Discussion Paper Series

RIEB

Kobe University

DP2012-11

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Revised December 14, 2012

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First Draft: 10th March 2012
This Draft: 14th December 2012

Abstract

This study investigates whether mother's empowerment as measured by mother's relative (to father) bargaining power affects children's nutritional status using the National Family Health Survey (NFHS) and National Council of Applied Economic Research (NCAER) data spanning the period between 1992 and 2006. First, the relative bargaining index defined as the share of mother's schooling years over father's schooling years positively and significantly influences z scores pertaining to the short-term measures of nutritional status of children, 'weight-for-age' and 'weight- for-height'-. The results of quantile regression suggest, however, that the bargaining power will improve the chronic measure of nutritional status 'height-for-age', at the low end of conditional distribution of z score.. Further, we find that access to health scheme or health insurance and health-related facility, infrastructure and environment are important factors in reducing child malnutrition.

Key Words: Child Nutrition, Malnutrition, Empowerment, Bargaining, NFHS, NCAER, Quantile Regressions, Pseudo Panel, India
JEL Codes: C21, C23, C26, I14

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Acknowledgements
This study is funded by ESRC research grant entitled 'On the Change of Poverty and Undernutrition in Rural India' (RES-000-22-4028). We appreciate useful comments from the participants in Workshop on Poverty and Inequality in China and India, the University of Manchester in March 2012, the 15th Kansai Development Microeconomics (KDME) Workshop at Osaka, Japan, July 2012, and a research seminar at Dosisha University in August 2012. We thank Md Azam, Subhasish Dey, Per Eklund, Raghbendra Jha, and Takahiro Sato for their valuable advice at various stages of the project. The views expressed here are those of the author and the usual disclaimer applies.

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1. Introduction

Malnutrition remains a major concern in India despite the country's impressive economic growth. India has one of the worst levels of low birth weight, underweight and wasting among children in BRIC and SAARC[1] countries (IAMR, 2011). While 43% (38%) of children under age five are moderately underweight (stunted) in India, the corresponding figures are 6% (11%) in China, 23% (14%) in Sri Lanka, 31% (37%) in Pakistan, 39% (43%) in Nepal and 41% (36%) in Bangladesh in 2000-7 (ibid., 2011).

However, this is not to deny the gradual decline experienced over the past three decades in the rates of moderately underweight and stunted children (Deaton and Drèze, 2009). A recent study employing the first two rounds of National Family Health Survey (NFHS) data dated 1992-93 and 1998-99, documents that notwithstanding the rise in rural-urban disparity favouring urban children and in gender disparity favouring girls, there was an improvement in overall nutritional status of children under three improved during the 1990s (Tarozzi & Mahajan, 2007). Another piece of research based on the survey covering 112 rural districts of nine relatively poor states conducted in 2010-11, reports that (i) the prevalence of underweight children has decreased from 53 % in 2004 to 42 % in 2010-11 with an average annual rate of reduction of 2.9%; (ii) the nutritional advantage of girls over boys aged 0-3 years is reversed in the 3-5 age category (in both height-for-age and weight-for-age) suggesting neglect of girls; and (iii) underweight children are more prevalent among mothers with low levels of education (Naandi Foundation, 2011).

In spite of the positive trends in the reduction of malnutrition levels, the rates are high enough to cause concern, especially since they persist amidst a phase of impressive economic growth. The high levels of child malnutrition potentially impact country's prospects for

continued economic growth as child malnutrition in early years may result in malnutrition and lower cognitive skills in adult years. Additionally, it is a humanitarian concern requiring policy-makers and international communities to refocus their policy priorities on direct and indirect interventions to reduce children's malnutrition.

The extant literature on determinants on child health and malnutrition in the developing countries in general and in India in particular highlights the significance of economic, social, cultural, infrastructural factors impacting at multiple levels, such as individual, household and community (. Ackerson & Subramanian, 2008; Allendorf, 2007; Kandpal & McNamara, 2009; Kravdal 2004; Smith et.al 2003). Recent empirical studies on child malnutrition in India tend to focus on one of the following three factors as determinants of children's nutritional or health status: (i) mothers' education, empowerment, and/or relative bargaining power vis-a-vis fathers', (ii) social capital at the community level; and (iii) policy interventions such as the Integrated Child Development Services (ICDS) in addition to taking into account variables such as household income or consumption, household composition and characteristics, composition of children, caste affiliation, hygiene and sanitation facilities, and food prices. Though the results are context specific, mother's characteristics do consistently emerge as significant when examining child malnutrition status (Gaiha & Kulkarni 2005; Kravdal 2004; Luke & Xu 2011; Shroff et,al 2009).

The present study estimates the determinants of nutritional measures of children under age three in rural India during the period 1992-2006 with the focus on role of mother's empowerment as measured by mother's relative (to father) bargaining power. The study therefore contributes to our understanding of the factors related to child nutrition in India. We assess the following two questions: (i) Whether the mother's relative bargaining power affects the nutritional status of her children? and (ii) What are the household level and infrastructural and policy related variables that impact children's nutrition status?.

