Poverty and nutrition: a case study of rural households in Thailand and Vietnam

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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 Vietnam are 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 and especially of children. We find that undernutrition continues to be a problem in Vietnam with child underweight rates of 27% and therefore higher than headcount rates of the 1.25$ poverty line. Also in Thailand, after the economic crisis with 19% of children underweight is still above the WHO 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 poverty and income to influence nutrition outcomes, but other factors such as mothers' height, education, migration and sanitation to condition nutrition as well. 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 here 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.

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1. Introduction

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

Clearly one of these dimensions is nutrition. The global food price crises reminded the development community that food security remains a global concern. The number of undernourished people in the world passed beyond the 1 billion mark, the majority of them belongs 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 Vietnam, 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 and 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 Vietnam 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 the two countries?
3. What are the factors that influence nutrition outcomes as households depart from the 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 the next section the conceptual framework is introduced which outlines the measures and the models used in this analysis. In section three a description of the data is performed. In section four the econometric model results and a prediction of nutrition outcomes are shown. Finally, chapter five 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 in order to identify the nutrition outcome variables. Second we discuss the direction of influence between wealth and nutrition by reviewing relevant literature and 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 WHOs Global Targets 2025. Also, the largest share of scientific publications on malnutrition concentrates on children below 5. 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 are already adults. Second, children`s bodies react faster to changes in food supply and food shortages manifest faster in weight and height than for adults. Therefore, the nutritional status of children below 5 is a good proxy for the current nutritional situation of a population. However, only a share of households has children below 5. 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 (a – d) while for adults the body mass index (e) is the only measure.

(a) Weight-for-age (WFA) (underweight)
(b) Height-for-age (HFA) (stunting)
(c) Weight-for-height (WFH) (wasting)
(d) Body Mass Index (BMI) for age (for children)
(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. All five indicators are used as a proxy of undernutrition relative to defined threshold values. Although calculated from the same anthropometric data, these indicators measure different aspects of undernutrition and therefore can give different results for the same population. The most commonly used measure is Weight-for-age (WHO Working Group, 1986) for example used in the Millennium Development Goals, since it reveals both, acute and chronic malnutrition (de Onis & Blössner, 2003). Stunted growth, which means low height relative to age (HFA), is an indicator for chronic malnutrition and early childhood illnesses. WFH height is regarded as an indicator for acute undernutrition as weight can drop rapidly in cases of acute food shortages while 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, Flegal, Nicholls, & Jackson, 2007)

Statistically, child undernutrition is measured using growth data in comparison to an international healthy reference population of the same age (height), based on WHO standards (de Onis et al. 2009). To describe the extent of malnutrition for (a) to (d) z-scores are used which are defined as "observed value minus the median value of a reference population divided by the standard deviation of that reference population." 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 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 while 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 & Thomas, 1995). Aside from income, health and nutrition can be considered as components of a household's utility function, given a household's 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 & Currie (2011) it is increasingly recognized that the health and nutrition status of children is not only subject to postnatal but to prenatal conditions as well. This suggests that information about mother's health prior to child birth is important to assess the nutrition status of children. Modelling nutrition outcomes (N) therefore can be formulated as a function of household income, household

(X) and village (Z) characteristics, child (C) and mother's (M) characteristics. Following Kabubo-Mariara et al. (2009) we specify a model for the nutritional status of children below the age of five (equation1):

(1) $N_{it} = f\,(Y_{jt,}\, C_{it},\, M_{it},\, X_{jt,}\, Z_{kt,}\, \varepsilon_{it})$ for children below 5

N_{it} is the nutritional outcome of child *i* at time *t*, Y is income of household *j*, C are child, M mother and A adult characteristics of person *i*, X describe household characteristics and Z is a vector of characteristics of village *k,* all at time *t*. In our models, we use z-scores of WFA as dependent variables for children.

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 intake is subject to food access which is determined by market infrastructure and the general state of agricultural development. As basic cause of undernutrition maternal and child care practices is hypothesized to influence 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 has positive effects on nutrition and health (e.g. Anand & Ravallion, 1993; Strauss & Thomas, 1998) but this relationship can vary across countries and within households (Haddad, Alderman, Appleton, Song, & Yohannes, 2003). This difference can be attributed to inequality and the extent to which public goods are directed towards nutrition (Anand & Ravallion, 1993).

Further, we include for child characteristics age, gender and a dummy to reflect whether the child was sick in the reference period. Since the risk of malnutrition has been shown to differ with age of children (Alderman, Hoogeveen, & 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, & 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 et al., 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 which may benefit a child's nutrition status. Adult characteristics include similar variables: gender, education, age and a dummy on sickness. For household characteristics (X) we include household size and dependency ratio which

may influence the resource situation of the household and the degree of child care (Belitz et al., 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 a dummy on having running water and whether or not the household has a private water toilet. For village characteristics health infrastructure is included proxied by 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 average income of the village. In Vietnam we also include a dummy for ethnic minorities and control for different agro-ecological zones, i.e. whether the household is located in the mountainous region.

Most studies on child undernutrition use Demographic and Health Survey data (e.g. Agee, 2010; Kabubo-Mariara et al., 2009; Kandala et al., 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 we do have direct measures available, therefore we include (log) income per capita income as Y. We take WFA as nutrition outcome indicator (Ni) as a continuous variable in z-scores for children below 5. First, we estimate an OLS over the entire sample. In accordance with our objective to explore the relationship between poverty reduction and nutritional status of the rural population in Vietnam and Thailand we establish four groups, namely: (a) children who live in poor households based on poverty line of 2 $ per capita income and are underweight based on – 2 z-score cut-off 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 and not underweight(as expected).

As the dependent variable we use z- scores of WFA. The dependent variable is truncated at the upper limit of -2 for groups (a) and (c) and truncated at the lower limit -2 for groups (b) and (d). 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 factor for undernutrition as we look at those households which are income poor but do not have underweight children. Since households tend to shift income shares to food when resources become scarce, an increase in income might have different influence 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. As we have pooled panel data, we use cluster robust standard errors on individual level. All models are estimated for both countries together, controlling for country effects with a dummy, and separated by country. As pointed out by several authors (e.g.

Alderman et al., 2006; Haddad et al., 2003) income measures can be subject to endogeniety, e.g. due to measurement errors. A possible solution is to use asset value as instrumental variable. We tested for endogeniety using the Durban-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 exogeniety of the income measure and therefore prefer OLS and Tobit variants to instrumental variable approaches. Where we detected endogeniety (Vietnam data, full model on all groups), we additionally reported a IV 2sls regression.

