Nam	
		Mean	SD	Mean	SD
Z_scoreWFA	Z-score of weight-for-age	0.33	2.49	-0.62	2.34
Income					
Income PC	Income per capita and month, \$PPP	121.70	177.97	88.68	123.71
Child					
sick	Child was sick (yes=1, no=0)	0.04	0.20	0.05	0.22
childGirl	Girl (yes=1, no=0)	0.45	0.50	0.50	0.50
Mother					
m_height	Height of the mother (cm)	156.96	6.60	153.98	7.87
m_edueyears	Education of the mother (years)	8.47	3.56	6.62	3.98
m_migrant	Dummy: mother migrated (yes=1, no=0)	0.20	0.40	0.01	0.10
Household					
HHsize	Nuclear family household size	5.38	1.98	5.28	1.80
dep.ratio	Dependency ratio (HHsize/dependents)	?	0.77	2.14	0.74
migmonth_other	No. of months other HH mem. migrated	3.21	7.28	1.11	1.44
ethnicMin	HH is ethnic minority (yes=1, no=0)			0.31	0.46
PrivToilet	Private water toilet (yes=1, no=0)	0.96	0.19	0.18	0.39
Tapwater	HH has tap water (yes=1, no=0)	0.28	0.45	0.11	0.31
Village					
VPsanitation	% of HHs with sanitation facilities	76.51	40.03	14.30	28.79
VpubWater	Access to public water (yes=1, no=0)	0.89	0.32	0.22	0.42
DISTtown	Distance to town (minutes) ¹⁾	53.56	30.44	46.47	53.74
VILLinc	Average income in the village (pc/month)	164.93	152.99	106.02	74.08
VSmount	Village in mountain region (yes=1, no=0)			0.39	0.49
N		1,947		1,960	

Source: Household Survey 2007, 2008 and 2010. ¹⁾ Distance was measured in minutes using the most common form of transport (e.g., bus or motorcycle)

Table 2 shows the poverty headcount ratios for 2007, 2008 and 2010 for the \$1.25 and the \$2 income per capita per day poverty lines for each of the provinces involved. The data show that whereas absolute poverty is relatively low (i.e., using the \$1.25 line), a large number of the rural population in both countries is just above the poverty line. Increasing the threshold to \$2 per day in 2007 puts between 36% and 45% of the Thai households and almost 70% of the Vietnamese households below the poverty line. In both countries, poverty increases by 10% to 20% when the poverty line is increased from \$1.25 per day to \$2 per day. Variation between provinces is small but increased in 2010, i.e., after the food price and economic crisis, suggesting that provinces have been coping differently with the crisis. It is also interesting to note that poverty in 2010 decreased more in Thailand than in Viet Nam which suggests that Thailand recovered better from the crisis and social protection measures may have been effective in favor of the poor.

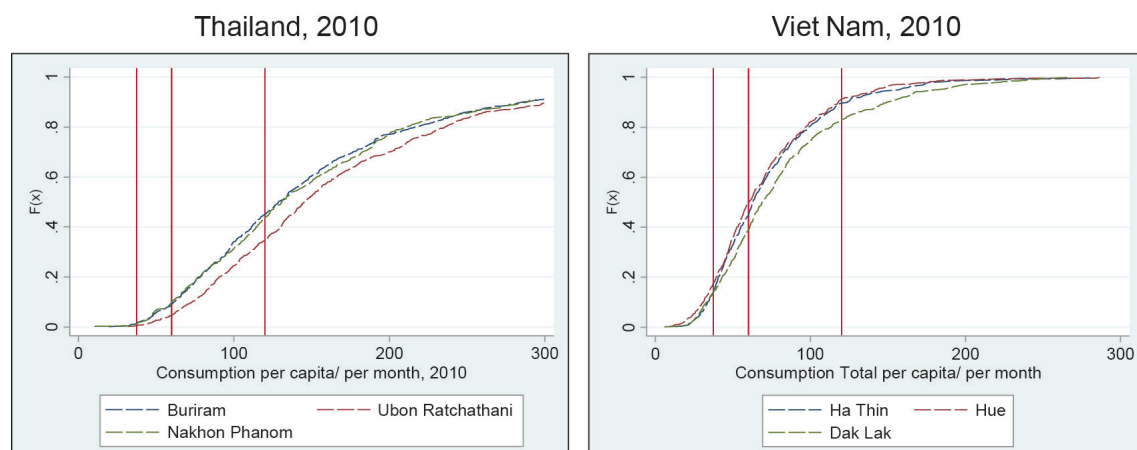
Table 2: Poverty Headcount Ratios in Thailand and Viet Nam based on per Capita Income in 2007, 2008 and 2010

	\$1.25 poverty line			\$2 poverty line		
	2007	2008	2010	2007	2008	2010
Thailand						
Buriram	30.2	33.0	7.7	44.8	44.2	17.5
Ubon Ratchathani	21.8	21.7	12.3	36.3	36.3	21.8
Nakhon Phanom	23.5	31.2	14.3	41.2	48.1	29.3
Viet Nam						
Ha Thin	55.7	18.5	16.6	69.9	36.3	31.5
Thua Thien Hue	38.1	27.5	16.6	57.4	46.9	31.7
Dak Lak	29.9	23.2	23.3	45.4	37.2	36.6

Note: Poverty based on income measure, VN adjusted for survey weights.

Source: Household Survey 2007, 2008 and 2010.

This is further illustrated in Figure 1, which shows the cumulative empirical distribution functions of consumption expenditures in 2010 for both countries. The probability of a rural household with a consumption level below the poverty line is very low for Thailand and even at a level of \$120 per capita per month (\$4 per capita per day) some 60% of the households are above this level. In the Vietnamese provinces, consumption poverty is much higher (see right panel of Figure 1) and less than 20% of them would surpass a level of \$4 per day which could be considered a “middle-class threshold”. Consumption is more evenly spread among different levels whereas differences among provinces are more pronounced in Viet Nam.