Methodologically, by combining multiple rounds of one data source with another comparable data source, our analysis overcomes the limitation of the previous studies that considered either fewer rounds of data or a single cross-sectional data. We employ all the three rounds of National Family Health Survey data (NFHS henceforth) conducted in 1992-93, 1998-99 and 2005-06 and called as NFHS-1, NFHS-2 and NFHS-3 respectively. We also draw upon the two rounds of data collected by National Council of Applied Economic Research (NCAER hereafter) in 1994-95 and 2005. We construct pseudo panel data and hence as ,mentioned previously are abel to obviate the shortcomings stemming from the cross-sectional nature that majority of the previous studies suffer from. Further, we conduct robustness checks using NCAER data to test if the results based on NFHS data could be generalised, something that was not possible with the previous studies.

The rest of the paper proceeds as follows. The next section briefly reviews the previous studies on child malnutrition in India. Section 3 discusses theoretical issues and presents the basic analytical framework that underlies our econometric analysis. After describing the data in Section 4, we discuss the econometric models and specifications in Section 5. Section 6 reports econometric results. The final section offers few concluding remarks.

2. Previous Research

The empirical findings from previous research using NFHS and NCAER data present a mixed picture. For instance, drawing upon the 1994 NCAER data, Gaiha and Kulkarni (2005) apply Poisson model and use the wage gap between men and women as a measure of women's empowerment. They find that reduction in wage gap reduces severe stunting in terms of the number of stunted children in a household. Also, their analysis indicates that household income, household and children compositions, and caste affiliations matter in

reducing stunting. Using NFHS-2, Maitra (2004) shows that child health is affected only indirectly through the improved usage of health care, which is determined by women's education and control over the household resources or bargaining power. Kravdal's (2004) study, again, employing NFHS-2 data finds that both women's empowerment index (a sum of binary response variables, such as, whether a husband is justified beating his wife in certain situations) as well as the average women's education in the census enumeration area have significant association with child mortality levels.

With respect to the methodology, a couple of recent studies (Borooah, 2005; Kandpal and McNamara, 2009) use quantile regression (QR) to estimate the effects of various factors on child nutritional status across the distribution of nutritional levels, for example, for underweight and overweight children separately. This can be considered to be an improvement over OLS as the results of OLS based on the conditional mean may be misleading due to different behavioral response towards malnourished children and overweight children. The results from Borooah's (2005) application of QR to 1994 NCAER data indicate that height-for-age is positively associated with households' access to safe water and to good hospital care in the low to middle range region of the distribution of nutritional status. However, the relationship (of height-for-age) with mother's literacy is significant only in the middle of the distribution of children's nutritional status. Kandpal and McNamara's (2009) study based on NFHS-3 also finds that maternal health and education have greater effects at the lower end. While the present study too applies QR, it is as mentioned earlier, unique as it is based on two sources of national household survey data sets in 1992-2006, namely, three rounds of National Family Health Survey (NFHS) data and two rounds of National Council of Applied Economic Research (NCAER). The analysis therefore enables cross-checking the results across data sources and years, which, following Tarozzi and Mahjajan's (2007) recommendation for, adds to the robustness to the process of

identifying the real causes of children's malnutrition in India. In line with the previous studies, we estimate the effects of mother's bargaining power relative to father's on child malnutrition by using an IV (instrumental variable) model where mother's bargaining power as well as access to health insurance scheme are treated as endogenous variables. Further, we use QR with the focus on difference of effects of various factors for different parts of nutritional distribution.[2] QR helps us take into account the different behavioural response of households towards malnourished children and those with children in the normal range of height or weight or overweight. Pseudo panel data models are also applied to identify the determinants of child malnutrition over the years.

3. Analytical Framework

Theoretical Considerations

This section discuses theoretical aspects of the determination of child nutritional status and outlines an analytical framework to explain how the bargaining power of the mother relative to the father's affects the nutritional status of children. In conceptualizing the determinants of child nutritional status, researchers choose to either specify a structural health production function (. Thomas, 1994) or to model the intrahousehold bargaining model between a mother and a father and then derive the reduced form equation for the child health or nutrition where the bargaining or empowerment index is used as a determinant together with household characteristics.

Thomas (1994) combines a health production function where child health as an output is a function of a number of inputs (e.g. nutrient intakes and the quantity and quality of child/ health care and individual and household characteristics) with a standard utility function of the household member under a budget constraint for the household. This process can be typically done in the framework of unitary household models in which the household head

makes a decision on behalf of household members, all the household resources are pooled, and a mother and a father have an identical taste (Becker, 1974, see Park, 2007 for the application to child nutrition)[3].

