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Is the Nutritional Status of Males and Females Equally Affected by Economic Growth? Evidence from Vietnam in the 1990s

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Abstract

While the nutritional status of individuals became in recent years a central issue in development economics, relevant and reliable data are often scarce. Available living standard surveys provide a wide set of information about household food consumption and calorie intake. Yet, due to the focus on households, the surveys are, in general, little informative about the intra-household allocations. The present study, after comparing calorie intake and anthropometric measures, proposes the BMI of adult males and females as a useful tool to understand the intra-household allocations and to check whether there is gender discrimination on food access inside the households. Vietnamese data show that anthropometric measures tend to improve less quickly than the calorie intake and males tend to benefit more than females from economic improvements. This tendency is visible in particular in the northern regions, in rural areas and among the poorest quintile of the population. We tested econometrically the robustness of our findings. The results confirm the occurrence of gender discrimination in nutritional status. Moreover, it emerges very clearly that the distribution of the economic improvements inside the households is extremely unfair. The males' BMI growth elasticity to expenditures variation is found to be almost double as compared to the females' one. Also, results confirm that inside the more disfavoured groups (ethnic minorities, northern rural areas) females are even more discriminated and show a very poor nutritional status relative to males.

Keywords: food security, anthropometrics, gender discrimination
JEL classification: I31, O15, Q18

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Tables appear at the end of the paper.

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1 Introduction

Over the 1990s, Vietnam has experienced impressive economic growth, with an average annual growth rate of around 10 per cent. This economic growth has been accompanied by increased food availability and consumption. In almost all Vietnamese regions, empirical evidence shows robust and consistent improvements in the household calorie consumption and an increasing diversification in the diet, in particular in urban areas (Molini 2007).

So far, few studies tried to further verify the robustness of these findings comparing the variation in calorie availability with variation in anthropometric measures. As regards nutrition, it is expected that increased levels of household food consumption be accompanied by reduced levels of undernutrition in children and adults. Numerous studies have shown that, in general, with increasing levels of household expenditures and kcal consumption, the prevalence rates of children with a low weight-for-age, or the prevalence rates of adults with a low BMI, will decrease (Nubé et al. 1998; Subramanian et al. 2006; Cuong et al. 2007). Yet, though for Vietnam the anthropometric information is available, little attention has been paid to the dynamics of adults' anthropometrics and its sensitiveness to calorie intake variation.

One particular question that may be raised when total food availability and consumption are increasing is whether the benefits are equally distributed over all households' members. By using anthropometric indicators it is possible to estimate the production function for household members' nutritional status and consequently test whether there is some gender discrimination or other form of within-household inequality in the access to food.

Given the limited availability of anthropometric indicators,[1] few contributions tried to analyse the pattern of intra-household allocation using these measures. In particular, a limited number used data on adult males and females (Klasen 1996; Svedberg 1996 *inter alia*) and to our knowledge, none disposed of a panel of adult individuals surveyed in a period of radical economic changes.

The plan of the paper is as follows. In section 2, the difference between anthropometric measures and calorie intake measures are briefly discussed, in section 3 descriptive data on anthropometrics and calorie intakes are presented to show the various patterns, and then, subdividing the anthropometric measures in various subgroups (gender, regions, quintiles and urban-rural) we compare the different profiles. In section 4 we present the model and in section 5 the results of the regression analysis.

2 Methodological differences between nutritional assessment on the basis of kcal consumption and of anthropometric data

The impressive GDP growth registered during the 1990s has been accompanied by a significant increase in average household income and expenditures, as for example described by Glewwe et al. (2002). Economic literature on Vietnam (Dollar and Kraay

[1] Also in the new survey on Vietnam, the VLSS 2001, anthropometric indicators disappear from the questionnaire, hindering any comparison with the 1993 and 1998 data.

2002; Fritzen 2003) widely focused on the economic improvements but also non-monetary and social aspects have been analysed.

The main line of research moved in the direction of testing whether the indubitable economic improvement traduced in a generalized improvement in the living standard of individuals. Wagstaff et al. (2003) analyse child malnutrition and healthcare access trying to identify the determinants via a regression based decomposition. Against the trend of general economic improvements, they find a worsening in the healthcare access.

Baulch and Masset (2003) investigate whether monetary and non-monetary indicators of poverty coincide. In this case, nutritional poverty is identified using stunting among children and energy deficiency among adults. Moreover, the authors enrich the multidimensionality of their analysis by including education access. The results confirm that non-monetary poverty is more persistent than the monetary one and that there is a modest association between monetary and non-monetary measures.

Thang and Popkin (2004) looking at the per capita calories intake, find that after reaching in the early 1990s the dietary adequacy of 2100 calories, there were no further improvements in the late 1990s. By contrast, there are clear improvements in the diet diversification: households tend to consume less starchy staples and more proteins and lipids. At the same time, the authors argue that the situation of food security is controversial. Although there are some signals of improvements in the diet also among more vulnerable groups, the gap in the quantity and quality of calories consumed among different economic groups is widening.

Also on calorie intake, in a previous study we have shown that over the period 1992-1998 there has been an overall increase determined by an increase in per capita food expenditure (Molini 2007). Yet, similarly to Thang and Popkin (2004) we find an increase in inequality in particular when looking at the diet diversification. The increase in calorie intake is in line with national aggregate information on trends in per capita food consumption. For example FAO reports for Vietnam an increase in food energy consumption over the period 1992-1998 from 2230 kcal/cap/day to 2420 kcal/cap/day (FAO 2007).

When assessing the nutrition situation in a country or for a population group on the basis of food consumption data, it is important to note that food consumption estimates as derived from household expenditure surveys have their limitations (Nubé 2001).