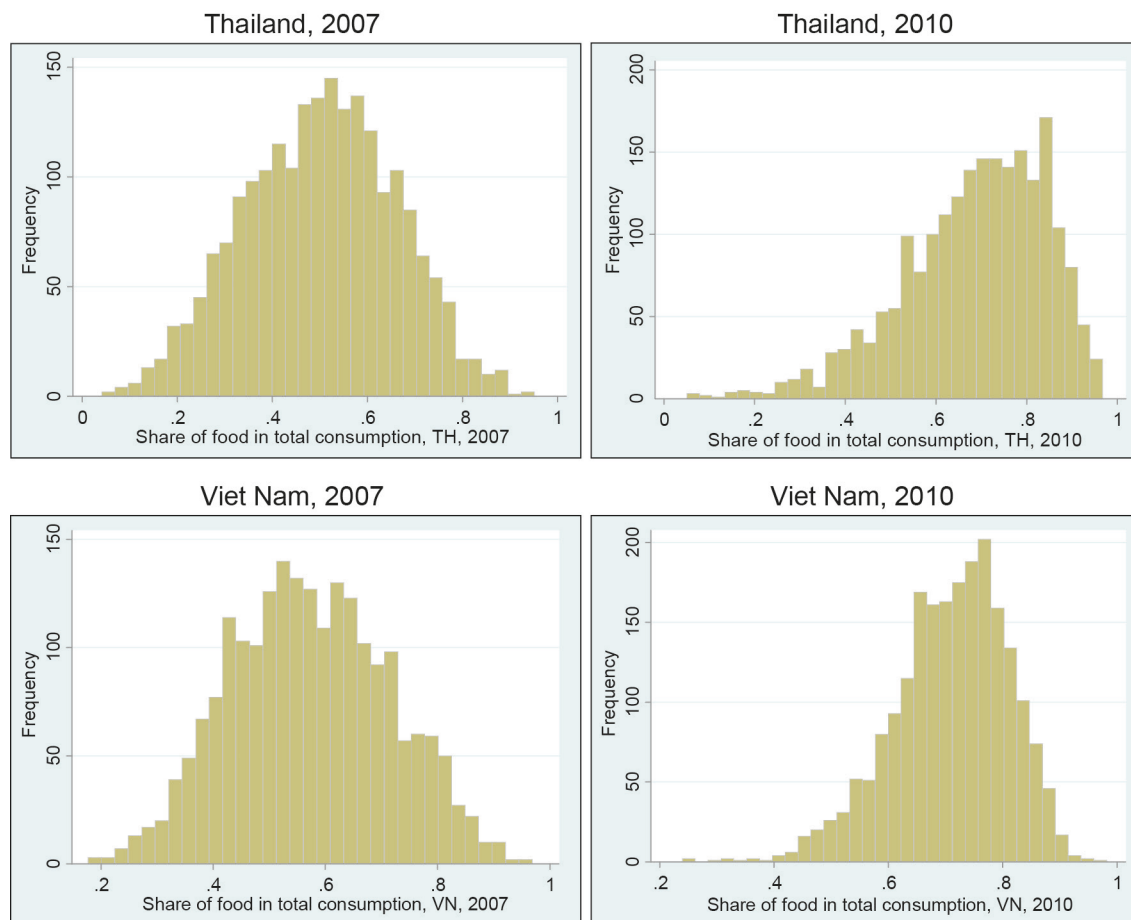
Figure 1: Distribution of Consumption Expenditures for Three Provinces in Thailand and Viet Nam, 2010. Poverty Lines at \$1.25, \$2 and \$4 per day.

Source: Household Survey 2010.

In Figure 2, the effect of food prices on the distributions of food consumption shares are shown for both countries aggregating the data for the three provinces in the respective countries. It can be seen that, in 2010, i.e., after the economic crisis, but at a time when food prices were still higher than in 2007, the distributions shifted to the right for both countries. This indicates that the majority of rural households had to allocate a much higher share of their consumption expenditures to food. The effect was stronger in Viet Nam where the mode shifted to about 80% whereas it increased to above 60% in Thailand. Relating these observations to the data on poverty and consumption

shows that, in spite of a decline in poverty, adjustments in food consumption became necessary and, therefore, consequences for nutrition are likely.

Figure 2: Share of Food in Total Consumption, 2007 and 2010, Thailand and Viet Nam



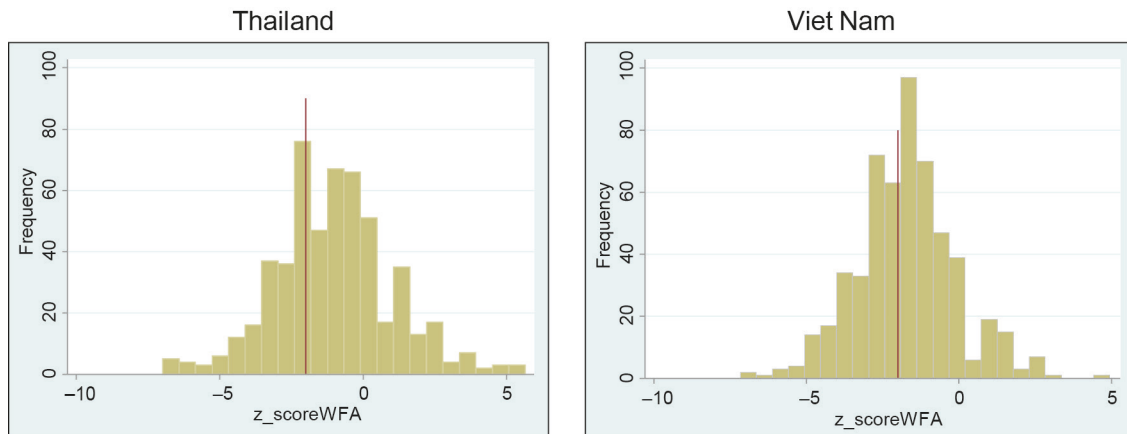
Source: Household survey 2007 and 2010.

We now assess nutritional outcomes of the households in our sample. Figure 3 shows the distribution of the weight-for-age Z-scores for children below five years in 2010. Referring to the -2 Z-score threshold, it is noted that about 19% of the pre-school children in Thailand and 27% of the children in Viet Nam are considered undernourished based on WFA. Only around one third of households have children below the age of five—and only these can be included in any child-nutrition measures. Again, it is worth noting that the rate of undernutrition of children is similar or even higher than the rate of poverty both for the \$1.25 and the \$2 poverty lines. This supports the notion that the reduction of monetary poverty is not a sufficient condition for the elimination of undernutrition.

A complete overview of nutrition indicators, pooled over three years, is presented in Table 3. We calculated the means in nutrition outcomes for the pooled data set of three years on average and across different intervals of per capita income for Thailand and Viet Nam separately. We observe that values for stunting are much higher than for those for underweight and wasting, which is consistent with the standards defined by WHO (2014). As expected, undernutrition rates are still higher in Viet Nam. For the comparison across income groups, we start with a per capita income of below \$2 per

day until above \$10 per day as the upper range. For nutrition indicators, we take the respective shares based on WFA, BMI, HFA, and WFH for children and BMI for adults.