One could use the non-unitary models where a personal preference and bargaining power matter. This consists of cooperative bargaining models and non-cooperative bargaining models. In the cooperative bargaining models, a mother or a father derives his or her utility from own consumption of commodities and public goods (e.g. health or nutritional status of children) and the bargaining process is affected by an outside option or the extra-household environmental parameters (EEP) which are, for example, conditional on the threat of martial dissolution or on other environmental factors (McElroy & Horney, 1981; McElroy, 1990). In case of bargaining over child health or nutritional status, a mother and a father are assumed to make decisions over the quality of health, nutritional conditions of children or the spending in child health care independently as a part of his or her utility maximization problem (Maitra, 2004, Park, 2007; Fafchamps et al. 2009)[4]. Non-cooperative bargaining models include Lundberg and Pollak's (1993) model which specifies the threat point as a non- cooperative equilibrium within marriage and define it in terms of traditional gender roles and gender role expectations.

Because the health production approach requires detailed data on health inputs (e.g. health care, nutritional intakes, and prices), our conceptual framework is based on the cooperative bargaining model following most of the empirical studies of child health and nutrition.

We assume that a household consists of a mother, m, a father, f, and a certain number of children, k, considered to be 'a public good' for both parents. It is assumed that children are not decision-makers and parents care about the average health quality or nutritional status of children. Let x_j be the j^{th} person's consumption ($j = m, f$), and q be the (average) health quality of children. The j^{th} person's utility is defined as $U_j\left(x_j, q_j \middle| A_j\right)$. Here we define A_j,

EEP, a vector consisting of exogenous factors that determine the preferences of the individual *j*. A_j may depends on the factors determined outside the household, e.g. unearned income for *j*, as well as his or her individual characteristics.

Each individual is assumed to choose x_j (own consumption) and q (child quality) to maximise. In this setting, the household utility function is defined as $\gamma U_m(x_m, q;\ A_m) + (1-\gamma) U_f(x_f, q;\ A_f)$ where γ represents the "bargaining power" of the mother (wife) in a household ($0 < \gamma < 1$). The household's utility maximization problem is specified as follows:

$$\underset{x_m, x_f,\ q}{Max}\ U^H = \gamma U_m(x_m, q;\ A_m) + (1-\gamma) U_f(x_f, q;\ A_f) \qquad (1)$$

subject to

$$I = p_m x_m + p_f x_f + p_c q \qquad (2)$$

where I is a household's income, p_i is the price of the private goods for the mother or the father, and p_c is the shadow price of public goods, that is, children in this case. In general, the optimal q^* (health quality of child) will depend on parameters such as γ, p_c, I, p_i, and A_i as follows:

$$q^* = q^*(\gamma, I, p_m,\ p_f,\ p_c,\ A_m,\ A_f) \qquad (3)$$

This model sheds light on the household decision on child health. For example, "bargaining power" γ may reflect women's empowerment represented by female education and female labour force participation. Given that a female is more likely than a male, to value q, the quality of children's health, the stronger bargaining power of a female reflected in higher γ leads to a better nutritional outcome. In this framework, higher level of education is likely to improve the nutritional status of children through higher γ. A_i represents each household member's attitude toward health care, which may be different in various classes or

social groups. Economic growth increases a household's income level *I* and improves the health of children.

4. Data

This study draws upon three rounds of NFHS data, NFHS-1 for the year 1992-3, NFHS-2 for the year 1998-9 and NFHS-3 for the year 2005-06 and two rounds of NCAER data for the years 1994 and 2005. The NFHS is a major nationwide, large multi-round survey conducted in a representative sample of households in India with a focus on health and nutrition of household members, especially of women and young children.[5] The survey covers the issues including fertility, family planning, maternal and child health, gender, HIV/AIDS, nutrition and malaria. Data were collected at the individual level (children, mothers and fathers in NFHS-3) as well as household and community level. This study uses data on children aged zero to three years in rural areas for NFHS-1, 2 and 3. This is because children below age four are covered in NFHS-1, below age three in NFHS-2, and below age five in NFHS-3. It is also well known that nutritional conditions from zero to three years have the most fundamental effect on stunting in later life (Maluccio et al., 2007).

We supplement NFHS data by NCAER data. NCAER data stem from multi-purpose household survey that was designed and conducted by NCAER, an internationally known think-tank based in New Delhi, India. The first round of the survey was carried out in 1994 covering 16 states with a multi-stage sample design where the districts were cross-classified by income from agriculture and female literacy rate to form homogeneous strata in terms of these variables.[6] The 2005 round, called the Indian Human Development Survey (IHDS), is a collaborative initiative between NCAER and the University of Maryland, USA. Part of the IHDS data comprises a panel for 1994 and 2005. Both rounds (1994 and 2005) of data are nationally representative (covering all the states of India) and the thematic areas include

education, health, livelihoods, family processes and the social structure within which the households operate.