First, the collected information is generally based on questionnaires in which households report for a certain period (often one or two weeks) their expenses on various types of food. Whether these expenses represent annual expenditure patterns cannot be easily assessed, and, for example, seasonal variations may not be adequately accounted for (Deaton and Zaidi 2002). Using information on prices, the expenditures are converted into quantities, and it is therefore crucial to have accurate local prices on all foods consumed. Such information is not always available.

Then, the quantities of the various foods are converted into calories, and possibly also into amounts of nutrients (proteins, carbohydrates, fats), but also here some introduction of errors cannot be excluded, as accurate information on the nutrient contents of the various foods may not always be sufficiently available. Finally, when using expenditure data for assessing human food consumption, estimates have to be made on factors such household food losses, the utilization of food for other purposes, such as feeding animals, the contribution of home produced food in the total food supply of the households, and also on the consumption of food outside the home, for example in schools, offices, etc. (Deaton and Zaidi 2002). Clearly, all such information is not easily collected.

Apart from these methodological issues in estimating per capita food consumption, a more fundamental problem is that food expenditure data are only available at the level of households, not at the level of individuals, unless the questionnaire is specifically targeted to this purpose (Aromolaran 2004). Moreover, since collecting this information for nationally representative surveys is extremely complicated, in general these studies are restricted to only few households (100-200) not representative of the entire country. However, also in this case, most flaws we mentioned above remain unsolved.

With most of available household surveys it is thus not possible to assess whether changes in food consumption are equally distributed over different household members, for example over children and adults (Micklewright and Ismail 2001), or over males and females, or whether certain household members are benefiting more, and other members less, from an overall increase in household food consumption.

Anthropometric information is different in almost all these respects. Anthropometric data, such as height and weight, are taken from individuals, and therefore the nutritional information is available at the level of individual household members. By collecting anthropometric information on individual household members, an assessment can be made whether an increase in household level food consumption has resulted in an improved nutritional status of all household members, or only of specific members of the households, for example children or adults, or males or females.

As argued by Saith and Harriss-White (1999) anthropometric indicators have also the advantage to ascertain joint outcomes of nutrition and health functioning. They can be thus, easily used as proxies of morbidity indicators, always difficult to measure and often unreliable. Furthermore, it is important to note that, in strong contrast to data on food consumption, anthropometric measurements are relatively easy to collect, just by measuring heights and weights in individuals.

In the present study, use will be made of anthropometric information, as collected in the 1992 and 1998 Vietnamese Living Standard Survey (VLSS) rounds, in order to investigate whether overall changes in food consumption are accompanied by changes in the intra-household distribution of food. It will be in particular investigated to what extent, increased levels of food consumption result in similar improvements in nutritional status of adult males and females or whether there appear to be differences between genders.

3 Data and summary statistics

The data used are extracted from the two available rounds of the VLSS, 1992-1993 and 1997-1998. Although they are outdated in particular for estimating the recent trends in the Vietnamese economy, until now they are the most widely used and most reliable data source for investigating the well being of Vietnamese families.

The 1992-93 round is a self-weighted sample of 4,800 household stratified in urban (911) and rural (3,889) households. The 1998 sample is stratified in rural (4,234) households and urban (1,766) households and then in seven macro regions, with an over-sampling of some groups (ethnic minorities and the residents in the Central Highland region) in order to make it possible also to assess the living conditions of groups which are demographically marginal. For estimating national means, it is generally recommended to use sample weights provided in the same dataset.

The two datasets can be unified by constructing a panel of about 4,200 households. A reduction in the number of observations results from the fact that the two surveys are different in dimension and the attrition is high. Since the aim of the present paper is to closely monitor the evolution of anthropometric measures and of the intra-household distributions during the 1990s, it was decided to use the panel of households (Tables 1, 2, 3).

In a second stage (Tables 4, 5 and regressions), not only households but also adult individuals in the households were linked in order to compare the evolution of BMI on the same person over a period of five years. Out of 10,000 adults, 6,500 of them could be included in the individual panel. While the household identifier was the same in the two years, the individual identifier number differed. Therefore, age was used as the identifying variable. The consistency was further checked by controlling for other individual variables (years of education, sex, and anthropometry).

In Tables 1, 2 and 3, the anthropometric measures (BMI for adults, weight for age and height for age for children) are compared with the calorie availability per capita at regional, quintile and urban-rural level. The calorie intake per capita is computed using an equivalence scale that attributes a weight of 0.5 to household members below 14 years (Deaton 1997). In columns three and four of these tables we calculated the percentage of adults who are below the conventional BMI cut-off of 18.5, in columns five and six the percentage of children who are below the -2 Z scores[2] for Weight for Age (WAZ) and Height for Age (HAZ). Finally, in column seven the per capita calorie availability is reported. By row it is possible to compare the results for 1993 and for 1998.

The regional grouping (Table 1) shows a certain regional diversification in the results. Children’s conditions improved in the whole country although with different intensities.

The best performing region is the Red River Delta, since the results for Central Highlands are hardly comparable due to the sampling difference the two periods (VLSS 1998). In terms of Z-scores, this region is clearly approaching, the rich and urbanized Ho Chi Minh City region. Since the two surveys have been implemented with five years of difference and as both the two measures (WAZ and HAZ) were collected on children from 0-5, the result clearly shows that the cohort of children born in 1998 is less malnourished than that of 1993.

The other interesting result is a clear indication of an uneven distribution of the nutritional improvements between males and females. The percentage of adults with a

2 In nutrition anthropometry, the common cut-off point for undernutrition is the median of the reference population minus 2 standard deviations.

BMI below the cut off point decreases in all regions for males, but increases in three regions for females. Moreover, the rate of decline is much faster for males than for females in the four regions where both face a reduction.