Figure 3: Distributions of the Weight-for-Age Z-scores for Children below 5 years; Thailand and Viet Nam, 2010



Source: Household Survey 2010.

Table 3: Mean Differences in Nutrition Outcomes of Households in Thailand and Viet Nam, 2007, 2008, 2010 (Pooled)

Income (\$ PPP per capita per day)	Total	0 – <2	2 – <3	3 – <5	5 – <7	7 – <10	≥10
Thailand							
Share of children underweight (WFA)	0.12	0.12	0.13	0.13	0.10	0.07	0.11
Share of children underweight (BMI)	0.13	0.14	0.13	0.12	0.13	0.15	0.15
Share of children stunted (HFA)	0.42	0.43	0.45	0.45	0.41	0.33	0.37
Share of children wasted (WFH)	0.12	0.12	0.12	0.12	0.11	0.15	0.11
Share of adults underweight (BMI)	0.12	0.13	0.13	0.12	0.12	0.12	0.11
Viet Nam							
Share of children underweight (WFA)	0.27	0.33	0.27	0.18	0.21	0.16	0.14
Share of children underweight (BMI)	0.14	0.14	0.14	0.15	0.14	0.09	0.13
Share of children stunted (HFA)	0.50	0.52	0.50	0.49	0.45	0.50	0.53
Share of children wasted (WFH)	0.13	0.14	0.13	0.15	0.16	0.08	0.12
Share of adults underweight (BMI)	0.25	0.29	0.26	0.24	0.22	0.20	0.20

Source: Household Survey 2007, 2008 and 2010.

In the next step of the descriptive analysis, we establish four groups based on the criteria, poverty and nutrition. Group (1) consists of children living in households below the \$2 poverty line and who are underweight, according to the WFA indicator. Group (2) represents children from poor households who are not underweight. Groups (3) and (4) involve children from non-poor households who are underweight or not, respectively.

From Table 4, we note differences in parameters on individual, household and village levels among the four groups in Thailand. Firstly, poor households with underweight children have lower per capita food consumption although they may have the same level of income as compared to poor households with no underweight children. Also the former have a lower share of agricultural income and rely relatively more on food from natural resources which tend to be more erratic in supply. Such difference can no longer be observed for non-poor households. Another difference is migration of the child's mother. Poor households with normal weighted children have an eight percent

higher share of mothers working outside the village. This is also reflected in the time that mothers spend outside the household, i.e., mothers from poor households with normal weighted children spend almost thrice the time away. In non-poor households such differences are smaller.

A major factor seems to be assets. Poor households with underweight children (Table 4) have only about half the assets in value terms compared with their counterfactual group. Again this difference is smaller in absolute and relative terms for the non-poor groups.

Table 4: Comparison of Children by Poverty (\$2 Poverty Line) and Nutritional Status (WFA), Thailand 2007–2010

Groups	(1) Poor and Underweight	(2) Poor and No Underweight	(3) Non-poor and Underweight	(4) Non-poor and No Underweight
Income				
Income per capita and month (PPP \$)	22.53	22.91	165.63	185.63
Share Agricultural Income*	0.41	0.53	0.21	0.22
Share Natural Resources Income*	0.09	0.07	0.04	0.03
Food Consumption per capita and month (PPP\$)	41.88	49.09	72.90	68.83
Share Food of total Consumption	0.60	0.62	0.63	0.60
Share households with small scale business	0.19	0.20	0.33	0.34
Child				
Share of children sick	0.05	0.05	0.01	0.04
Share of Girls	0.44	0.46	0.42	0.45
Mother				
M_height (cm)	153.89	156.07	156.76	157.82
M_edu (years)	7.02	7.30	8.60	9.31
Share M_migrant	0.15	0.23	0.17	0.18
Household				
HHsize	5.28	5.32	5.11	5.27
Dependency ratio	2.18	2.05	2.01	1.89
Migmonth_other	1.03	2.70	0.96	2.06
Share Agricultural Worker	0.59	0.62	0.52	0.49
Share Wage Worker	0.05	0.05	0.10	0.10
Share business worker	0.36	0.33	0.38	0.41
Share PrivToilet	0.91	0.95	0.97	0.97
Share Tapwater	0.25	0.27	0.23	0.30
Value assets per capita (PPP \$)	717.04	1,364.20	1,648.86	2,014.91
Value livestock per capita (PPP \$)	195.47	179.28	201.43	241.39
Land per capita (ha)	0.67	0.57	0.73	0.76
Village				
VPsanitation	75.69	75.2	80.34	77.25
VpubWater	0.88	0.88	0.91	0.90
Distance market	17.73	19.96	18.27	16.79
Distance hospital	23.43	23.70	21.05	21.54
N	97	586	132	831

Notes: * negative crop/natural resource incomes excluded.

Source: Household Survey 2007–2010.

The prenatal condition of children, as indicated by the mother's height, shows some differences in the poor household group while the mother's education is considerably higher in the non-poor groups.

Interestingly, no difference can be observed in the food consumption expenditure shares among the four groups which suggest that differences may exist in the quality of food assuming positive income elasticity for food expenditures, i.e., as households get better off their absolute expenditures on food increase. Also, no difference can be observed in sanitation parameters, neither on household nor village level.

The respective comparison for Viet Nam also shows differences among the four groups (Table 5). Among the poor households differences in food consumption are relatively higher for households with normal weighted children than differences in per capita income although absolute differences are small. Unlike in Thailand, this difference is higher in the two non-poor groups. Poor households with undernourished children are less likely to have a small-scale business and must rely on own agriculture, food from natural resources and wage employment. A marked difference can be observed in health with a higher share of children who were reported sick. Also undernourished children tend to have mothers with fewer years of education. A marked difference is also in ethnicity. The share of ethnic minorities is highest among poor households with undernourished children.

Marked differences exist between poor and non-poor households, e.g., in labor allocation, poor households are more agriculturally based and non-poor households have a higher share of wage employment and small-scale business. Furthermore differences also exist in sanitary conditions, e.g., non-poor households have better access to water and better hygienic conditions. Furthermore, poor households tend to live in remote mountainous areas. However differences between households with underweight and normal weighted children for both income groups (poor and non-poor) are small. Nevertheless, the share of undernourished children among poor households is about 1:2, whereas it is about 1:5 in non-poor households.