One of the limitations of NCAER data in 2005 is that age of a child is recorded only in years, not in months. Therefore, we construct the z scores of 'weight-for-height' (wasting) for children below three years using NCAER data. For NFHS data, z scores of 'height-for-age' (stunting), 'weight-for-age' (underweight) as well as 'weight-for-height' for children below three years are used. On z scores, we follow the z score based on WHO (2006) which included 'children from a diverse set of countries: Brazil, Ghana, India, Norway, Oman and the USA' (ibid., 2006, p.1) as the reference group to capture the ethnic and racial diversity. Following WHO (1997), we define z score as:

$$z - score = (x_i - x_{median}) / \sigma^x \qquad (4)$$

where x_i is, for example, height of child i, x_{median} is the median height from the reference population of the same age and gender, and σ^x is the standard deviation from the mean of the reference population. The z-score for the reference population has a standard normal distribution in the limit. Thus, there is a less than 2.3% probability that a healthy child will have a z score less than -2 (WHO, 1997). It is normally assumed that children with a z score below -3 is classified as 'severely stunted', those with a z score between -3 and -2 are 'moderately stunted'. Underweight or wasting is defined in the same manner. In this study, however, we define children with z score below 4 as 'acutely malnourished' given the large number of children severely or moderately malnourished. Also, as the factors influencing underweight and overweight children are likely to be different, we consider the factors affecting those in other appropriate ranges, defined by z scores of -1, -2, 0, 1, 2, and 3.

5. Econometric Specifications

Our main objective of the econometric analyses is to identify determinants of child malnutrition in rural India to test (i) 'Whether the mother's empowerment as measured by mother's relative (to father) bargaining power affects the nutritional status of her children?' and (ii) 'What are the factors (including those associated with children, households, infrastructure and policy) are likely to change the their nutritional status?'.

Methodologically, we apply multiple techniques which make the present study distinct from extant empirical studies on child malnutrition in India. First, following Borooah (2005) and Kandpal and McNamara (2009), we apply QR (in addition to OLS) to estimate different coefficient estimates at different points in the conditional distribution of nutritional status, rather than at the mean. Second, IV estimation has been also applied to take into consideration (i) bargaining power of women and (ii) access to health insurance schemes. Third, we use pseudo panel data models in order to combine the three rounds of NFHS data (and two rounds of NCAER data).

OLS and IV

We presented a simple version of bargaining models in Section 3, but it is not easy to find the variables which would exactly capture different factors specified in the theoretical model (e.g. the extrahousehold environmental parameters and the bargaining coefficient, γ). We therefore use the reduced form equation approach where the child nutritional condition is a function of the bargaining indicators and household characteristics since the household survey data we use (namely, NFHS or NCAER data) do not contain the variables, such as prices specific to father or mother's consumption or the individual unearned income.

We consider the reduced form equation which estimates the effect of (a proxy of) the bargaining power on child nutritional status. Here we distinguish three units, child, household and community.[7] We denote i for the i^{th} child (or an ID number identifying a particular child)

and h for the h^{th} household (a household ID number) in a total sample at time t (year). We estimate q_{ih}, a nutritional status indicator (namely, z score of height for age, weight for age, or weight for height) as:

$$q_{ih} = q_{ih}(\gamma_h,\ B_i,\ X_h,\ Z_h,\ H_h, R, P) \tag{5}$$

It is assumed here that A_m and A_f (or A_m / A_f) in the equation (3) can be captured by a single variable γ_h representing the mother's relative (to father) bargaining power. The variable, γ_h is our measure of women's empowerment and comprises our central independent variable. We proxy γ_h by (i) the proportion of mother's years of schooling to father's years of schooling ([schooling years of mother]/ [schooling years of father]) (after controlling for an average schooling years of mother and father); (ii) a dummy variable on whether the father (husband) is justified for hitting or beating the mother (wife) when the mother (wife) is unfaithful to the father (husband) (1 for Yes; 0 for No); (iii) a dummy variable on whether the mother (wife) needs permission from the father (husband) when she goes to market (1 for Yes; 0 for No).

In case of the IV, γ_h is instrumented by the (proportional) difference of father's age and mother's age on the grounds that the relatively older father tends to have a greater bargaining power, but it does not have a separate and direct impact on their child's nutritional conditions.

B_i is a vector of characteristic of the i^{th} child: whether male or not; age and its square; and whether the second, third or fourth child.

X_h is a vector of household specific variables, such as household characteristics and compositions, such as, household size; share of children under the age of five in total number of household members; the average schooling years of the mother and the father; mother's age; its square; a wealth index; and whether a household has access to electricity; whether a household has a radio (or a TV; bicycle; a flush toilet).

Z_h is a vector of variables capturing the social, environmental or infrastructural factors specific to the h^{th} household: time necessary for getting water; whether a household belongs to scheduled castes (SCs) (or scheduled tribes (STs), other backward groups); religion dummies (e.g. Hindu, Muslim, Christians). H_h is a policy variable that would affect child's health: whether a household has access to a health scheme or health insurance. This is instrumented by the infrastructure variable to capture the availability of information, that is, how many households in the village have access to a telephone in IV. R is a vector of regional dummies (BIMARU [8], South, East, West) as well as state dummies to take account of state fixed effects. P is a price vector (sugar, egg, cereal).