Table 2 provides focus on this phenomenon by analysing the distribution of BMI changes over quintiles. Females belonging to poorer households (the first and the second quintile) clearly do not face any improvement while males do. Females start to see an improvement only from the 3rd quintile. Neither calorie intake variation nor the children's z-scores follow a similar pattern. Both improve at a very fast rate among the poorest strata of the population and in five years, malnutrition appears to be almost halved in the three first quintiles.

A similar trend is revealed by the urban-rural grouping (Table 3). The percentage of females below the BMI's cut-off point decreases only by one point in rural areas and by three points in urban areas, while the decline for males is more accentuated. Also, it is worth noting that while for females there is a difference in the rates of decline of underweight prevalence among urban and rural areas (respectively from 0.32 to 0.29 in urban areas and from 0.36 to 0.35 in rural areas) and, for males this difference is minimal (one per cent only due to rounding).

The panel analysis

In Tables 4 and 5, the analysis was focused on those individuals for whom it was possible tracing the identity in both years. In this way, any potential bias generated by variation in the household dimension and composition was eliminated. We obtained a sample of 6,462 individuals, 3,103 males and 3,359 females. Although restricted, the obtained sample kept the same characteristics as the original one: the distribution of age, years of education and income per capita are practically the same as the original one.

Using a simple cross tabulation, we compared the results obtained using the calorie intake approach and the BMI approach. Hence, it was checked whether a household defined malnourished according to the calories intake approach (cut off 1,800 calories per day per capita) contains individuals who are malnourished according to the BMI's approach. The aim was to further strengthen the two arguments previously discussed. The anthropometric measure and the per capita calorie intake measure are not necessarily convergent in defining the group of malnourished and, most importantly, data on calorie intake obtained from our questionnaire, do not capture problems of intra-household inequalities with respect to food access.

Ideally, the two measures should identify in a consistent way those who are malnourished and those who are not, implying that high percentages appear on the diagonals of all sub-tables (by regions).[3] Unfortunately, this is not entirely true since in most regions the non-coincidence of the two measures accounts for about 50 per cent of the observations: there are lot of malnourished individuals according to the BMI-criterion but living in a household with sufficient per capita calorie intake and vice versa. This consideration can be extended to all the regions and is valid for both males and females.

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3 For example in Table 4, the correspondence Below-Below and Above-Above by regions

However, in between the two periods some interesting modifications occurred. Comparing the two tables (4 and 5), a reduction in the number of households below the cut off-point of 1,800 clearly emerges. This latter is accompanied by a more pronounced reduction in the number of individuals below-the BMI cut-off among males than females, in particular in northern regions (from 1 to 4).

Differently from 1993, where the differences in percentages of females and males above the calories cut off and below the BMI cut off were minimal, in 1998 these differences widen. For example, in 1998 in the Red River Delta, the share of females undernourished according to the BMI but not calories cut off is 39.2 per cent against 33.7 of males, while in 1993 the proportion was almost similar (33.9 and 33.3). The same result holds for almost all northern regions except Northern Uplands. However, the pattern is completely reversed in the Mekong Delta in which improvements are larger for females than for males.

This preliminary data analysis suggests some interesting insights regarding both anthropometrics and gender discrimination. Synthetically, it can be argued that anthropometric measures tend to improve less quickly than the calorie availability and males tend to benefit more than females from economic improvements. This tendency is visible in particular in northern regions, in rural areas and among the poorest quintile of the population. Similar results are obtained when we analyse the trend on a panel of individuals or a panel of households.

4 OLS AND 2SLS regression models

The above presented descriptive statistics suggest some striking differences between the performance of males and females. Notably, there is a difference in the BMI variation across years and more males than females seem to have moved away from malnourishment. Especially in northern regions, males undernourished in 1993 have in 1998 a higher probability to move above the cut-off point than females. Using the information of the same 6,500 individuals collected in the two periods we tried to explain the differences, through regression models.

For this purpose, the variation of BMI above and below the cut-off has been transformed in an ordered discrete variable assuming 4 values: -1, 0, 1, and 2. Comparing the two periods, -1 has been assigned to those in 1993 above the cut off and then felt below in the second period, 0 to those remaining below the cut off in both periods, 1 to those below in 1993 and above in 1998, and finally 2 to those above in both periods. The resulting discrete dependent variable is then regressed on a simple reduced form of a production function including household and personal characteristics and expenditures.

In this paper, consumption (expenditures) is used rather than income. As argued by a relevant part of the survey analysis literature (Deaton 1997), consumption is considered a better measure of human well-being. Also, relative to the income variable, consumption shows less volatility as it is not so vulnerable to idiosyncratic shocks. Moreover, consumption data are less influenced by measurement errors, particularly for rural households.

With respect to the relationship between expenditures and BMI, the causality relation is not immediately clear. In particular, for farmers, a higher BMI may increase the work capacity in agricultural activities (most of them are still using work force) and consequently expenditures. However, the relation can also be inverted since higher expenditures may affect the BMI of the individual through higher food availability, or reduced workload. To avoid endogeneity, instead of using a simple OLS model we regressed a two stage model (2SLS) instrumenting the expenditure variation that occurred between 1993 and 1998.

Other variables are personal characteristics as age, ethnicity, the BMI in 1993, sex and a dummy for being occupied in agriculture. Household characteristics instead include the residence in rural or urban areas and some regional dummies. As a matter of fact, in the previous section data have shown a clear regional pattern in the BMI performance that should be taken into account. To check the robustness of our findings we compare the probability of belonging to one of the 4 classes with the real probability and discuss the differences.

Then, a similar model has been used to test the determinants of BMI variations, although with some relevant changes. The dependent variable is now a continuous one enabling us to use an OLS lognormal model. Since the available tools for correcting endogeneity are now increased, we regressed BMI variation not anymore in a static way, say against expenditures in 1993, but dynamically using the income variation between the two years plus other variables.