In summary, our descriptive and explorative analyses for some 4,000 rural households consisting of over 22,000 individuals, including adults and children, allow us to draw some lessons that provide some initial answers to the questions asked in Section 1 of the paper. These findings also form the basis for the establishment of some hypotheses to be further explored in the econometric analysis below.

First, we observe that, whereas poverty reduction has been quite successful in both countries, this success is subject to the choice of the poverty line. Clearly, extreme poverty is now negligible in both countries but, by increasing the poverty line to \$2 or \$4 per day, headcount ratios increase. This suggests that poverty does not end when a household surpasses the official poverty line and that vulnerability to poverty continues to be a problem.

Second, we note that nutrition problems persist in both countries in spite of their success in poverty reduction. Again, the problem is bigger in Viet Nam than in Thailand. For children, HFA and WFA the respective shares below the critical levels are 42% and 12% for Thailand and 50% and 27% for Viet Nam, which suggests that particularly underweight is still a problem, especially in Viet Nam. The latter value corresponds well with Haddad et al. (2003) who predicted, on the basis of their cross-country nutrition model, underweight (WFA) for pre-school children in Viet Nam to be at around 28% in 2015.

Table 5: Comparison of Households by Poverty (\$2 Poverty Line) and Nutritional Status of Children (WFA), Viet Nam 2007–2010

Groups	(1) Poor and Underweight	(2) Poor and No Underweight	(3) Non Poor and Underweight	(4) Non Poor and No underweight
Income				
Income per capita (PPP \$)	24.55	26.93	147.67	162.50
Share of agricultural Income*	0.51	0.65	0.36	0.33
Share natural resources Income*	0.07	0.07	0.02	0.03
Food consumption per capita/month(PPP \$)	33.01	34.93	47.5	52.92
Share food in total Consumption.	0.70	0.69	0.68	0.66
Share households with small-scale business			0.36	0.41
Child				
Share of children sick	0.09	0.04	0.04	0.02
Share of Girls	0.56	0.49	0.49	0.50
Mother				
M_height (cm)	154.69	154.62	155.12	154.99
M_edu (years)	5.43	6.12	6.80	8.27
M_migrant	0.00	0.01	0.02	0.01
Household				
HHsize	5.50	5.56	5.15	5.03
Dependency ratio	2.27	2.26	1.97	2.03
Migmonth_other	0.04	0.08	0.15	0.14
Share Ethnic Minority	0.39	0.30	0.21	0.10
Share Agricultural Worker	0.82	0.78	0.66	0.54
Share Wage Worker	0.04	0.05	0.16	0.18
Share business worker	0.15	0.17	0.19	0.28
Share PrivToilet	0.09	0.12	0.23	0.31
Share Tapwater	0.05	0.07	0.10	0.15
Value assets per capita (PPP \$)	379.06	382.59	791.10	1,049.20
Value livestock per capita (PPP \$)	160.50	140.28	332.96	223.60
Land per capita (ha)	0.13	0.14	0.22	0.17
Percent HH with no land	8.10	6.53	4.36	12.56
Village				
VPsanitation	11.37	12.00	22.69	18.96
VpubWater	0.13	0.17	0.13	0.19
Distance market	20.06	18.38	17.97	15.69
Distance hospital	37.07	35.90	30.65	31.58
Share households in mountain region	0.31	0.29	0.24	0.16
N	297	658	144	632

Source: Household Survey 2007–2010.

Third, as suggested in the literature, income is a poor predictor for success in reducing undernutrition. Increasing the poverty line from \$2 per capita income and going beyond \$10 per capita income shows that undernutrition of children declines only slightly in Thailand, but it more rapidly declines in Viet Nam, starting at a higher level, but clearly with a declining rate above \$5 per day. This underlines the role of non-income factors for governments wanting to improve the nutritional status of their population.

Exploring the relationship between consumption levels and nutrition suggests that the poverty line is not a strong indicator for the disappearance of nutrition problems because the share of individuals who fall out of the norm values for nutrition outcomes only gradually decline with higher incomes. This lends some support to the hypothesis that reducing or eliminating monetary poverty does not automatically reduce other forms of poverty to the same extent. Although there are some differences between poor and non-poor when comparing nutrition indicators, nutrition problems do exist beyond the poverty line. This suggests that the factors responsible for income poverty are not necessarily the same as those for nutrition and other forms of poverty and therefore additional exploration using the econometric model described above is warranted.

Finally, by establishing four different household categories based on poverty and nutrition, it is observed that households with undernourished children have some common characteristics that are independent of monetary wealth. Undernourished children live in settlements where sanitation is generally poorer than in other villages. The comparison across household types also suggests that non-monetary factors are important for reducing undernutrition of children.

4. ECONOMETRIC ANALYSIS

To further explore the hypotheses derived from the literature and the findings of our descriptive and explorative analysis, the econometric model outlined in Section 2 is applied for different nutrition variables. The first dependent variable for this model is the WFA Z-score; hence a positive significant sign of any explanatory variable suggests improvement of the nutritional status of a child. An ordinary least-squares (OLS) regression was estimated for the pooled data set for the years, 2007, 2008 and 2010, including data for both countries and capturing the country effects by a dummy variable. Also, separate models were estimated for the four household groups based on poverty and nutritional status. We first estimate the models combined for Thailand and Viet Nam, and supplement it with a version only including data from Viet Nam, where the nutritional problem is more severe.

In column 1 of Table 5, the results of the OLS regression are shown. As expected, log income positively influences the nutrition outcome, but with a relatively low coefficient of 0.162, which is in line with previous estimates in the literature (e.g., Alderman, Hoozevee, and Rossi 2006; Haddad et al. 2003). Child characteristics also have a significant influence, i.e., if a child was sick in the previous period its nutrition outcome is negatively affected. On average, a sickness event decreases Z-scores by 0.3. The gender variable is significant but with a sign contrary to expectations. On average, girls seem to be better nourished, which does not seem to be in line with usual gender discrimination patterns against girls, but this finding has also been reported by some authors (Belitz, Hübner, and Klasen 2010; Svedberg 1990). However, the variable mother's height is positive which is consistent with findings in the literature and suggests that prenatal conditions influence the nutritional status of the child. On the other hand, we do not find a significant effect of education nor the migrant status of

the mother. The same is true for a range of household characteristics including size and dependency ratio. Other household and village characteristics, however, are significant. Sanitary conditions of a household and the sanitation infrastructure at the village level significantly increase nutritional outcomes. Being born in an ethnic minority decreases the nutritional outcome, which is plausible because, in Viet Nam, many ethnic minorities belong to economically disadvantaged, and often marginalized, population groups. The observation from the descriptive analysis that the nutritional status in Thailand is better than in Viet Nam is reflected in the significant country dummy.