Quantile Regressions

As discussed by Aturupane et al. (2008) and Borooah (2005), it is important to estimate the effect of various variables on child nutritional status on different points in its conditional distributions as behavioral response to predictors (e.g. health insurance, mother's bargaining power) is likely to be different between a malnourished child and an overweight child. As in Koenker and Bassett Jr. (1978), quantile regression for the θ^{th} percentile takes the form:

$$\underset{b \in R^{k}}{Min}\left[\sum_{i \in \{i: q_i \geq X_i b\}} \theta\left|q_i - \mathrm{X}_i b\right| + \sum_{i \in \{i: q_i \prec X_i b\}} (1-\theta)\left|q_i - \mathrm{X}_i b\right|\right] \qquad (6)$$

where $0 < \theta < 1$, q_i is a dependent variable (z score of child nutritional status), and X_i is a vector of all the explanatory variables in the equation (5). For example, if θ=0.5, this is a median regression. Most of the studies show the results θ=0.05, 0.1, 0.25, 0.75 and so on, but we have chosen the median of each nutritional group for θ to estimate the (approximate) determinants of nutritional conditions for each group. For example, if we find that 12% of children are severely undernourished ($z < -3.0$), we have used 0.06 as θ. Also, because the

error terms in each group is unlikely to be without heteroscedasticity, bootstrap estimates of the asymptotic variances are calculated with 100 repetitions.

Pseudo Panel Data Model

One of the limitations of the above model is that each round of NFHS or NCAER data is used separately for the cross-sectional estimations. To overcome this and to identify the determinants of child nutritional status over the years, we also apply the pseudo panel model which aggregates micro-level data by any cohort that is common across cross-sectional data sets in different years. We apply the pseudo panel for the cohort *k* based on the combination of states and mother's age groups (15-19 years, 20-24 years, … , 45-49 years). The cohort is denoted as *k* in the equation (7) below.

$$\overline{q_{ih\,kt}} = \overline{q_{ih\,kt}}\left(\overline{\gamma_{h\,kt}}, \overline{B_{i\,kt}}, \overline{X_{h\,kt}}, \overline{Z_{h\,kt}}, \overline{P_{kt}}\right) \qquad (7)$$

where k denotes cohort and t stands for survey years for three rounds of NFHS data , 1992, 1998 and 2005, or two rounds of NCAER data in 1994 and 2005. The upper bar means that the average of each variable is taken for each cohort, k for each round, t. Regional variables do not have time variation and have been dropped. A variable on health scheme or health insurance has been also dropped as this is available only in NFHS-3.

The equation (7) can be estimated by the standard static panel model, such as fixed effects or random effects model.

$$\overline{q_{i\,kt}} = \alpha + \sum_{l=1}^{w} \overline{X_{i}^{l}}_{kt} \beta^{l} + D_t\,\chi + \bar{\mu}_{kt} + \bar{e}_{kt} \qquad (8)$$

where $\overline{q_{i\,kt}}$ is a dependent variable, $\overline{X_{i\,kt}^{l}}$ represents explanatory variables in the equation (7), D_t is a vector of year dummies, $\bar{\mu}_{kt}$ is the unobservable individual effect specific to the cohort *k* (e.g. cultural effects which are not captured by explanatory variables), and $\bar{e}_{kt}$ is an error term. The issue is whether equation (8) is a good approximation to the underlying

household panel models for household i in equation (8)' below. It is not straightforward to check this as we do not have 'real' panel data.

$$q_{it} = \alpha' + \sum_{l=1}^{w} X^{l}_{it} \beta^{l} + D_t \chi + \mu_i + e_{it} \qquad (8)'$$

However, as shown by Verbeek and Nijman (1992) and Verbeek (1996), if the number of observations in cohort k tends to infinity, $\bar{\mu}_{kt} \to \mu_k^*$ and the estimator is consistent. In our case, k is reasonably large and thus the estimator is likely to be almost consistent. Once we take account of the cohort population, equation (8) will become the model developed by Deaton (1985) whereby $\overline{q}_{i\,kt}$ and $\overline{X}_{i\,kt}$ are considered to be error-ridden measurements of unobservable cohort means, which leads to so-called 'error-in-variables estimator' (see Fuller, 1987 for more details).

6. Results

This section discusses econometric results based on the models given in Section 4. Because the results are voluminous, we highlight only key variables, such as bargaining variables in this section. Table 1 summarizes the coefficient estimates of bargaining indicators estimated by NFHS data, namely, the ratio of mother's schooling years to father's schooling years (for NFHS-1, 2 and 3); whether a husband is justified in beating his wife when she is unfaithful; or whether a wife is allowed to go to the market without permission from a husband (NFHS-2 and 3 only). Each variable is included one at a time. Average education of a father and a mother is considered as a control variable for the ratio of schooling years. Table 2 shows the corresponding results for NCAER data.