3. Descriptive Analysis

In this section we describe the background of our data which were collected among some 4000 households in three provinces of both countries respectively in 2007 2008 and 2010. A summary table of all variables included in the model is available in the appendix. The areas covered by our panel survey belong to areas that can be characterized as vulnerable to poverty due to poor infrastructure and a generally strong reliance on natural resources for livelihoods. Table 1 shows the poverty headcount ratios for 2007, 2008 and 2010 for the 1.25 $ and the 2 $ income per capita and day poverty lines. The data show that while absolute poverty is relatively low (i.e. using 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 household and between 45 and almost 70 % of the Vietnamese household below the poverty line. In both countries, poverty increases by 10 to 20% when the poverty line is increased from 1.25 $ to 2 $. Variation between provinces is small but has 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 has declined stronger in Thailand than in Vietnam which suggests that Thailand recovered better from the crisis and social protection measures may have been effective in favor of the poor.

Table 1 Poverty headcount ratio in Thailand and Vietnam based on per capita income 2007, 2008 and 2010

	1.25$ poverty line			**2$ poverty line**		
	2007	**2008**	**2010**	**2007**	**2008**	**2010**
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
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 - 2010.

This is further illustrated in Figure 1, which shows the cumulative distribution 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 and month (4 $ 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 while differences among provinces are more pronounced in Vietnam.

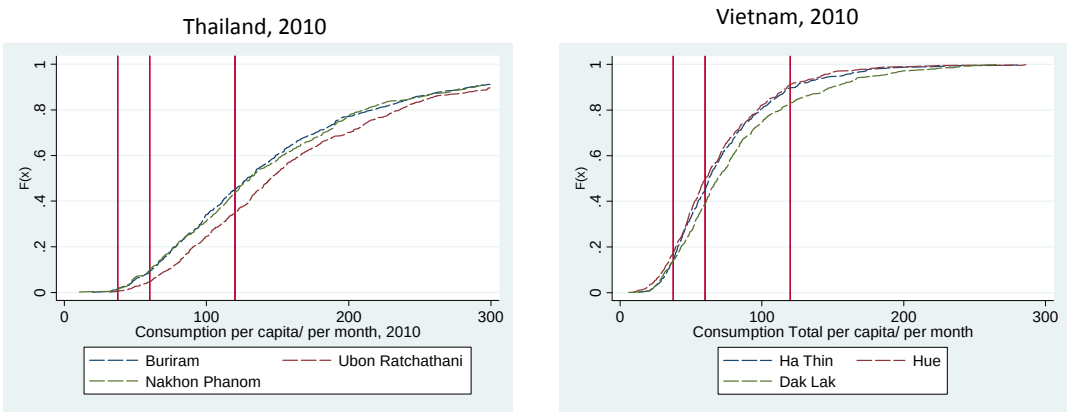

Figure 1: Distribution of Consumption in Thailand and Vietnam, 2010. Poverty lines at 1.25$, 2$ and 4$ per day.
Source: Household Survey 2007 and 2010.

In Figure 2 the effect of food prices on the distribution of food consumption shares is shown for both countries aggregating the data of the respective three provinces. 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, in both countries distributions shifted to the right. 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 Vietnam where the mode shifted to about 80 % while 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.

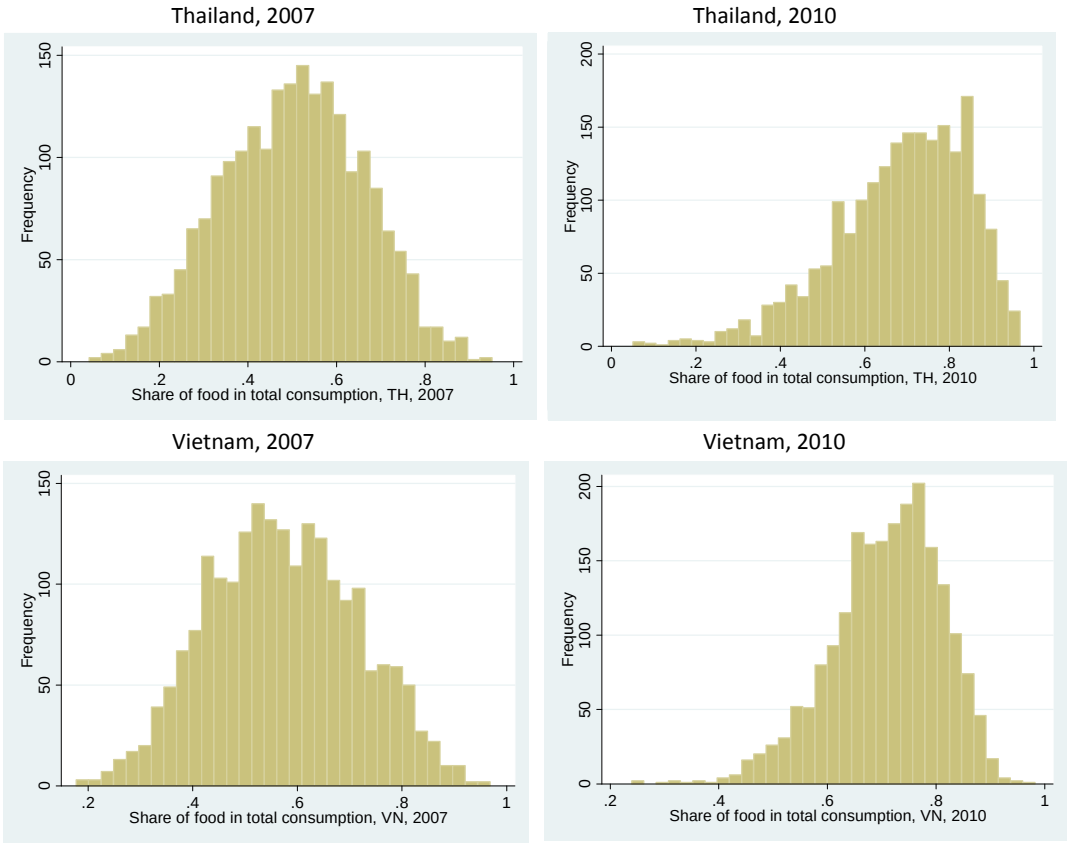

Figure 2: Share of food in total consumption, 2007 and 2010, Thailand and Vietnam
Source: Household survey 2007 and 2010.