In Columns 2–5 of Table 6, regression results of the truncated Tobit regressions on Z-scores of WFA for the four different groups are presented. The income variable is only significant in one of the four groups, namely, for non-underweight children that live in poor households (Column 3). A higher income, i.e., an income nearer to the \$2 threshold is positively correlated with a better child nutritional outcome above the underweight cut-off point.

A similar observation can be made for child sickness. Generally, sickness leads to decreasing nutrition Z-scores; the effect is larger, if good health care is not available or not used. Although in the regression with the complete data set, sickness is correlated with lower nutrition Z-scores, this effect can only be observed for the poor and undernourished children. Whereas well-nourished children might be less often those with sickness, richer households might have access to better health care to invalidate the effect. The presence of girls in the household does have significantly higher Z-scores in all groups. Mother characteristics are differently correlated with Z-scores over the groups. Mother's height is positively correlated with nutrition only for those children who are non-poor and well-nourished. For those above the poverty line, a long-term economic and nutritional well-being of the household improves nutritional status of the children. Education, as measure for child care, is, as expected, positively correlated with nutrition for poor and undernourished children as well as for non-poor and well-nourished. Interestingly, better nourished poor children have less educated mothers. A possible explanation might be overweight; some of those children classified as well-nourished might even suffer from overweight, which might be favored by low nutritional knowledge. For stronger explanations, more research on this topic is necessary. Migration status of the mother gives a clearer picture because it is correlated positively with nutrition for those children below the poverty line. Although the effect appears quite clear, channels are less clear. On the one hand, migrated mothers can spend less time with their children, which might be especially negative for very young children because of breastfeeding. For older children, especially in Thailand, grandparents, who are experienced in child care, take over responsibility. Additionally, mothers might gain knowledge on child care in the cities where they work, and send back remittances, which might be directed at their children's well-being. For the children below the poverty line, positive effects dominate.

As in the model using the complete sample, household size, dependency ratio and migration of other household members do not significantly affect nutrition, except for household size which is positively correlated with nutrition for those underweight children above the poverty line. Ethnicity of a child has a different effect depending on the group. For poor and well-nourished children, belonging to an ethnic minority is correlated with lower nutrition Z-scores. This might be interpreted as children below the poverty line and belonging to ethnic minorities are rather those close to the cut-off than at the upper tail of the distribution of Z-scores. For non-poor and non-underweight children, a positive correlation is observed, hinting at the possibility of over-nourished ethnic minority children.

Table 6: Estimates for Pooled OLS and Tobit Models for WFA Z-scores for Four Different Groups Households based on Poverty and Nutritional Status

Variables	ALL (OLS)	Poor and Underweight	Poor and No Underweight	Non Poor and Underweight	Non Poor and No Underweight
Income					
Income PC	0.162*** (0.036)	0.038 (0.036)	0.206*** (0.061)	-0.037 (0.092)	0.105 (0.091)
Child					
Sick	-0.312* (0.163)	-0.292* (0.161)	-0.142 (0.210)	-0.190 (0.252)	-0.235 (0.242)
ChildGirl	0.170* (0.088)	0.257*** (0.093)	0.220* (0.118)	0.459*** (0.125)	0.232** (0.106)
Mother					
m_height	0.018*** (0.007)	-0.003 (0.007)	0.012 (0.010)	-0.016 (0.014)	0.020** (0.008)
meduyears	0.012 (0.012)	0.030** (0.014)	-0.032* (0.018)	-0.001 (0.020)	0.026* (0.015)
m_migrant	0.270 (0.221)	0.459** (0.213)	0.598** (0.274)	-0.431 (0.470)	0.354 (0.257)
Household					
HHsize	0.024 (0.024)	0.003 (0.023)	0.039 (0.027)	0.060* (0.032)	0.003 (0.035)
Dep.ratio	0.051 (0.059)	0.023 (0.052)	0.064 (0.079)	0.162 (0.104)	0.071 (0.070)
Migmonth_oth	0.017 (0.012)	-0.010 (0.009)	-0.007 (0.017)	0.040 (0.040)	0.007 (0.013)
EthnicMin	-0.295** (0.126)	0.039 (0.113)	-0.348** (0.155)	-0.009 (0.204)	0.356* (0.206)
PrivToilet	0.339*** (0.123)	-0.259 (0.263)	0.430** (0.193)	0.086 (0.184)	0.186 (0.132)
Tapwater	0.003 (0.093)	0.045 (0.110)	-0.116 (0.141)	0.011 (0.134)	0.168 (0.115)
Village					
VPsanitation	0.003** (0.001)	0.003 (0.002)	0.005*** (0.002)	-0.000 (0.002)	0.002 (0.002)
DISTtown	-0.001 (0.001)	-0.001 (0.001)	-0.000 (0.001)	0.001** (0.001)	-0.001 (0.001)
VILLinc	-0.000 (0.000)	-0.000 (0.001)	-0.001 (0.001)	-0.001 (0.000)	0.000 (0.000)
Thailand	0.256* (0.146)	-0.112 (0.263)	-0.109 (0.222)	-0.170 (0.203)	0.411** (0.161)
_cons	-0.743 (1.107)	-2.539** (1.145)	0.877 (1.524)	-0.709 (2.023)	-0.988 (1.339)
N	2,873	365	959	264	1,285

Notes: * $\Rightarrow p < 0.1$; ** $\Rightarrow p < 0.05$; *** $\Rightarrow p < 0.01$. Standard errors are clustered on individual level. Households with negative incomes are excluded. Year is controlled for. Age is controlled for and significant. Migrantmonths normalized (+1).

Source: Household Survey 2007–2010.

For household and village-level effects, our results show that sanitation is important. Having a private toilet as well as the percentage of households with sanitation in the village has a positive effect on nutrition for those well-nourished children below the poverty line. Good sanitary facilities and hygiene is one way to improve nutrition and overcome undernutrition for the poor. Distance to town (exception: non-poor underweight) and the average income level in the village seem to not influence nutrition to a measurable extent. The Thailand dummy is positive and significant for the complete sample and in the non-poor group with normal weight children. This confirms that the overall nutritional conditions are better in Thailand. However, in all other equations the coefficient is not significant. Therefore, additional models were estimated for the Thailand data set separately and results are reported in the Appendix.

Not reported are the control variables for the year, which shows negative significant effect for 2010, and the age of children, which shows, as expected from the literature, significantly worse nutrition values for older children.