(Table 1 to be inserted)

The first panel of Table 1 shows the results for NFHS-1 (1992-93). It is observed that the results of OLS do not necessarily represent the results at the ends of distributions, though they are roughly close to those in the middle (e.g. z score from -1 to 1). The estimates indicate that increase in mother's relative bargaining power (in terms of schooling) tends to improve the nutritional status of "severely and moderately stunted children" as well as "severely underweight children". Further, average education is positive and significant. In the second panel for NFHS-2 (1998-99), we find that (i) mother's relative bargaining is positive and significant for 'weight-for-age' and for 'weight-for-height' (only for those who are undernourished in both cases), but statistically not significant for 'height-for-age' (ii) average education is positive and mostly significant (iii) 'beating' negatively and significantly affects 'weight-for-age' and 'weight-for-height' in the range 'acutely malnourished' and (iv) woman's autonomy (in terms of going to the market) positively and significantly affects 'weight-for-age' (for the malnourished) and 'weight-for-height' (for the acutely malnourished).

From NFHS-3 (2005-06), we do not find many cases where a bargaining variable is statistically significant, while average education is positive and significant in most cases. In one case ($0<z<1$ for 'weight-for-height'), the relative schooling years has a significant and positive effect on the nutritional indicator. And in another ($-2<z<-1$ for 'weight-for-height'), it tends to be worsened by a father's 'beating'. We have carried out IV estimation where a bargaining indicator is instrumented by the relative age difference of a husband and a wife. As in OLS, bargaining variables remain statistically non-significant.

A main insight here is that improvement in women's bargaining power over men tends to improve children's nutritional status mainly for households in the 1990s, but this effect became weak in 2005-06. To see if this conclusion will hold if we use NCAER data, we have carried out OLS and quantile regressions for NCAER data in 1994 and 2005. However, we

have found that while average education is generally positive and significant, the bargaining variable is not significant. Hence, the results in Table 1 will have to be interpreted with caution because conflicting results imply that regression results are likely to be context-specific.

(Table 2 to be inserted)

In the interest of brevity, we summarise the results based on the cross-sectional regressions (OLS, IV and QR) for three rounds of NFHS data and two rounds of NCAER data.[9] The first column of each panel summarises the results of OLS and IV where '+' or '-' are shown in case the coefficient estimate is significant. If it is significant only for OLS or IV, it is shown as, e.g., "+(ols)". If the variables are not available, it is shown as 'NA'. In case of QR, while '+' and '-' signs indicate statistically significant cases, we show, e.g. '+M' for the case where a positive and significant coefficient is found in one of the categories 'malnourished' (z score <-2.0), '+N' (or '-N') for significant cases for 'normal' (-2.0<z < 2.0) and '+O' (or '-O') for significant cases for 'over-nourished'.

(Table 3 to be inserted)

It is important to note that the coefficient estimates of OLS based on the mean of the conditional distribution of a dependent variable do not necessarily reflect the coefficient estimates of each group derived by QR, though as expected the results of OLS by and large reflect the results for the 'normal' group (which is closer to the median regression). The results of QR will be useful for us to check whether those of OLS will hold for all the nutritional groups across the entire conditional distribution of z. In a few cases, the results of QR are not only different from those of OLS, but changes the signs at different points of conditional distributions. For example, a child's age is not statistically significant for 'weight-for-height' (wasting) in OLS or IV for NFHS-3, but it is positive and significant up to the group with z score <-1.0, not significant for the group with z between -1 and negative and

significant for those with z score >1.0. This implies that the change of 'weight for height' is in the direction of being equalized which is statistically significant, but OLS is not able to capture that. This is the point emphasized by Borooah (2005).

However, such cases are few and far between and we get results mostly consistent across different estimation methods. Again, given the space limitations, we highlight the important results. Consistent with previous studies (Borooah, 2005;, Kandpal & McNamara, 2009), whether a child is male is negative and significant in most cases. However, as suggested by Charmarbagwala et al. (2004), the sign of a sex dummy of a child can differ across countries, over the years, and our results are likely to be context specific. Age of a child is negative and significant with its square positive and significant, implying that z score is decreasing as a child grows but a marginal change will be smaller as he or she grows. Consistent with Gaiha and Kulkarni (2005), the present estimates suggest that higher birth order negatively affects nutritional status in case of the NFHS data, irrespective of which measure is used. In case of the NCAER data, however, a negative effect of higher birth order is not clearly observed for a z score of weight-for-height.

The variable on whether a household has access to health scheme or health insurance is available for only NFHS-3. Only in case of IV applied to 'weight-for-age', where it is instrumented by the availability of telephone in the region[10],the result suggests that household access to heath scheme and health insurance improves the child's nutritional condition (in terms of underweight measure) after taking account of the endogeneity problem.

'Time necessary for getting water' has an expected negative and significant sign in some cases, in particular, for underweight and wasting. As women are responsible for fetching water, there is an unavoidable trade-off between this activity and child care. Access to electricity has a positive and significant coefficient for underweight and wasting measures. Among the variables on household characteristics, mother's age is highly significant and

positive with its square negative and significant for all the three measures. Access to a radio is positive and significant only for children malnourished or in the normal range in 1992-93. Access to a TV is positive and significant mainly in 1998-99. Having fridge is positive and significant only in 2005-06. Children from scheduled castes or scheduled tribes tend to have lower levels of z scores.