It resulted in a more precise model controlling also for possible variations that occurred in expenditures. To correct for endogeneity, we instrumented the expenditures variation (Appendix, Table A1) with some exogenous variables such as assets in 1993 and education (Garret and Ruel 1999). In the second stage regression, the fitted values from the consumption variation are used as independent variables in the BMI-variation model. Like in the previous case, the model was tested for the whole sample and then separately for males and females to check whether there are relevant differences in the elasticities. A clear discrepancy between male and female expenditures elasticities, for example, represents an evidence of uneven intra-household distribution of economic growth.

5 Regression estimates

The ordered-logit estimates of factors affecting adults' nutritional status and the predictions of the models are reported respectively in Tables 6 and 7. Results of the full model (column 2 Table 6) are highly consistent with the expectations. A higher expenditures level in 1993 combined with a higher BMI increases the probability in the following period to move or stay above the 18.5 cut-off point.

By contrast, age and residing in northern regions always affects negatively the probability of being above the cut-off point. Northern Upland, Red River Delta and North Coastal dummies are significant and negative as compared to the Mekong Delta reference dummy and confirm the regional pattern evidenced by the descriptive statistics. Not surprisingly, the sex dummy is positive and significant, suggesting a clear advantage for males. This result is further confirmed when splitting the regression into males and females.

Elasticities (Table 7) computed for the two most relevant outcomes – accounting for about 75 per cent of the sample – confirm our preliminary conclusions. *Ceteris paribus*, being male increases with 5 per cent the probability of staying above the cut-off point in both periods and decreases with 4 per cent the probability of being below the cut-off point in both periods.

Comparing the categories prediction and the real ones (Table 8), it appears that the three models (total, males and females) overestimate the percentage of better-off (results 1 and 2), but only the male model estimates a probability for the last category (above the BMI in both periods) 4 per cent bigger than the real one (Table 8). The male-female models provide other interesting results. In accordance with previous findings, the probability of females to move above the cut-off point is reduced by living in rural areas, in the northern part of the country (the dummy for North Central is also negative and significant) and by belonging to an ethnic minority (although non-significant). The same results do not hold for males for whom the regional divide and the rural urban one do not condition significantly their nutritional performance.

So far, we looked at the variation above and below the cut-off line without considering the whole variation that occurred in the BMI. Using the same panel of individuals, we estimated the determinants of the BMI variation (Table 9). As previously mentioned, the expenditures variation has been instrumented with some exogenous variables (Appendix, Table A1). The R-squares and the F-statistics of first stage equation confirm that we found good instruments.[4] Hausman test rejects the hypothesis of systematic difference between OLS and 2SLS coefficients. The 2SLS estimator, therefore, should be preferred to the most efficient but inconsistent OLS.

Comparing the OLS and the 2SLS coefficient of expenditures variation, it appears clearly that without instrumenting we would have underestimated the impact of expenditures variation on the BMI variation. In all the three versions of the model, the OLS coefficient is lower than the 2SLS one; this is particularly evident in the case of the male model. This may be an indicator of a measurement error in the expenditures data that affects particularly those households entirely composed by adult males (537 out of 3,437 in the sample).

The other variables are significant and show the expected signs. Age is negatively correlated indicating that old people tend to face slower improvements. The negative sign of the BMI in 1993 indicates a declining rate of growth in the BMI. Urban households are relatively advantaged and also southern residents, since all the northern regional dummies are negative and significant. When focusing our attention on the sex of respondents, we confirm that males tend to be advantaged in the BMI variation. According to our model, *ceteris paribus*, being male increases the rate of growth of BMI with about 1 point. This is a big amount considering that the average rate of growth of BMI in our sample was around 2 per cent (Appendix, Table A2).

Looking at the male-female division helps to shed some light on the determinants of this different performance. Males increase their BMI in the period considered with an

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[4] In the first stage (see Appendix 1) the R square of the total model is 20 per cent and F (17,6444) = 45.13, female model R square 19.4 per cent and F (15,3343) = 26.84, male model R square 18.5 per cent and F (15,3087) = 28.11.

average 2.4 per cent while women with only 1.4 per cent (Appendix, Table A2). This gap is explained in a relevant part by the different elasticities to income growth: that of males is quasi-double as compared to the females' one. While for males (Table 9, column 4) an increase of expenditures of about 1 million dong (around US$70) would determine, *ceteris paribus*, an increase in BMI of about 1.83 per cent in 5 years, for females a similar increase in expenditures makes the BMI growing of only 0.9 per cent (Table 9, column 6).

Since household expenditures increased in the period considered by about 900,000 dong for both males and females combined (a rate of growth of 30 per cent in 5 years), income accounts for 1.64 per cent out of the 2.4 per cent BMI growth for males (0.68 per cent) and 0.81 per cent out of 1.4 per cent for females (57 per cent). Thus, the increase in the household income benefits more males rather than females. This might suggests that, without a fairer intra-household allocation of expenditures, women will increase their well-being slower than males. Unfortunately, the information about women's income shares is not available in the VLSS, and therefore our hypothesis cannot be tested, although it is reasonable according to the results of literature on gender discrimination in Southern and Eastern Asia (Harriss-White 1995; Osmani and Sen 2003, *inter alia*).

For females, the regional and rural/urban pattern of the BMI's growth is extremely evident. While for males these dummies are practically insignificant (except in the very poor Northern Uplands region), females living in northern Vietnam and in rural areas are extremely worse off, facing lower BMI's rates of growth. On average, there are 2 points of difference between rural and urban areas (3 points according to the model).