In the next step we assess nutritional outcomes of the households in our sample. In Figure 3 the distribution of BMI for the adult rural population in both countries is presented and Figure 4 the WFA z-scores for children are shown using the 2010 data set. For adults, average BMI in Thailand is higher than in Vietnam where the share of persons below the 18.5 threshold is considerably higher. This suggests that undernutrition is still a problem. Interestingly, the proportion of adult people which are underweight is in both countries similar or even higher than the share of poor people. In addition, in Thailand the so called double-burden phenomena can be observed whereby the share of obesity is almost at par with the occurrence of undernutrition.

Figure 3 shows the distribution of the Weight-for-age z-scores for children below 5 years in 2010. Referring to the – 2 z-score threshold it can be shown that about 19 % of the pre-school children in Thailand and 27 % of the children in Vietnam in can be 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 to note 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 $ line. This supports the notion that the reduction of monetary poverty is not a sufficient condition for the elimination of undernutrition.

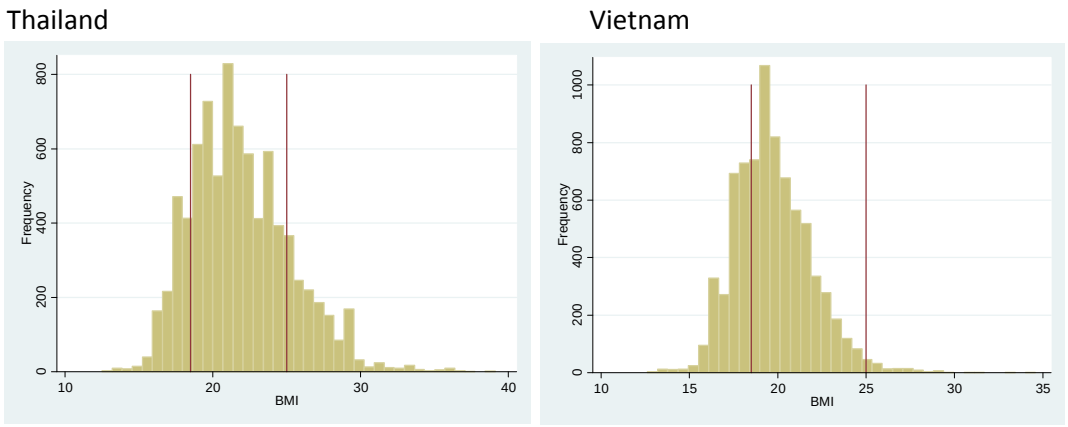

Figure 3: Distribution of the Body-Mass-Index over adult household members; Thailand and Vietnam 2010
Source: Household Survey 2010

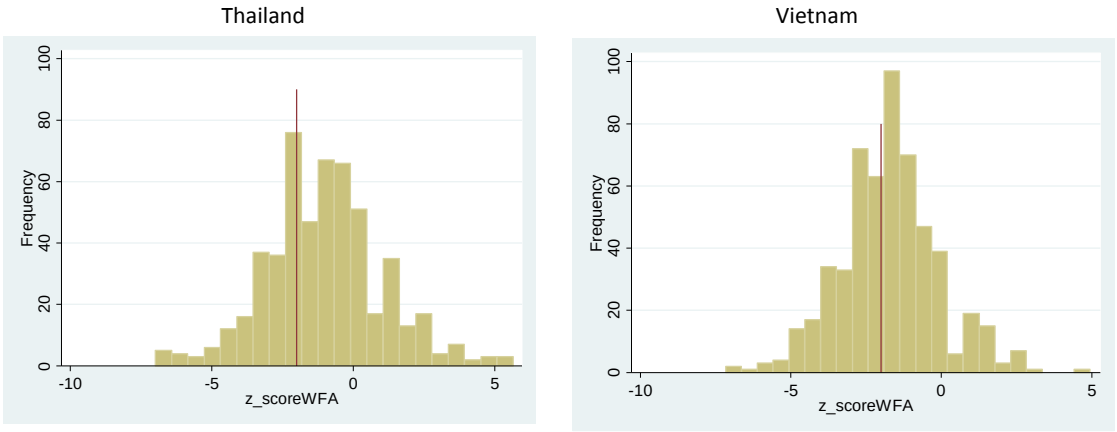

Figure 4: Distribution of the Weight-for-age z-scores over children below 5 years; Thailand and Vietnam 2010
Source: Household Survey 2010

A complete overview of nutrition indicators, pooled over three years, is presented in Table 2. We calculated the mean differences in nutrition outcomes for the pooled data set of three years on average and across different intervals of per capita income for Thailand and Vietnam separately. We can 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 Vietnam. For the comparison across income groups, we start with a PCI of below 2 and take 10 $ or more per day as upper range. For nutrition indicators we take the respective shares based on WFA, BMI, HFA, WFH for children and BMI for adults.

Table 2: Mean differences in nutrition outcomes of households in Thailand and Vietnam, 2007, 2008, 2010 (pooled)

Income (PPP-$ per capita and day)		**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
VIETNAM							
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 2007-2010

From Figure 5, it can be seen that in Vietnam there is a clearer relationship between the decline in undernutrition and per capita income as compared to Thailand. However, in the latter country the shares for WFA for children and BMI for adults at the lowest income level are only about one third of those for Vietnam. Nevertheless it can also be shown for Thailand that as households move into the middle income category nutrition tends to improve. In Vietnam the most dramatic decrease for WFA appears to take place between 3 and 5 $ per day with a lower decline even at income levels below 10 $. While causality cannot be assumed with this type of comparisons as other factors may be confounding the decline, it is consistent with earlier predictions for Vietnam in the literature (e.g. Haddad et al., 2003).

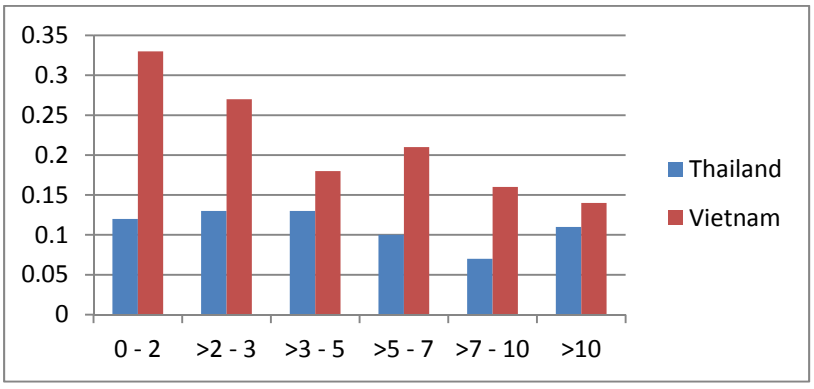

Figure 5: Share of children underweight based on WFA, across income groups.
Source: Household Survey 2007-2010