Empirical results obtained by applying the regression model to the data for Viet Nam only are presented in Table 7. Because we cannot reject exogeneity in the case of the full model for Viet Nam, we also estimated an instrumental variable (IV) model, using value of assets as an instrument (following Haddad et al. 2003). Results from the OLS and IV estimations are quite robust. The coefficient of the income variable is larger from the IV regression, but both are positive. As in the regression for both countries, sickness of a child has a negative effect on nutrition, but gender discrimination is not significant in the general model. The influence of household characteristics differs slightly for the two estimations. In the IV case, household size and dependency ratio positively influence nutrition, but, in the OLS case, a private toilet has a positive influence. In both equations, belonging to an ethnic minority decreases nutrition whereas migration of other household members increases nutritional outcomes. The effect of migration was not significant in the combined Thailand/Viet Nam model. Village characteristics do not have significant influences in this model.

In the truncated models, we find no significant income effect which might be a result of the lower variance due to the income restriction whereas, in the OLS and IV models, this is not the case. Sickness has mainly a negative effect in the “poor and underweight” group. Although no gender discrimination was observed in the complete models, girls seem to be better off in all groups, except in the “non-poor/non-underweight” group where, however, mother’s height is significant and positive. Although in both underweight groups, education of the mother increases nutrition outcomes, it is negative for the “poor and non-underweight” children. Belonging to an ethnic minority has a negative effect on nutrition; having a private toilet increases nutritional outcomes in the “poor and non-underweight” group. We also find positive provincial effects for Dak Lak, a more commercialized province with much better infrastructure than Ha Thin (the poorest among the three provinces in Viet Nam) in both the poor and non-poor underweight groups. Also, for Hue province, Z-scores decrease for “poor and non-underweight” group and increases for the “non-poor underweight” group.

In summary, we find different variables to be correlated with nutrition outcomes, depending on whether the child is undernourished and poor or not. This supports our assumption of non-linearity in factors influencing nutrition outcomes depending on income and nutritional status. In general, income has an influence, but only for parts of the population. Child and mother characteristics show a correlation, whereas household characteristics, except for ethnic minority, are less important. However, quite consistently, sanitation has been found to be important, especially in the poor but non-underweight group.

Table 7: Continuous Outcome Variable for Children: Pooled OLS/Tobit VN, Indicator WFA, Poverty Line \$2 (PPP \$), Viet Nam

	ALL (OLS)	All (IV)	Poor and Underweight	Poor and No Underweight	Non Poor and Underweight	Non Poor and No Underweight
Income						
income PC	0.123*** (0.046)	0.420*** (2.75)	0.032 (0.039)	0.053 (0.074)	-0.071 (0.145)	0.022 (0.127)
Child						
sick	-0.541** (0.239)	-0.441* (-1.84)	-0.356** (0.180)	-0.020 (0.272)	-0.303 (0.271)	0.334 (0.385)
childGirl	0.161 (0.101)	0.163 (1.62)	0.342*** (0.104)	0.312** (0.132)	0.611*** (0.161)	0.202 (0.127)
Mother						
m_height	0.014 (0.009)	0.013 (1.38)	-0.008 (0.008)	0.010 (0.010)	-0.027 (0.017)	0.028** (0.012)
meduyears	-0.005 (0.015)	-0.015 (-0.99)	0.043*** (0.015)	-0.069*** (0.022)	0.041* (0.023)	-0.004 (0.018)
Household						
HHsize	0.034 (0.032)	0.056* (1.67)	-0.003 (0.024)	0.041 (0.040)	0.066** (0.032)	0.058 (0.045)
dep.ratio	0.106 (0.069)	0.143** (2.04)	0.054 (0.052)	0.034 (0.092)	0.485*** (0.129)	0.064 (0.095)
migmonth_oth	0.028* (0.017)	0.027* (1.69)	0.067*** (0.025)	0.017 (0.022)	0.057* (0.029)	0.032*** (0.012)
EthnicMin	-0.364** (0.147)	-0.282* (-1.85)	-0.131 (0.130)	-0.451** (0.184)	-0.064 (0.195)	0.148 (0.218)
PrivToilet	0.290** (0.142)	0.170 (1.21)	-0.196 (0.344)	0.621*** (0.212)	-0.199 (0.192)	0.108 (0.153)
Tapwater	-0.007 (0.139)	0.001 (0.01)	0.063 (0.153)	-0.055 (0.189)	-0.113 (0.176)	0.289 (0.180)
Village						
VPsanitation	0.000 (0.002)	-0.000 (-0.20)	-0.000 (0.003)	0.004 (0.003)	-0.000 (0.003)	-0.001 (0.003)
DISTtown	-0.001 (0.001)	-0.000 (-0.98)	-0.000 (0.002)	-0.001 (0.001)	0.001*** (0.001)	0.001 (0.000)
VILLinc	0.001 (0.001)	-0.000 (-0.58)	-0.001 (0.001)	0.001 (0.001)	-0.000 (0.001)	-0.000 (0.001)
Hue	0.050 (0.174)	0.013 (0.07)	0.139 (0.198)	-0.419* (0.225)	0.653** (0.266)	-0.193 (0.215)
DakLak	0.229 (0.169)	0.086 (0.47)	0.342** (0.149)	-0.096 (0.204)	0.642** (0.278)	-0.133 (0.207)
VSmount	-0.206 (0.137)	-0.199 (-1.45)	0.024 (0.134)	0.007 (0.180)	-0.097 (0.147)	-0.166 (0.154)
_cons	0.322 (1.376)	-0.482 (-0.34)	-2.155* (1.236)	2.076 (1.643)	0.355 (2.430)	-1.262 (2.001)
N	1,586	1,586	292	547	151	596

Notes: * $\Rightarrow p < 0.1$, ** $\Rightarrow p < 0.05$, *** $\Rightarrow p < 0.01$. Standard errors are clustered on individual level. Households with negative incomes are excluded. Year is controlled for. Age is controlled for and significant. Migrantmonth normalized (+1). IV: Asset value.

Source: Household Survey 2007 – 2010.

To further illustrate the implications of our findings, we establish a prediction for child nutrition outcome by the year 2030, i.e., the year when based on some income projections (ADB, UNDP, and UN ESCAP 2013) income poverty will have disappeared in almost all Asian countries when using the \$1.25 poverty line. For our prediction, we follow the approach of Haddad et al. (2003). The authors made a prediction for WFA in several countries including Viet Nam for the year 2015. Based on the assumption of an average annual income growth of 2.5%, they predicted the WFA to decline from some 40% in the 1990s to 27% in 2015. Interestingly, the latter value is close to what we find with our data set for rural children in the three Vietnamese provinces.