Finally, it is interesting to note the impact of ethnicity and the occupation in agriculture. Ethnicity affects negatively both groups but while for males the variable is non-significant, for females it confirms the particular hardship faced by females belonging to this group: in five years, on average, their BMI did not increase. Being occupied in agriculture affects negatively the BMI's growth for both males and females. Yet, the dummy for females is insignificant probably because the effect is captured by other dummies such as rural/urban and the regional ones.

In general, we can conclude that females tend to benefit less from the economic improvements, in particular those belonging to more disadvantaged groups. The females' nutritional status improves less not only because the socio-economic improvements of the whole group are limited but also because, within the group (i.e. ethnic minority or rural household) females tend to be worse off. The same can be argued, but less evidently, with regional dummies. Females dummy coefficients are always lower when negative and significant. Since the distribution of males and females is similar across the regions, this might suggest a female-specific disadvantage that increases the disadvantage of residing in a poor region.

6 Conclusions

While in recent years the nutritional status of individuals became a central issue in development economics, relevant and reliable data are often scarce. Available Living Standard surveys provide a wide set of information that enables researchers to say a lot about household food consumption and calorie intake, however little can be said on intra-household allocations. In presence of gender discrimination, this lack of data, seriously limits the capacity of policy makers to monitor the effectiveness of the intervention: without any information on intra-household distribution, a generalized increase in the household calorie intake might hide a serious female nutritional deficiency.

The present study, after comparing calorie intake and anthropometric measures, proposes the BMI of adult males and females as a useful tool to understand the intra-household allocations and to check whether there is gender discrimination on food access inside the households.

In this regard, the two rounds of Vietnamese household surveys (1993, 1998) offer a unique opportunity to construct both a panel of about 4,200 households and a panel of about 6,500 adult individuals for which the variations of individuals' nutritional status in a period of sustained economic growth and radical social changes has been analysed.

Already at the stage of descriptive statistics, some preliminary conclusions can be drafted. Vietnamese data show that anthropometric measures tend to improve less quickly than the calorie intake and males tend to benefit more than females from economic improvements. This tendency is visible in particular in northern regions, in rural areas and among the poorest quintile of the population. These results are obtained both when analysing the trend in a panel of household or when looking at the panel of individuals.

To test the robustness of our findings, we first regressed on a simple reduced form of a production function a discrete variable obtained by ranking the BMI variations. In the second step, we used as a dependent variable the variation in the BMIs between the two years and regressed it on similar model but including income variation and correcting for endogeneity. The results of the 2SLS and OLS models confirm the high level of gender discrimination in nutritional status. It emerges also very clearly that the distribution of the economic improvements inside the households is extremely unfair.

The male BMI growth elasticity to expenditures variation is found to be almost double as compared to the female one. Results confirm also that inside the more disfavoured groups (ethnic minorities, northern rural areas) females are even more discriminated. Their very low BMI growth is then a combination of lower expenditures that affect the whole group plus a gender specific negative effect.

References

Aromolaran, A. B. (2004). 'Household Income, Women's Income Share and Food Calorie Intake in South Western Nigeria'. *Food Policy*, 29: 507–30.

Baulch, B., and N. Masset (2003). 'Do Monetary and Non-Monetary Indicators Tell the Same Story About Chronic Poverty? A Study of Vietnam in 1990s'. *World Development*, 31(3): 441–53.

Cuong, T. Q., M. J. Dibley, S. Bowe, T. T. M. Hahn, and T. T. H. Loan (2007). 'Obesity in Adults: an Emerging Problem in Urban Areas of Ho Chi Minh City'. *Journal of Clinical Nutrition*: 1–9.

Deaton, A. (1997). *The Analysis of Household Surveys: A Micro-Econometric Approach to Development Policy*. Baltimore and London: Johns Hopkins University Press.

Deaton, A., and M. Zaidi (2002). 'Guidelines for Constructing Consumption Aggregates for Welfare Analysis'. *LSMS Working Paper* 135.

Dollar, D., and A. Kraay (2002). 'Growth is Good for the Poor'. *Journal of Economic Growth*, 7(3): 195–225.

FAO (2007). 'FAOSTAT Statistical Databases-Agriculture'. Food Balance Sheets (Archives); http://faostat.fao.org/default.aspx.

Fritzen, S. (2003). 'Growth Inequality and the Future of Poverty Reduction in Vietnam'. *Journal of Asian Economics*, 13: 635–57.

Garret, J., and M. T. Ruel (1999). 'Are Determinants of Rural and Urban Food Security and Nutritional Status Different? Some Insight from Mozambique'. *World Development*, 27: 1955–75.

Glewwe, P., M. Gragnolati, and H. Zaman (2002). 'Who Gained from Vietnam's Boom in the 1990s? An Analysis of Poverty and Inequalities Trends'. *Economic Development and Cultural Change*, 50(4): July 773–82.

Klasen, S. (1996). 'Nutrition, Health and Mortality in Sub-Saharan Africa: Is There a Gender Bias? *Journal of Development Studies*, 32(6): 913–32.

Harriss-White, B. (1995). 'The Intrafamily Distribution of Hunger in South Asia'. In J. Drèze, A. Sen, and A. Hossein (eds) *The Political Economy of Hunger*: *Selected Essays*, 224–97. Oxford: Oxford University Press for UNU-WIDER.

Micklewright, J., and S. Ismail (2001). 'What Can Child Anthropometry Reveal About Living Standards and Public Policy? An Illustration from Central Asia'. *Review of Income and Wealth*, 47.

Molini, V. (2007). 'Food Security in Vietnam During the 1990s: The Empirical Evidence'. In B. Guha-Khasnobis, S. S. Acharya and B. Davis, *Food Security Indicators, Measurement, and the Impact of Trade Openness*. Oxford: Oxford University Press for UNU-WIDER.