The relationship between income and nutrition outcomes is further demonstrated in Figure A 1 (see appendix), showing a scatterplot of the data set relating monthly per capita consumption and adult BMI. For Thailand it can be shown that while the likelihood of a person to fall out of the norm tends

to decrease with higher income the dispersion is high and is even increasing in 2010, i.e. after the crisis. In Vietnam this pattern is clearer and also more consistent between the two years. In both countries it can be established that there is a considerable share of undernutrition beyond the poverty line, i.e. the nutrition problem does not end when a household has surpassed the poverty line. In Figure A2 a similar exercise is performed for WFA of children. Generally dispersion is higher than for adult BMI. While the share of underweight children is higher in Vietnam there is a fair amount of overweight existing among children in both countries which suggests misguided developments in nutrition. In any cases what can be said for adult also seems to be true for children, i.e. the end of poverty is not the end of malnutrition; and in addition other problems emerge such as obesity.

In the next step of the descriptive analysis of our data we establish four groups based on the criteria poverty and nutrition. Group (1) are children living in households below the 2 $ poverty line and who are underweight based on the WFA indicator. Group (2) also represents children from poor households who are not underweight. Group (3) and (4) are children from non-poor households with and without underweight respectively.

It can be shown in Table 3 that children's characteristics on individual, households and village level differ among the four groups. Some of the parameters are related to income such as per capita consumption and the sources of income. In Thailand, poor households tend to have less small scale businesses and tend to rely more on own agriculture and wage labor. Poor households with underweight children have less consumption than poor households with normal weighted children, and therefore shift a higher share towards food. Poor households also tend to live in villages with less favorable infrastructure conditions as they live in villages which are less well connected to health services and markets suggesting the existence of environments of the poor. There are also distinct characteristics of poor and non-poor households with underweight children. Undernourished children compared to their counterpart group in the same income category (poor vs non poor) tend to have mothers who are less educated and of shorter height and tend to have mothers (and other household members) who spent less months working as migrant worker. Also, undernourished children live in villages where sanitation is generally poorer than in reference locations. Hence it can be concluded that for nutrition there are factors which are beyond monetary wealth such as living in certain environments and inherited and other pre-natal conditions.

Table 3: Comparison of children by poverty (2 $ PL) and nutrition status (WFA), Thailand 2007 – 2010.

Group	(1) Poor & Underweight	(2) Poor & No underweight	(3) Non poor & Underweight	(4) Non poor & No underweight
Income				
Consumption PC	71.50	76.01	110.50	110.31
Share Agric Income*	0.40	0.52	0.21	0.22
Share Nat Income*	0.09	0.11	0.04	0.03
Food Consumption PC	33.64	47.35	72.94	68.16
Share Food Cons.	0.75	0.58	0.57	0.57
D: business income	0.19	0.21	0.35	0.34
Child				
sick	0.05	0.05	0.01	0.04
childGirl	0.48	0.46	0.44	0.45
Mother				
m_height	154.32	156.1	156.90	157.84
meduyears	7.09	7.40	8.66	9.33
m_migrant	0.15	0.22	0.15	0.19
Household				
HHsize	5.30	5.46	5.17	5.37
dep.ratio	2.18	2.05	2.01	1.89
migmonth_other	1.03	2.67	0.92	2.20
Share business worker	0.05	0.05	0.27	0.10
PrivToilet	0.89	0.95	0.98	0. 97
Tapwater	0.25	0.27	0.23	0.30
Value assets PC	628.45	1342.20	1677.86	1986.50
Value livestock PC	189.87	180.64	202.15	245.11
Landsize PC (ha)	0.67	0.57	0.74	0.78
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	685	137	979

Notes: * negative crop/natural resource incomes excluded.
Source: Household Survey 2007 – 2010

The respective comparison for Vietnam shows similar results. For a household's poverty status occupational orientation and sources of income and migration play an important role. In addition land size plays a bigger role than in Thailand. Furthermore the living environment, i.e. when a household lives in mountainous areas, this increases the chance that a child will be undernourished independent of the poverty status of its household. One distinct difference between the two countries is the shares of undernourished children in the respective poverty class. In Vietnam for poor households the ratio is about 1:2, i.e. at least one out of three children in poor households is undernourished while for non-poor households it is one out of five. For Thailand the respective ratios are about 1:7 and 1:8, respectively, which once more underlines the expectation that nutrition problems continue to exist beyond the poverty line.

Table 4: Comparison of households by poverty (2 $ PL) and nutrition status of children (WFA), Vietnam 2007 – 2010.

	(1) Poor & Underweight	(2) Poor & No underweight	(3) Non poor & Underweight	(4) Non poor & No underweight
Income				
Consumption PC	47.80	50.44	68.68	78.51
Income PC	24.65	25.63	148.43	165.82
Share Agric Income	0.53	0.71	0.37	0.34
Share Nat Income	0.05	0.06	0.02	0.03
Nat Resource Income	1.14	1.36	2.30	3.97
Public Transfer income	2.18	1.43	7.01	6.11
Food Consumption PC	33.28	34.51	47.09	51.99
Share Food Cons.	0.75	0.87	0.75	0.67
D: business income	0.14	0.18	0.33	0.38
child				
sick	0.08	0.04	0.04	0.02
childGirl	0.59	0.48	0.52	0.50
mother				
m_height	154.69	154.62	155.12	154.99
meduyears	5.43	6.12	6.80	8.27
m_migrant	0.00	0.01	0.02	0.01
household				
HHsize	5.49	5.62	5.12	5.03
dep.ratio	2.25	2.27	1.95	2.01
migmonth_other	0.04	0.09	0.15	0.20
Share worker own agric.	0.81	0.80	0.68	0.56
Share business worker	0.15	0.15	0.18	0.28
Ethnic Min	0.37	0.31	0.33	0.17
PrivToilet	0.09	0.10	0.19	0.29
Tapwater	0.06	0.06	0.07	0.14
Value assets PC	389.82	345.02	788.00	1043.70
Value livestock PC	152.35	145.35	337.57	237.58
Landsize PC (ha)	0.13	0.14	0.22	0.17
Share 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 markt	20.06	18.38	17.97	15.69
Distance hospital	37.07	35.90	30.65	31.58
VSmountain	0.31	0.29	0.44	0.37
N	341	693	161	672

Source: Household Survey 2007 – 2010

In summary, our descriptive and explorative analysis for some 4000 rural households corresponding to over 22000 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 could also form the basis for the establishment of some hypotheses to be further explored in subsequent econometric analysis.