In Table 8, predicted shares of underweight children are reported separately for Thailand and Viet Nam and cover WFA and HFA indicators, to reflect developments in current and chronic malnutrition. The predictions are made using income coefficients from regressions on Z-scores, for the two countries separately. For Thailand, OLS is used but, for Viet Nam, we use an IV regression. Coefficients are higher for Viet Nam than for Thailand. The prediction for each country is based on the distribution of incomes and Z-scores from the 2010 data. Predictions are made for different rates of average annual income growth ranging from a modest 2% to an overoptimistic 8% and assuming that growth is equally distributed. As a reference point, projected shares can be compared with the WHO thresholds for situations of low severity (WHO, 2014). The WHO defined low severity when less than 10% of children are underweight (WFA) and less than 20% are stunted (HFA), respectively.

**Table 8: Predicted Values of Child Nutritional Outcomes in 2030
for Different Levels of Average Income Growth by Country**

	Income Growth (%)	Thailand		Viet Nam	
		WFA	HFA	WFA	HFA
Base year (2010)		18.9	47.0	29.8	59.3
	2	17.2	46.7	21.9	47.4
	4	15.8	45.1	18.1	45.4
	6	14.5	39.5	13.4	35.7
	8	11.2	36.4	6.5	17.9

Notes: Income growth assumes average annual income growth. Coefficients are from OLS in Thailand (WFA: 0.144; HFA: 0.123) and IV in Viet Nam (WFA: 0.442; HFA: 1.048).

Source: Household Survey 2010.

Results in Table 7 show the shares of underweight children, in the 2030 target year. For Thailand, the decline is modest; for the 2% scenario underweight, shares decline by less than two percentage points and, even for the (unrealistically) high income scenario, underweight in 2030 is still above 10% (see Table 6). In Viet Nam, the income effect is somewhat stronger, which is to be expected because the point of departure is much higher with an almost 30% underweight share. A 2% income growth would bring down underweight to 21% whereas the high income scenario would, however, result in a low-severity situation, based on the WHO definition. The picture is similar for the HFA indicator, which reflects chronic malnutrition. The difference in the income effect between Thailand and Viet Nam is even higher for this indicator. Thailand, starting with 47% of children being stunted in 2010, even under optimistic growth assumptions, will not be able to reach a level of low severity. In Viet Nam, where almost 60% of children in our sample were stunted in 2010, a stronger influence of income on nutrition leads to a faster reduction of stunting rates than in Thailand. Hence, with 6% growth, Viet Nam will achieve lower stunting rates than Thailand and, with 8%, will even be able to reach a level of low severity. However, results must

be treated with care because it is not clear if the underlying pattern of nutritional improvement will continue.

5. SUMMARY AND CONCLUSIONS

In this paper, we investigate the relationship between poverty and nutrition of rural households in the context of two emerging Asian market economies, namely, Thailand and Viet Nam. We started out by asking four questions. First, we examine to what extent the problem of undernutrition continues to exist in spite of the enormous progress that these two countries have made in poverty reduction. Second, we try to identify the characteristics of households that have children with undernutrition problems. Third, we assess the relationship between monetary wealth and nutrition by analyzing the factors that influence the nutritional status of children in rural households as these households move out of poverty. Fourth, and building on the results of the third point, we speculate about the future of undernutrition by setting 2030 as the target because this is believed to be the period when poverty will have come to an end in most Asian countries.

The answer to the first question is a clear yes! As expected, there are differences between the two countries. The rate of undernutrition based on WFA Z-scores from our 2010 data set is clearly lower in Thailand with just about 19% of children below the WHO-defined threshold and some 30% in Viet Nam. The latter figure is quite close to the one predicted by Haddad et al. (2003) for 2015.

As regards a typology of households with undernourished children, we conclude that, as expected, socioeconomic conditions matter. For example, undernourished children live in households with less migrant members and, thus, fewer remittances which limit their possibility to buy higher quality food. They also tend to have mothers who are less educated than children who are beyond the nutrition threshold. However, it is not merely the wealth status that matters. There seem to be distinct environments of undernourishment, especially related to poor sanitation. The comparison across household types suggests that non-monetary factors are important for reducing undernutrition of children and, therefore, monetary poverty reduction is unlikely to be a sufficient condition for solving the nutrition problem of rural populations in emerging market economies.

For the third question, we developed a model linking nutritional outcomes for children with income and a set of other control variables. The results are similar to findings in the literature (e.g., Alderman, Hoogeveen, and Rossi 2006). Our four categories based on poverty and nutritional status show that the factors that condition a child's nutritional outcome differ by poverty status. As expected, growth in income helps to improve nutritional outcomes, but the effect is weak, which is in line with the conclusions in the literature. However, child and mother characteristics have effects as well. For example, education matters regardless of whether the household is below or above the poverty line. In addition, there is a significant child-gender effect that is consistent across all four groups, with girls having better nutrition Z-scores. Migration and remittances are important for poor households. Similarly, ethnicity matters in Viet Nam because children without nutritional problems who live in poor households tend to belong to the ethnic majority. The models also reveal differences between the two countries, as shown by a positive country effect for Thailand.

Regarding the fourth question, we conclude that our predictions show that undernutrition is likely to exceed the period after which most Asian countries might be out of poverty. Even when using quite optimistic assumptions for growth in income,

undernutrition is predicted to persist beyond 2030 so that it cannot be expected that the WHO threshold of 10% will be achieved for Viet Nam, which starts at a much lower level in the base year 2010, and, even for Thailand, this may not be the case.

Some caution is necessary when interpreting our results. Although the panel data set with some 4,000 rural households and 22,000 individuals, including adults and children, is suitable to conduct such analysis, the sample size for children under five years of age is not very large compared with other nutrition studies.

Overall, our results give some evidence that reducing or eliminating monetary poverty does not directly translate into reduction of non-monetary poverty. Further advancing the econometric analysis, however, will help to establish stronger evidence for the persistence of nutritional poverty beyond income poverty.