As hypothesised, we obtained negative and significant coefficient estimates for food price for NFHS-1 and NCAER data in 2005. The coefficient estimate, however, became positive and significant for NFHS-2. Prices of sugar, egg and cereal are negative and significant for weight-for-age in 2005-06 (for NFHS-3). While the coefficient estimates of cereal prices were positive and significant for NCAER in 1994 data, those for sugar and cereal were negative and significant in 2005. The reasons for this inconsistency across years call for further examination.

Table 4 reports the results of pseudo panel model based on NFHS data. As the variables available for NFHS-1 are limited, we present two cases – NFHS 1, 2 and 3 and NFHS 2 and 3 - for three different child nutrition indicators. These are presented shown in columns (1) through (6) in Table 4. The choice between fixed effects model and random effects model is based on the Hausman test and except for one estimation for 'weight-for-age' (column (2), Table 4), we have chosen the fixed effects model.

(Tables 4 to be inserted)

The relative bargaining power of mother in terms of schooling years is positive and statistically significant for 'weight-for-age' and 'weight-for-height' in columns (2), (3), (5) and (6) of Table 4. The coefficient estimate of the relative bargaining indicator for mothers is also positive and significant for 'weight-for-height' in column (1) of Table 5, based on the fixed effects model. Our hypothesis that the role of mother's relative bargaining power or

empowerment in improving her children's nutritional status in terms of short-term nutritional deprivation is corroborated by both NFHS data and NCAER data. However, the relative bargaining indicator is not significant for 'height-for-age' which represents chronic or long-term nutritional deprivation in Table 4, although as discussed earlier, the bargaining variable's effect is positive and significant on those malnourished in QR for NFHS-1.

However, 'whether a husband is justified in beating his wife' is *positive* and significant for weight-for-age in the column (5), contrary to our prediction. Looking more closely at the corresponding case of QR for NFHS-2 and 3 in Table 1, we find that 'beating' is not significant for NFHS-2 (except for the first category of 'acutely malnourished' where 'beating' is negative and significant) or for NFHS-3. It is likely that positive and statistically insignificant results in OLS and QR for NFHS-3 become dominant once we highlight inter-state variations. 'Whether a wife is allowed to go to the market without permission from husband' is positive and significant for 'height-for-age' and 'weight-for-age'. [11]

Table 5 presents the results of the pseudo panel data model based on two rounds of NCAER data in 1994 and 2005 for 'weight-for-height'. The results of both fixed effects and random effects models are shown in columns (1) and (2), while the Hausman test result favours fixed effects model. While the share of children under age five is negative and significant for 'weight-for-height' in column (1) of Table 5 for NCAER data, it is positive but statistically insignificant in column 3, and positive and significant in column (6) for NFHS data. But it is negative for 'height-for-wage' and 'weight-for-age'. The results are mixed, but by and large, having more children under five tends to result in worse nutritional conditions of children. Consistent with previous results, boys under three are worse nourished than girls. A child's age is mostly negative and significant with its square positive.

(Table 5 to be inserted)

As before, mother's age is positive and significant (with square positive and significant) for 'weight-for-age' and 'weight-for-height'. The effect of having a 'flush toilet' on child nutritional status is more clearly observed in case of pseudo panel (Table 5) where it is positive and significant at the 1% level.

The effect of 'time for getting water' on child nutrition is also more clearly observed in pseudo panel models in Tables 4 and 5. It is negative and significant for 'weight-for-height' in columns 3 and 6 of Table 4 and column 1 of Table 5. Electricity is also negative and significant for 'weight- for- height' in column 3. 'Access to a TV' positively increases z score irrespective of its definition when NFHS-2 and 3 are used, while it is significant only for 'weight-for-height' for NFHS 1, 2 and 3. Children belonging to scheduled castes (SC) are more likely to be undernourished for all the measures for NFHS.[12] Food price is not significant in most of the cases except for 'weight-for-age' in column (5) of Table 4 where the coefficient of food price is positive and significant.

7. Concluding Observations

This study investigates whether mother's empowerment measured as mother's relative bargaining power affects children's nutritional status using three rounds of NFHS data in 1992-93, 1998-99, 2005-06 as well as the National Council of Applied Economic Research (NCAER) data in 1994 and 2005. NCAER data are used as a robustness check to see if the results based on NFHS data could be generalised. OLS, IV, QR and pseudo panel model are applied to these data sets. We summarise our central findings in the following paragraphs.

First, the relative bargaining index defined as the share of mother's schooling years over father's schooling years positively and significantly influences z scores pertaining to the short-term measures of nutritional status of children, namely, 'weight-for-age' and 'weight-for-height'. The results of QR suggest, however, that the bargaining power will improve a

chronic measure of nutritional status, 'height-for-age', at the low end of conditional distribution of z score or those stunted.