The first observation is that while poverty reduction has been 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 when increasing the poverty line to 2 $ 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.

The second point is that nutrition problems persist in both countries in spite of their success in poverty reduction. Again the problem is bigger in Vietnam as compared to Thailand. A considerable share of the rural adult population falls out of the norm based on a minimum body mass index of 18.5. In Thailand, this share is about 13 % and in Vietnam 25 % of the adult rural population in the three provinces is underweight. For children under 5, the shares below the critical level of BMI are 13 % and 12%, respectively. However, HFA and WFA are more meaningful and there the respective shares below the critical levels are 42 and 12% for Thailand and even 50 % and 27 % for Vietnam which suggests that underweight is still a problem especially in Vietnam. The latter value corresponds well with Haddad et al (2003) who predicted, with their cross country nutrition model, underweight (WFA) for pre-school children in Vietnam to be at around 28 % in 2015.

Third, as suggested in the literature, income is a poor predictor for success in reducing undernutrition. Moving up the income scale starting with 2 $ PCI and going beyond 10 $ PCI shows that undernutrition of children declines only slightly in Thailand. It does more rapidly in Vietnam 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 nutrition 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 as 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 model described above may be warranted.

Finally, by establishing four different household categories based on poverty and nutrition it can be observed that households with undernourished children have some common characteristics which 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 literature and the findings of our descriptive and explorative analysis econometric models as outlined in section 2 have been developed. The dependent variable of these models is the WFA z-score, hence a positive significant sign of any exploratory variable suggests improvement of the nutrition status of a child. First, an ordinary OLS was estimated for the pooled data set of 2007, 2008 and 2010 including both countries and capturing the country effects by a dummy variable. Second, separate models were estimated for the four household groups based on poverty and nutrition status. We first estimate the models combined for Thailand/Vietnam, and supplement it with a version only including data from Vietnam, where the nutritional problem is more severe.

In column 1 of Table 4 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 et al., 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 has been found by some authors (Belitz et al., 2010; Svedberg, 1990). However, the variable mother's height is positive which is consistent with findings in the literature and suggests that pre-natal conditions influence the nutrition status of the child. On the other hand we do not find a significant effect of education and 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 village level significantly increase nutritional outcome. Being born in an ethnic minority decreases the nutritional outcome, which is plausible as in Vietnam 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 Vietnam is reflected in the significant country dummy.

In columns 2-5 of table 5 regression results of the truncated Tobit regressions on z-scores 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. While 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. While well-nourished children might be less often those with sickness, richer households might have access to better health care to invalidate the effect. As second variable of child characteristics, girls do 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 would be necessary. Migration status of the mother gives a clearer picture as it is correlated positively with nutrition for those children below the poverty line. While the effect appears quite clear, channels are less clear. On the one hand, migrated mothers can spent 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, will 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 are not correlated with nutrition, except for household size which is positively correlated with nutrition for those underweight children above the poverty line. Ethnic group 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 overnourished ethnic minority children.

Furthermore on household and village level results show that sanitation is important. Having a private toilet as well as the percentage of households with sanitation in the village are positively correlated with 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 for most groups not significant, indicating that the situation is generally comparable in Vietnam and Thailand. An exception is the group of non-poor non-undernourished children in Thailand suggesting again the existence of an overnutrition problem. Not reported are the control variables for the year, which shows negative significance for 2010, and the age of children, which shows, as expected from the literature, significantly worse nutrition values for older children.

Table 5: Pooled OLS & Tobit Model of WFA z-scores for four different groups households based on poverty and nutrition status

Variables	ALL (OLS)	Poor & Underweight	Poor & No underweight	Non poor & Underweight	Non poor & No underweight
Income					
income PC	0.162***	0.038	0.206***	-0.037	0.105
	(0.036)	(0.036)	(0.061)	(0.092)	(0.091)
child					
sick	-0.312*	-0.292*	-0.142	-0.190	-0.235
	(0.163)	(0.161)	(0.210)	(0.252)	(0.242)
childGirl	0.170*	0.257***	0.220*	0.459***	0.232**
	(0.088)	(0.093)	(0.118)	(0.125)	(0.106)
mother					
m_height	0.018***	-0.003	0.012	-0.016	0.020**
	(0.007)	(0.007)	(0.010)	(0.014)	(0.008)
meduyears	0.012	0.030**	-0.032*	-0.001	0.026*
	(0.012)	(0.014)	(0.018)	(0.020)	(0.015)
m_migrant	0.270	0.459**	0.598**	-0.431	0.354
	(0.221)	(0.213)	(0.274)	(0.470)	(0.257)
household					
HHsize	0.024	0.003	0.039	0.060*	0.003
	(0.024)	(0.023)	(0.027)	(0.032)	(0.035)
dep.ratio	0.051	0.023	0.064	0.162	0.071
	(0.059)	(0.052)	(0.079)	(0.104)	(0.070)
migmonth_oth	0.017	-0.010	-0.007	0.040	0.007
	(0.012)	(0.009)	(0.017)	(0.040)	(0.013)
EthnicMin	-0.295**	0.039	-0.348**	-0.009	0.356*
	(0.126)	(0.113)	(0.155)	(0.204)	(0.206)
PrivToilet	0.339***	-0.259	0.430**	0.086	0.186
	(0.123)	(0.263)	(0.193)	(0.184)	(0.132)
Tapwater	0.003	0.045	-0.116	0.011	0.168
	(0.093)	(0.110)	(0.141)	(0.134)	(0.115)
village					
VPsanitation	0.003**	0.003	0.005***	-0.000	0.002
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
DISTtown	-0.001	-0.001	-0.000	0.001**	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
VILLinc	-0.000	-0.000	-0.001	-0.001	0.000
	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
Thailand	0.256*	-0.112	-0.109	-0.170	0.411**
	(0.146)	(0.263)	(0.222)	(0.203)	(0.161)
_cons	-0.743	-2.539**	0.770	-0.709	-0.885
	(1.077)	(1.145)	(1.524)	(2.023)	(1.339)
N	2873	365	959	264	1285

Notes: * p<0.1, ** p<0.05, *** 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)
Source: Household Survey 2007 – 2010

We repeat the analysis presented in table 5 for Vietnam because of the more severe nutrition problem. As we cannot reject exogeniety in the case of the full model for Vietnam, we also estimated an IV model, using value of assets as instrument (following Haddad et al., 2003). Results between OLS and IV are from the broad picture robust. The coefficient of the income variable is larger in IV regression, but in the same direction. As in the regression of both countries, sickness of the child has a negative effect on nutrition, but gender discrimination cannot be observed in the general model.