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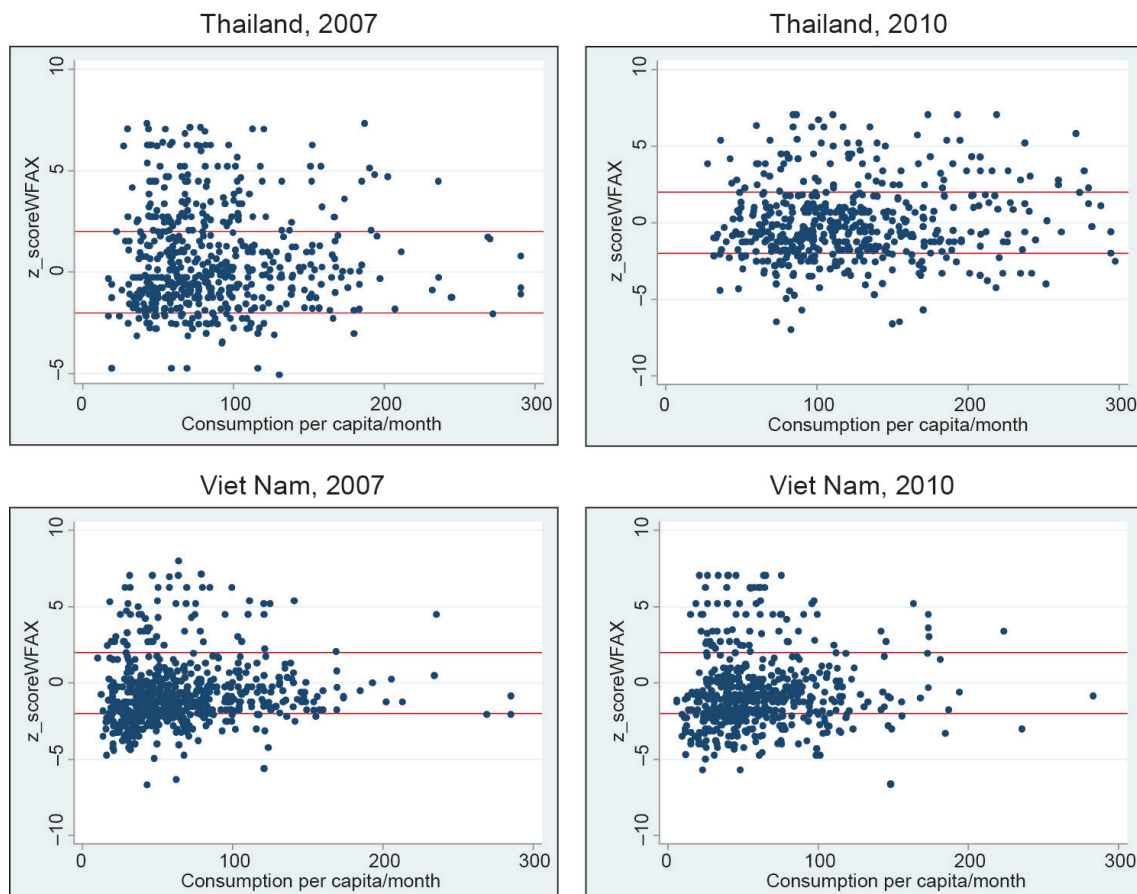
APPENDIX

Figure A.1: Consumption and BMI of Adults, TH and VN, 2007 and 2010



Source: Household Survey 2007 and 2010.

Figure A.2: Consumption and Weight for Age of Children below 5 Years, TH and VN, 2007 and 2010



Source: Household Survey 2007 and 2010.

Appendix Table A.1: Nutrition Models for Children, Thailand

Dependent variable: Z-score WFA	ALL (OLS)	ALL (IV)	0-2\$	>2-4\$	>4\$
Income					
Income per capita (log)	0.503 (0.319)	2.968* (1.660)			
Child					
Child was sick	0.117 (0.227)	0.181 (0.252)	0.127 (0.360)	1.214** (0.476)	-0.746*** (0.285)
Child is a girl	0.156 (0.140)	0.210 (0.148)	0.033 (0.205)	0.142 (0.268)	0.533** (0.212)
Mother					
Mother height	0.018* (0.010)	0.014 (0.010)	0.023* (0.013)	-0.002 (0.017)	0.017 (0.017)
Mother education	0.039* (0.021)	0.001 (0.032)	0.022 (0.036)	0.048 (0.040)	0.040 (0.029)
Mother is a migrant	0.295 (0.213)	0.363 (0.223)	0.461* (0.272)	-0.228 (0.392)	0.501 (0.462)
Household					
Household size	-0.006 (0.034)	0.028 (0.040)	0.040 (0.041)	0.076 (0.072)	-0.114** (0.056)
Dependency ratio	-0.066 (0.096)	-0.037 (0.098)	-0.037 (0.137)	-0.131 (0.150)	-0.033 (0.161)
Migration of HH members	0.010 (0.011)	0.012 (0.011)	0.001 (0.014)	0.035 (0.024)	-0.003 (0.021)
Private Toilet	0.213 (0.251)	0.210 (0.254)	0.093 (0.387)	0.262 (0.314)	-0.097 (0.494)
Tap water	-0.005 (0.138)	-0.036 (0.141)	0.031 (0.228)	-0.440* (0.254)	0.225 (0.209)
Village					
% HHs with sanitation	0.004** (0.002)	0.004** (0.002)	0.007** (0.003)	0.003 (0.003)	0.003 (0.003)
Distance to town	-0.003 (0.002)	-0.003 (0.002)	0.000 (0.004)	-0.002 (0.004)	-0.007* (0.004)
Village income mean (log)	-0.386 (0.473)	-1.064 (0.655)	-0.105 (0.789)	-0.865 (0.755)	0.065 (0.558)
Ubon Province dummy	0.252 (0.168)	0.216 (0.173)	-0.064 (0.274)	0.582* (0.312)	0.410* (0.246)
Nakhon Phanom Province dummy	0.140 (0.212)	0.132 (0.212)	0.100 (0.333)	0.515 (0.377)	0.245 (0.313)
2008 year dummy	-0.075 (0.126)	-0.085 (0.131)	-0.200 (0.213)	0.015 (0.282)	-0.068 (0.241)
2010 year dummy	-0.557*** (0.164)	-0.664*** (0.186)	-0.908*** (0.293)	-0.724** (0.302)	-0.165 (0.252)
_cons	0.365 (3.579)	-10.929 (8.296)	-1.453 (5.288)	7.433 (5.645)	0.036 (4.710)
N	1376	1376	567	363	446
R ²	0.20	0.16	0.18	0.25	0.27

Notes: * p<0.1, ** p<0.05, *** p<0.01. Standard errors are clustered on individual level. Age is controlled for and significant. IV: Asset value.

Source: Own calculations based on household surveys 2007–2010.