Nubé, M., W. K. Asenso-Okyere, and G. J. M. van den Boom (1998). 'Body Mass Index as Indicator of Standard of Living in Developing Countries'. *European Journal of Clinical Nutrition*, 52(2): 136–44.

Nubé, M. (2001). ‘Confronting Dietary Energy Supply with Anthropometry in the Assessment of Undernutrition Prevalence at the Level of Countries’. *World Development*, 29(7): 1275–89.

Osmani, S., and A. Sen (2003). ‘The Hidden Penalties of Gender Inequality: Fetal Origins of Ill Health’. *Economics and Human Biology*, 1: 105–21.

Saith, R., and B. Harriss-White (1999). ‘The Gender Sensitivity of Well-being Indicators’. *Development and Change*, 30: 465–97.

Subramanian, S. V., and G. Davey Smith (2006). ‘Patterns, Distribution, and Determinants of Under- and Overnutrition: A Population-Based Study of Women in India’. *American Journal of Clinical Nutrition*, 84: 633–40.

Svedberg, P. (1996). ‘Gender Bias in Sub-Saharan Africa: Reply and Further Evidence’. *Journal of Development Studies*, 32(6): 933–43.

Thang, N. M., and B. M. Popkin (2004). ‘Patterns of Food Consumption in Vietnam: Effects on Socioeconomic Groups During an Era of Economic Growth’. European Journal of Clinical Nutrition, 58: 145–53.

Vietnamese Living Standard Surveys (VLSS). 1992/1993-1997/1998.

Wagstaff, A. and E. van Doorslaer, and N. Watanabe (2003). ‘On Decomposing the Causes of Health Sector Inequalities with an Application to Malnutrition Inequalities in Vietnam’. *Journal of Econometrics*, 112(1): 207-23, January.

Table 1: Prevalence rates of under-nutrition in adults (females and males) and in children, and per capita calories in 1993 and 1998, by region

Year	Region	Female BMI <18.5	Male BMI <18.5	Children WAZ <-2	Children HAZ <-2	Per capita calories
1993	1	0.32	0.39	0.43	0.57	2046
1998	1	0.36	0.37	0.39	0.41	2320
1993	2	0.41	0.43	0.43	0.53	2101
1998	2	0.36	0.34	0.29	0.25	2404
1993	3	0.36	0.34	0.47	0.57	1879
1998	3	0.38	0.32	0.40	0.38	2205
1993	4	0.37	0.41	0.40	0.46	1977
1998	4	0.34	0.28	0.33	0.35	2199
1993	5	0.25	0.31	0.52	0.55	2080
1998	5	0.29	0.28	0.38	0.45	2145
1993	6	0.32	0.37	0.24	0.29	2005
1998	6	0.27	0.31	0.23	0.19	2241
1993	7	0.34	0.36	0.37	0.45	2173
1998	7	0.30	0.31	0.36	0.34	2209

Notes: 1 = Northern Uplands, 2 = Red River Delta, 3 = Northern Coastal, 4 = Southern Coastal, 5 = Central Highlands, 6 = Ho Chi Minh, 7 = Mekong Delta. 1993 Males 9,377, Females 10,448, Children 2,810; 1998 Males 12,007, Females 130,437, Children 2,203.

Source: Authors' calculation based on VLSS 1993 and 1998.

Table 2: Prevalence rates of under-nutrition in adults (females and males) and in children, and per capita calories in 1993 and 1998, by quintiles

Year	Quintile	Female BMI <18.5	Male BMI <18.5	Children WAZ <-2	Children HAZ <-2	Per capita calories
1993	1	0.36	0.41	0.45	0.58	1602
1998	1	0.39	0.36	0.26	0.29	1907
1993	2	0.39	0.42	0.46	0.58	1917
1998	2	0.40	0.35	0.20	0.22	2228
1993	3	0.39	0.39	0.38	0.45	2093
1998	3	0.34	0.34	0.17	0.18	2363
1993	4	0.34	0.36	0.38	0.44	2247
1998	4	0.32	0.33	0.13	0.14	2449
1993	5	0.30	0.35	0.26	0.29	2517
1998	5	0.26	0.25	0.07	0.08	2545

Notes: 1993 Males 9,377, Females 10,448, Children 2,810; 1998 Males 12,007, Females 130,437, Children 2,203.

Source: Authors' calculation based on VLSS 1993 and 1998.

Table 3: Prevalence rates of under-nutrition in adults (females and males) and in children, and per capita calories in 1993 and 1998, by residence

Year	Residence	Female BMI <18.5	Male BMI <18.5	Children WAZ <-2	Children HAZ <-2	Per capita calories
1993	Rural	0.36	0.39	0.42	0.53	2060
1998	Rural	0.35	0.34	0.19	0.21	2281
1993	Urban	0.32	0.36	0.29	0.32	2021
1998	Urban	0.29	0.28	0.09	0.09	2218

Notes: 1993 Males 9,377, Females 10,448, Children 2,810; 1998 Males 12,007, Females 130,437, Children 2,203.

Source: Authors' calculation based on VLSS 1993 and 1998.

Table 4: Cross tabulation of adults nutritional measures: percentages of males and females above and below the cut-off in 1993, by region

1993			Calories cut-off (1,800)			
	Region		Male		Female	
			Below	Above	Below	Above
BMI cut-off (18.5)	1	Below	13.2	27.3	11.6	26.5
	1	Above	16.8	42.6	21.5	40.4
	2	Below	14.2	33.3	12.8	33.9
	2	Above	11.3	41.3	12.8	40.6
	3	Below	15.2	23.1	17.6	22.8
	3	Above	24.2	37.6	24.9	34.7
	4	Below	14.5	26.4	16.4	24.5
	4	Above	18.4	40.7	22.8	36.3
	5	Below	7.8	25.6	5.6	21.1
	5	Above	22.2	44.4	25.6	47.8
	6	Below	12.5	27.5	15.4	21.7
	6	Above	19.7	40.3	21.2	41.7
	7	Below	8.5	27.8	8.2	26.8
	7	Above	13.9	49.8	13.7	51.3

Notes: 1 = Northern Uplands, 2 = Red River Delta, 3 = Northern Coastal, 4 = Southern Coastal, 5 = Central Highlands, 6 = Ho Chi Minh, 7 = Mekong Delta. Males 3,103, Females 3,359.