Influence of household characteristics differs slightly between OLS and IV. In the IV, household size and dependency ratio positively influence nutrition, in the OLS a private toilet has a positive influence. In both equations, belonging to an ethnic minority decreases while migration of other household members increases nutritional outcomes. The effect of migration has not been found in the combined Thailand/Vietnam model. Village characteristics do not have a significant influence in this model.

In the truncated models, we find no significant income effect which might be a result of low variance due to the income restriction while in the OLS and IV models this is not the case. Sickness is mainly a negative factor in the "poor and underweight" group. While there 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. While 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 decreases; 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 and much better infrastructure than Ha Thin (the poorest among the three provinces) in both the poor and non-poor underweight group. Also for Hue province, z-scores decreases for "poor and non-underweight" group and increases for the "non-poor underweight" group.

Table 6: Continuous outcome variable for children: Pooled OLS/ Tobit VN, indicator WFA, Poverty line 2 PPP$ (income), Vietnam.

	ALL (OLS)	All (IV)	Poor & Underweight	Poor & No underweight	Non poor & Underweight	Non poor & No underweight
Income						
income PC	0.123***	0.420***	0.032	0.053	-0.071	0.022
	(0.046)	(2.75)	(0.039)	(0.074)	(0.145)	(0.127)
child						
sick	-0.541**	-0.441*	-0.356**	-0.020	-0.303	0.334
	(0.239)	(-1.84)	(0.180)	(0.272)	(0.271)	(0.385)
childGirl	0.161	0.163	0.342***	0.312**	0.611***	0.202
	(0.101)	(1.62)	(0.104)	(0.132)	(0.161)	(0.127)
mother						
m_height	0.014	0.013	-0.008	0.010	-0.027	0.028**
	(0.009)	(1.38)	(0.008)	(0.010)	(0.017)	(0.012)
meduyears	-0.005	-0.015	0.043***	-0.069***	0.041*	-0.004
	(0.015)	(-0.99)	(0.015)	(0.022)	(0.023)	(0.018)
household						
HHsize	0.034	0.056*	-0.003	0.041	0.066**	0.058
	(0.032)	(1.67)	(0.024)	(0.040)	(0.032)	(0.045)
dep.ratio	0.106	0.143**	0.054	0.034	0.485***	0.064
	(0.069)	(2.04)	(0.052)	(0.092)	(0.129)	(0.095)
migmonth_oth	0.028*	0.027*	0.067***	0.017	0.057*	0.032***
	(0.017)	(1.69)	(0.025)	(0.022)	(0.029)	(0.012)
EthnicMin	-0.364**	-0.282*	-0.131	-0.451**	-0.064	0.148
	(0.147)	(-1.85)	(0.130)	(0.184)	(0.195)	(0.218)
PrivToilet	0.290**	0.170	-0.196	0.621***	-0.199	0.108
	(0.142)	(1.21)	(0.344)	(0.212)	(0.192)	(0.153)
Tapwater	-0.007	0.001	0.063	-0.055	-0.113	0.289
	(0.139)	(0.01)	(0.153)	(0.189)	(0.176)	(0.180)
village						
VPsanitation	0.000	-0.000	-0.000	0.004	-0.000	-0.001
	(0.002)	(-0.20)	(0.003)	(0.003)	(0.003)	(0.003)
DISTtown	-0.001	-0.000	-0.000	-0.001	0.001***	0.001
	(0.001)	(-0.98)	(0.002)	(0.001)	(0.001)	(0.000)
VILLinc	0.001	-0.000	-0.001	0.001	-0.000	-0.000
	(0.001)	(-0.58)	(0.001)	(0.001)	(0.001)	(0.001)
Hue	0.050	0.013	0.139	-0.419*	0.653**	-0.193
	(0.174)	(0.07)	(0.198)	(0.225)	(0.266)	(0.215)
DakLak	0.229	0.086	0.342**	-0.096	0.642**	-0.133
	(0.169)	(0.47)	(0.149)	(0.204)	(0.278)	(0.207)
VSmount	-0.206	-0.199	0.024	0.007	-0.097	-0.166
	(0.137)	(-1.45)	(0.134)	(0.180)	(0.147)	(0.154)
_cons	0.322	-0.482	-2.155*	2.076	0.355	-1.262
	(1.376)	(-0.34)	(1.236)	(1.643)	(2.430)	(2.001)
N	1586	1586	292	547	151	596

Notes: * p<0.1, ** p<0.05, *** 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

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, while 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.

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, & 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 Vietnam 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 in our data set for rural children in three Vietnamese provinces.

In Table 7, predicted shares of underweight children are reported separately for Thailand and Vietnam 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, for Vietnam, we use an IV regression. Coefficients are higher for Vietnam than for Thailand. The prediction is 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 to 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.

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 2 percentage points and even for the (unrealistically) high income scenario underweight in 2030 is still above 10 % (see table 6). In Vietnam the income effect is somewhat stronger which is to be expected since the point of departure is much higher with an almost 30 % underweight share. A 2 % income growth would bring down underweight to 21 % while the high income scenario would however result in a low severity situation based on WHO definition. The picture is similar for the HFA indicator, which reflects chronic malnutrition. The difference in the income effect between Thailand and Vietnam is even higher regarding 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 Vietnam, 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, so that with 6% growth Vietnam will overtake stunting rates from Thailand, and with 8% even be able to reach a level of low

severity. However, results must be treated with care as it not clear if the underlying pattern of nutrition improvement would remain.

Table 7: Predicted Values of child nutrition outcomes in 2030 for different levels of average income growth by country

		Thailand		Vietnam	
	Income growth	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 is assumed average annual income growth. Coefficients are from OLS in Thailand (WFA: 0.144, HFA: 0.123) and IV in Vietnam (WFA: 0.442, HFA: 1.048)
Source: Household survey 2010.

5. Summary and conclusions

In this paper we investigated the relationship between poverty and nutrition of rural households in the context of two emerging Asian market economies, namely Thailand and Vietnam. 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 which 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 as this is believed the period when poverty has 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 Vietnam. 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 can say 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 nutrition outcome for children with income and a set of other control variables. The results are similar to findings in the literature (e.g. Alderman et al., 2006). Our four categories based on poverty and nutrition status show that the factors that condition a child's nutrition outcome differ by poverty status. As expected, growth in income helps to improve nutrition outcome, but the effect is weak which is in line with the conclusions in the literature. However, child and mother characteristics show an effect as well. For example education matters regardless of whether the household is below or above the poverty line. Also there is a significant child gender effect which is consistent across all four groups with girls having better nutrition z-scores. Migration and thus remittances is important for poor households. Similarly, ethnicity matters (in Vietnam) as children without nutrition problems that live in poor households tend to belong to the ethnic majority (in Vietnam). The models also reveal differences between the two countries as shown by a positive country effect for Thailand.