Source: Authors’ calculation based on VLSS 1993 and 1998.

Table 5: Cross tabulation of adults nutritional measures: percentages of males and females above and below the cut-off in 1998, by regions

1998			Calories cut-off (1,800)			
Region			Male		Female	
			Below	Above	Below	Above
BMI cut-off (18.5)	1	Below	5.4	34.1	5.5	33.5
	1	Above	7.3	53.1	6.5	54.6
	2	Below	4.4	33.7	4.2	39.2
	2	Above	4.9	56.9	6.2	50.5
	3	Below	5.5	30.8	7.0	38.5
	3	Above	7.9	55.8	9.4	45.1
	4	Below	4.8	25.2	7.6	30.9
	4	Above	11.6	58.5	11.0	50.5
	5	Below	3.3	24.4	5.6	23.3
	5	Above	13.3	58.9	13.3	57.8
	6	Below	6.4	22.5	5.9	21.0
	6	Above	11.4	59.7	10.7	62.4
	7	Below	7.4	26.5	7.9	21.6
	7	Above	12.9	53.2	12.6	57.9

Notes: 1 = Northern Uplands, 2 = Red River Delta, 3 = Northern Coastal, 4 = Southern Coastal, 5 = Central Highlands, 6 = Ho Chi Minh, 7 = Mekong Delta. Males 3,103, Females 3,359.

Source: Authors' calculation based on VLSS 1993 and 1998.

Table 6: Ordered logit results

Dependent variable: ordered categorical variable (-1,0,1,2)	Total	Male	Female
Sex (1 = male)	0.2376		
	(4.58)**		
Expenditure in 1993	0.113	0.1156	0.1118
	(4.19)**	(2.81)**	(3.13)**
Age of the respondent	-0.0289	-0.0418	-0.0163
	(16.50)**	(16.56)**	(6.58)**
BMI 1993	0.6994	0.7507	0.6787
	(39.24)**	(26.76)**	(29.02)**
Dummy for urban rural (1 = urban)	0.1065	-0.0699	0.2628
	-1.36	-0.62	(2.40)*
Northern Uplands	-0.2325	-0.297	-0.2349
	(2.36)*	(2.13)*	-1.67
Red River	-0.2209	-0.1716	-0.2988
	(2.48)*	-1.35	(2.36)*
Northern Coastal	-0.2764	-0.2422	-0.3606
	(2.71)**	-1.64	(2.52)*
Southern Coastal	-0.0894	0.1215	-0.3002
	-0.82	-0.76	(1.99)*
Mekong Delta	-0.0341	-0.1732	0.0654
	-0.36	-1.25	-0.48
Dummy for agricultural occupation	0.382	0.7451	0.0836
	(5.31)**	(6.70)**	-0.88
Dummy for ethnic minority (1 = ethnic)	0.0371	0.2184	-0.1357
	-0.43	-1.73	-1.14
Observations	6462	3103	3359
Pseudo R-square	0.17	0.18	0.18.5

Absolute value of z statistics in parentheses

* significant at 5%; ** significant at 1%

Notes:

-1 = BMI moves from above the cut-off to below

0 = BMI remains below the cut-off in both years

1 = BMI moves from below the cut-off to above

2 = BMI remains above the cut-off in both years

Table 7: Ordered logit marginal effects: outcome 0 and outcome 2

	Total		Male		Female	
	0	2	0	2	0	2
Sex (1 = male)	-0.040**	0.058				
Expenditure in 1993	-0.019**	0.028	-0.020**	0.028**	-0.018**	0.027**
Age of the respondent	0.005**	-0.007	0.007**	-0.010**	0.003**	-0.004**
BMI 1993	-0.117**	0.172**	-0.129**	0.185**	-0.111**	0.167**
Dummy for urban rural (1 = urban)	-0.018	0.026	0.012	-0.017	-0.042*	0.064*
Northern Uplands	0.040*	-0.058*	0.053*	-0.074*	0.039	-0.058
Red River	0.038*	-0.055*	0.030	-0.042	0.050*	-0.074*
Northern Coastal	0.048**	-0.069**	0.043	-0.060	0.061*	-0.090*
Southern Coastal	0.015	-0.022	-0.020	0.030	0.051*	-0.075*
Mekong Delta	0.006	-0.008	0.030	-0.043	-0.011	0.016
Dummy for agricultural occupation	-0.061**	0.092**	-0.113**	0.173**	-0.014	0.020
Dummy for ethnic minority	-0.006	0.009	-0.036	0.053	0.023	-0.034

Notes:

significant at 5%; ** significant at 1%

0 = BMI remains below the cut-off in both years

2 = BMI remains above the cut-off in both years

Table 8: Ordered logit predictions

	Total		Male		Female	
	Predicted	Real	Predicted	Real	Predicted	Real
-1	6.9	7.6	5.9	6.6	7.9	8.8
0	26.7	29.7	25.8	29.7	27.5	29.8
1	12.4	10.9	11.9	11.3	12.9	10.6
2	54	51.7	56.4	52.4	51.6	50.8

Notes:

-1 = BMI moves from above the cut-off to below

0 = BMI remains below the cut-off in both years

1 = BMI moves from below the cut-off to above

2 = BMI remains above the cut-off in both years

Table 9: OLS and 2SLS results

Dependent variable: Log of BMI's variation	Total (2SLS)	Total (OLS)	Male (2 SLS)	Male (OLS)	Female (2 SLS)	Female (OLS)
Sex (1 = male)	0.73	0.71				
	(4.32)**	(4.21)**				
Log variation in expenditure	1.04	0.40	1.83	0.51	0.91	0.32
	(3.47)**	(5.08)**	(3.95)**	(4.16)**	(2.03)*	(3.07)**
Age of the respondent	-0.11	-0.11	-0.14	-0.14	-0.08	-0.08
	(17.30)**	(17.11)**	(16.85)**	(16.50)**	(8.23)**	(8.06)**
BMI 1993	-1.00	-0.98	-1.26	-1.22	-0.85	-0.83
	(20.07)**	(19.68)**	(16.47)**	(15.92)**	(12.91)**	(12.65)**
Dummy for urban rural (1 = urban)	0.71	1.30	-0.35	0.75	1.25	1.81
	-1.90	(4.91)**	-0.67	(2.05)*	(2.18)*	(4.80)**
Northern Uplands	-1.55	-1.85	-1.36	-2.03	-1.35	-1.76
	(4.20)**	(5.52)**	(2.59)**	(4.40)**	(2.43)*	(3.68)**
Red River	-1.08	-1.23	-0.78	-1.20	-0.98	-1.22
	(3.47)**	(4.07)**	-1.74	(2.87)**	(2.16)*	(2.83)**
Northern Coastal	-1.96	-2.26	-1.44	-2.15	-1.89	-2.28
	(5.30)**	(6.61)**	(2.79)**	(4.62)**	(3.39)**	(4.62)**
Southern Coastal	-0.12	-0.42	1.23	0.52	-0.84	-1.24
	-0.29	-1.10	(2.12)*	-0.98	-1.38	(2.32)*
Mekong Delta	0.32	-0.05	0.36	-0.63	0.93	0.43
	-0.85	-0.14	-0.64	-1.41	-1.59	-0.92
Dummy for agricultural occupation	-0.39	-0.42	-0.20	-0.35	-0.27	-0.32
	(2.00)*	(2.19)*	-0.76	-1.34	-0.95	-1.15
Dummy for ethnic minority (1 = ethnic)	-0.42	-0.67	0.31	-0.24	-0.85	-1.07
	-1.43	(2.41)*	-0.77	-0.67	-1.94	(2.55)*
Constant	25.18	25.55	30.99	31.72	20.86	21.36
	(21.73)**	(22.65)**	(18.15)**	(19.20)**	(13.08)**	(14.06)**
Observations	6462	6462	3103	3103	3359	3359
R-squared	0.15	0.16	0.22	0.23	0.11	0.11

Note: Robust t-statistics in parentheses. * significant at 5% level; ** significant at 1% level.

Appendix

Table A1: First stage regression

Dependent variable: Log variation in expenditure	Total	Male	Female
Sex (1 = male)	-0.09		
	(3.00)**		
Age of the respondent	0.01	0.01	0.01
	(6.87)**	(4.37)**	(5.48)**
BMI 1993	0.02	0.02	0.01
	-1.72	-1.71	-0.82
Dummy for sewer system in village (1 = have)	0.47	0.45	0.53
	(6.35)**	(4.45)**	(4.88)**
Farmers in household (%)	-0.18	-0.02	-0.01
	(2.47)*	-0.55	-0.16
Dummy for urban rural (1 = urban)	0.53	0.49	0.51
	(8.80)**	(5.84)**	(6.08)**
Education of member (years)	0.06	0.05	0.07
	(9.36)**	(6.08)**	(7.20)**
Dummy for electricity in village	0.18	0.16	0.15
	(6.10)**	(3.90)**	(3.25)**
Household size	0.01	0.01	0.01
	-1.37	-1.28	-0.66
Northern Uplands	0.00	-0.56	-0.74
	-0.03	(6.84)**	(8.10)**
Red River	0.10	-0.51	-0.65
	-1.96	(5.24)**	(5.98)**
Northern Coastal	0.03	-0.57	-0.72
	-0.69	(6.30)**	(7.21)**
Southern Coastal	0.07	-0.55	-0.65
	-1.40	(5.68)**	(6.23)**
Mekong Delta	0.75	-0.71	-0.76
	(10.71)**	(8.71)**	(8.33)**
Adult female in household (%)	0.19	-	-
	-1.64	-	-
Members <14 in the household (%)	-0.18	-0.30	-0.29
	-1.90	(2.99)**	(2.63)**
Dummy for ethnic minority	-0.15	-0.27	-0.18
	(4.87)**	(6.36)**	(4.04)**
Constant	-0.43	0.16	0.35
	(2.06)*	-0.61	-1.14
Observations	6462	3103	3359
R-squared	0.19	0.19	0.19

Notes: Robust t-statistics in parentheses. * significant at 5%; ** significant at 1%.

Table A2: Dependent and independent variables' means

Variable	Total	Male	Female
Log of BMI's variation	1.97	2.4	1.42
Sex (males on total)	0.48	-	-
Log variation in expenditures	0.89	0.86	0.91
Age of the respondent	37.9	37.8	37.9
BMI 1993	19.26	19.28	19.23
Dummy for urban rural (urban on total)	0.16	0.16	0.17
Northern Uplands (NU on total)	0.17	0.18	0.17
Red River (RR on total)	0.25	0.25	0.25
Northern Coastal (NC on total)	0.15	0.14	0.15
Southern Coastal (SC on total)	0.10	0.10	0.11
Mekong Delta (MD on total)	0.19	0.19	0.20
Dummy for agricultural occupation (agricultural on total)	0.17	0.15	0.19
Dummy for ethnic minority (ethnic on total)	0.13	0.14	0.13