Regarding the fourth question we can state 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 would persist by 2030 it cannot be expected that the WHO threshold of 10 % can be achieved for Vietnam, 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 4000 rural households and 22000 individuals including adults and children is suitable to conduct such analysis, the sample size for children under five is not that large as birth rates are declining in both countries and this family size decreases.

Overall the results so far may give some evidence to the notion that reducing or eliminating monetary poverty does not directly translate into reduction of non-monetary poverty. Further advancing the econometric analysis however could help to establish clearer evidence for the persistence of nutrition poverty beyond income poverty stronger.

References

ADB, UNDP, & UN ESCAP. (2013). *Asia-Pacific Aspirations: Perspectives for a Post-2015 Development Agenda*. Bangkok: ADB.

Alderman, H. (2012). The Response of Child Nutrition to Changes in Income: Linking Biology with Economics. *CESifo Economic Studies*, *58*(2), 256–273.

Alderman, H., Hoogeveen, H., & Rossi, M. (2006). Reducing child malnutrition in Tanzania: Combined effects of income growth and program interventions. *Economics & Human Biology*, *4*(1), 1–23.

Almond, D., & Currie, J. (2011). Killing Me Softly: The Fetal Origins Hypothesis. *Journal of Economic Perspectives*, *25*(3), 153–172.

Anand, S., & Ravallion, M. (1993). Human Development in Poor Countries: On the Role of Private Incomes and Public Services. *The Journal of Economic Perspectives*, *7*(1), 133–150.

Baulch, B., & Masset, E. (2003). Do Monetary and Nonmonetary Indicators Tell the Same Story About Chronic Poverty? A Study of Vietnam in the 1990s. *World Development*, *31*(3), 441–453.

Becker, G. S. (1965). Towards a theory of time allocation. *The Economic J*, *76*, 493–517.

Belitz, C., Hübner, J., & Klasen, S. (2010). Determinants of the socioeconomic and spatial pattern of undernutrition by sex in India : a geoadditive semi-parametric regression approach. In T. Kneib & G. Tutz (Eds.), *Statistical Modelling and Regression Structures: Festschrift in Honour of Ludwig Fahrmeir* (1. Aufl., pp. 155 – 179). 2010: Physica-Verlag.

Carter, M. R., & Barrett, C. B. (2006). The economics of poverty traps and persistent poverty: An asset-based approach. *Journal of Development Studies*, *42*(2), 178–199.

Clark, D., & Hulme, D. (2010). Poverty, time and vagueness: integrating the core poverty and chronic poverty frameworks. *Cambridge Journal of Economics*, *34*(2), 347–366.

De Onis, M., Garza, C., Onyango, A. W., Rolland-Cachera, M.-F., & le Comité de nutrition de la Société française de pédiatrie. (2009). [WHO growth standards for infants and young children]. *Archives de pédiatrie: organe officiel de la Sociéte française de pédiatrie*, *16*(1), 47–53.

Günther, I., & Klasen, S. (2009). Measuring Chronic Non-income Poverty. In T. Addison, D. Hulme, & S. M. R. Kanbur (Eds.), *Poverty dynamics: interdisciplinary perspectives* (pp. 77–101). Oxford: Oxford University Press.

Haddad, L., Alderman, H., Appleton, S., Song, L., & Yohannes, Y. (2003). Reducing Child Malnutrition: How Far Does Income Growth Take Us? *The World Bank Economic Review*, *17*(1), 107–131.

Kabubo-Mariara, J., Ndenge, G. K., & Mwabu, D. K. (2009). Determinants of Children's Nutritional Status in Kenya: Evidence from Demographic and Health Surveys. *Journal of African Economies*, *18*(3), 363–387.

Klasen, S., & Waibel, H. (Eds.). (2013). *Vulnerability to Poverty-Theory, Measurement, and Determinants*. Palgrave Macmillan.

Mckay, A., & Lawson, D. (2003). Assessing the Extent and Nature of Chronic Poverty in Low Income Countries: Issues and Evidence. *World Development*, *31*(3), 425–439. Menon, P. (2012). Childhood Undernutrition in South Asia: Perspectives from the Field of Nutrition. *CESifo Economic Studies*, *58*(2), 274–295. doi:10.1093/cesifo/ifs015

Sen, A. (2000). Social exclusion: Concept, application and scrunity. *Social Development Paper No.1, Manila: Asian Development Bank*.

Smith, L. C., Ramakrishnan, U., Ndiaye, A., Haddad, L., & Martorell, R. (2003). The Importance of Women's Status for Child Nutrition in Developing Countries. *IFPRI Research Report 131, Washington.* Retrieved from http://www.ifpri.org/sites/default/files/publications/rr131.pdf

Strauss, J., & Thomas, D. (1995). *Human resources: Empirical modeling of household and family decisions* (Handbook of Development Economics) (pp. 1883–2023). Elsevier. Retrieved from http://ideas.repec.org/h/eee/devchp/3-34.html

Strauss, J., & Thomas, D. (1998). Health, Nutrition, and Economic Development. *Journal of Economic Literature*, *36*(2), 766–817.

Svedberg, P. (1990). Undernutrition in Sub-Saharan Africa: Is there a gender bias? *Journal of Development Studies*, *26*(3), 469–486.

Tsui, K. (2002). Multidimensional poverty indices. *Social Choice and Welfare*, *19*(1), 69–93.

WHO. (2014). Global Database on Child Growth and Malnutrition. Retrieved April 9, 2014, from http://www.who.int/nutgrowthdb/about/introduction/en/index5.html

WHO Working Group. (1986). Use and interpretation of anthropometric indicators of nutritional status. *Bulletin of the World Health Organization*, *64*(6), 929–941.

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data* (2nd ed.). Cambridge: MIT Press.

Appendix

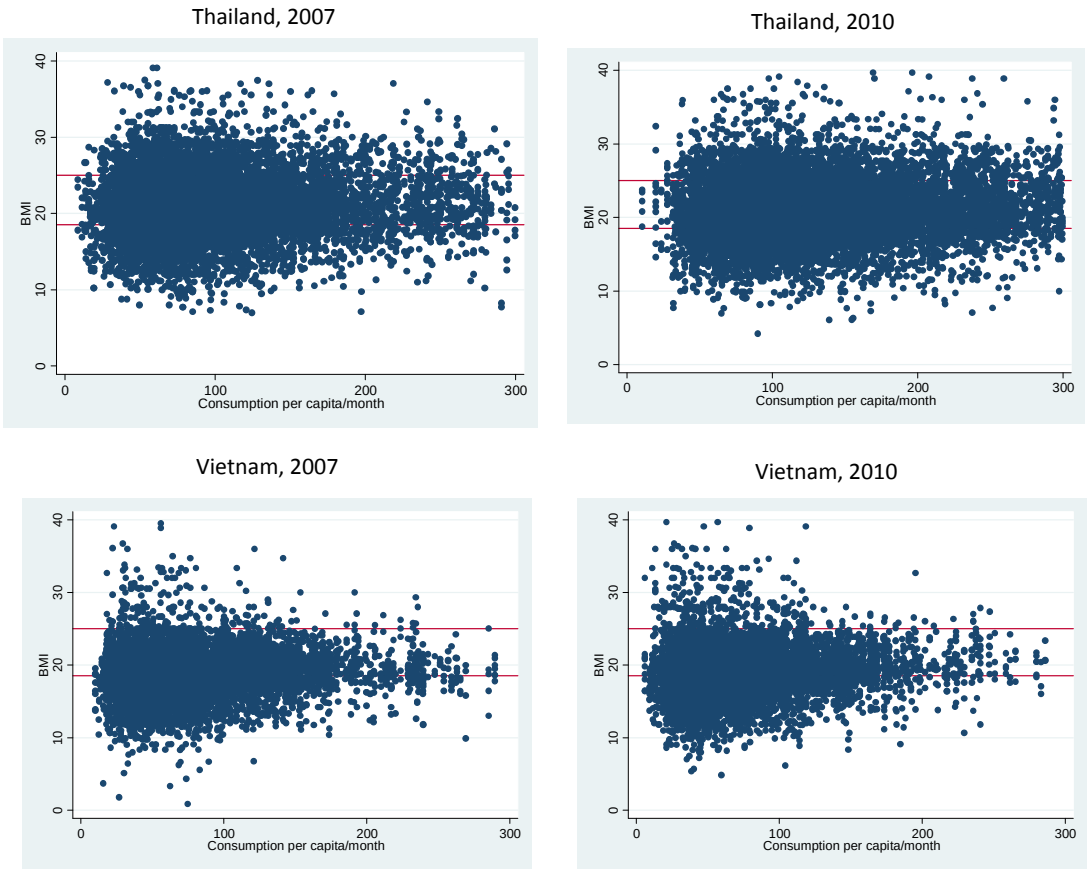

Figure A 1: Consumption and **BMI of adults**, TH VN, 2007 & 2010
Source: Household Survey 2007 & 2010

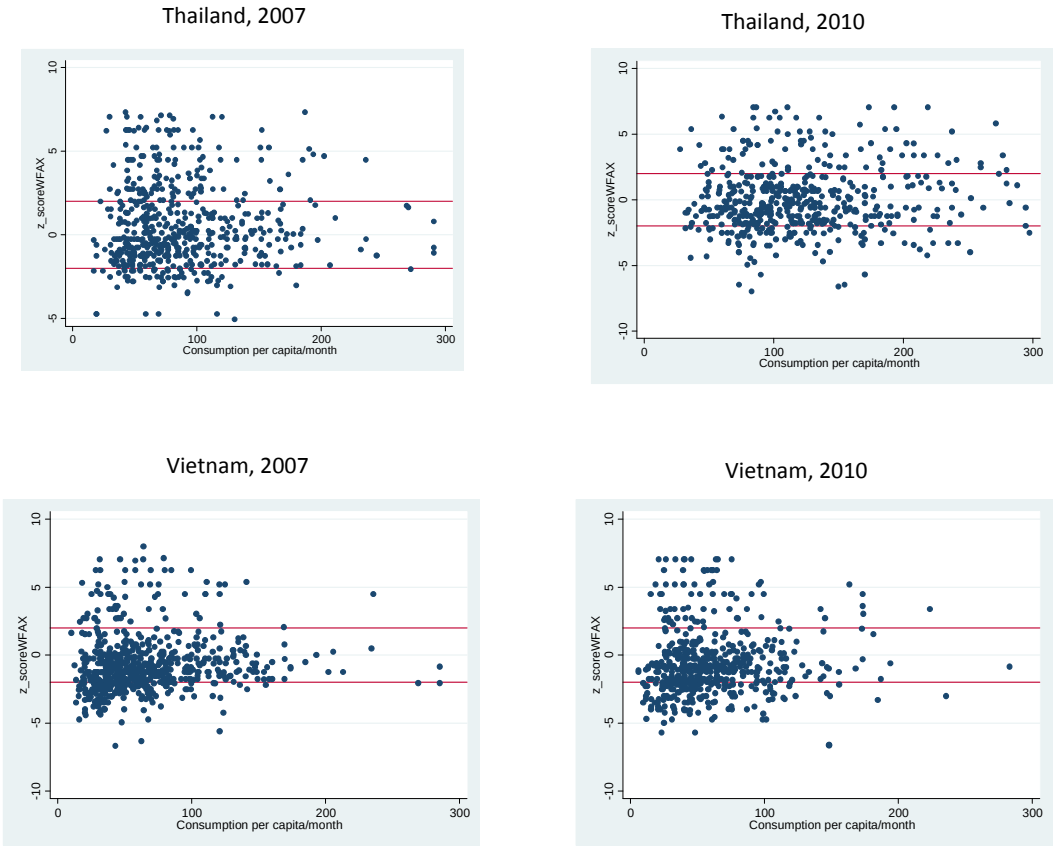

Figure A 2: Consumption and **Weight for Age of children below 5**, TH VN, 2007 & 2010
Source: Household Survey 2007 & 2010

Figure A 3: Definition and summary statistics of panel data Thailand and Vietnam, children below 5.

		Thailand		Vietnam	
Nutrition outcome		**mean**	**sd**	**mean**	**sd**
z_scoreWFA	z-score weight for age	0.33	2.49	-0.62	2.34
Income					
Income PC	Income per capita & 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_eduyears	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	Nucleus Household size	5.38	1.98	5.28	1.80
dep.ratio	Dependency ratio (HHsize/independent)	1.97	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 towm (minutes)	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		1947		1960	

Source: Household Survey 2007 & 2010