Second, the result of IV estimation indicates that access to health scheme or health insurance - which is instrumented by the proxy for infrastructure - tends to improve 'weight-for- age' in 2005-06.

Third, health-related facility, infrastructure and environment are important factors in reducing the prevalence of child malnutrition. For example, wider access to a flush toilet is likely to improve nutritional status of children in terms of stunting and underweight. Easier access to water is important in reducing 'wasting'. The results of QR imply that access to radio and TV is important for improving the measures of 'stunting' and 'underweight' particularly at the lower parts of the conditional distribution. Also, children belonging to scheduled caste are more likely to be undernourished. Fourth, QR yields an additional insight into child malnutrition because behavioural responses towards undernourished and over-nourished children are likely to differ.

Despite the steady decline in the prevalence of undernourished children, India is still one of a few countries with the worst levels of low birth weight, underweight and wasting among children in BRIC and SAARC countries. In terms of policy implications, more provisions of health scheme or health insurance are likely to be effective in reducing the temporary nutritional deprivation of children. Infrastructure (e.g. access to electricity) and health facilities are found to be also important. But policies to empower women in poor households that tend to have more malnourished children are required for reducing not only short-term nutritional deprivations but also chronic deprivations. If we go by the predictions of household models, both Beckerian and bargaining, expanding outside employment options for women is key to their empowerment.

References

Allendorf, Keera. (2007). Do Women's Land Rights Promote Empowerment and Child Health in Nepal? *World Development*, 35 (11), 1975-1988.

Ackerson, Leland K., & Subramanian, S.V. (2008). Domestic Violence and Chronic Malnutrition among Women and Children in India. *American Journal of Epidemiology*, 167 (10), 1188-1196.

Aturupane, H., Deolalikar, A., & Gunewardena, D. (2008). *The Determinants of Child Weight and Height in Sri Lanka: A Quantile Regression Approach*. Working Papers RP2008/53. World Institute for Development Economic Research. Helsinki: UNU-WIDER.

Becker, G. S. (1974). A theory of Social Interactions. *Journal of Political Economy*, 82, 1063-1094.

Borooah, V. A. (2005). 'The height-for-age of Indian children', *Economics and Human Biology*, 3, 45-65.

Charmarbagwala, R., Ranger, M., Waddington, H., & White, H. (2004). *The Determinants of Child Health and Nutrition: A Meta-Analysis*. Independent Evaluation Group (IEG) Working Paper. Washington DC: World Bank.

Deaton, A. (1985). Panel data from time series of cross-sections. *Journal of Econometrics*, 30(1-2), 109-126.

Deaton, A., & Drèze, J. (2009). Food and Nutrition in India: Facts and Interpretations. Economic and Political Weekly, XLIV(7), 42-65.

Fafchamps, M., Kebede, B., & Quisumbing, A. (2009). Intra-household Welfare in Rural Ethiopia. *Oxford Bulletin of Economics and Statistics*, 71(4), 567-599.

Fuller, W. A. (1987). *Measurement Error Models.* New York: Wiley and Sons.

Gaiha, R., & Kulkarni, V. (2005). Anthropometric Failure and Persistence of Poverty in Rural India. *International Review of Applied Economics*, 19(2), 179-197.

IAMR (Institute of Applied Manpower Research) (2011). *India Human Development Report 2011: Towards Social Inclusion.* New Delhi: Oxford University Press.

Kandpal, E. (2011). Beyond Average Treatment Effects: Distribution of Child Nutrition Outcomes and Program Placement in India's ICSD. *World Development,* 39(8), 1410-1421.

Kandpal, E., & McNamara, P. E. (2009). Determinants of Nutritional Outcomes of Children in India: A Quantile Regression Approach. *Conference Proceeding: the Agricultural and Applied Economics Association 2009 AAEA & ACCI Joint Annual Meeting*. Milwaukee, Wisconsin: AAEA & ACCI.

Koenker, R. W., & Bassett Jr, G. (1978). Regression Quantiles. *Econometrica*, 46(1), 33-50.

Kravdal, Ø. (2004). Child mortality in India: the community-level effect of education. *Population Studies*, 58, 177-192.

Luke, N., & Xu, H. (2011). Exploring the meaning of context for health: Community influences on child health in South India. *Demographic Research,* 24, 345-374.

Lundberg, S., & Pollak, R. A., (1993). Separate Spheres Bargaining and the Marriage Market. *Journal of Political Economy*, 101(6), 988-1010.

Maitra, P. (2004). Parental Bargaining, Health Inputs and Child Mortality in India. *Journal of Health Economics*, 23(2), 259-291.

Maluccio, J., Hoddinott, J., Behrman, J. R., Martorell, R., Quisumbing, A. R., & Stein, A. D. (2007). *The Impact of an Experimental Nutritional Intervention in Childhood on Education among Guatemalan Adults*. FCND Discussion Paper 207. Washington DC:, IFPRI.

McElroy, M. B. (1990). The empirical content of Nash-bargained household behaviour. *Journal of Human Resources*, 25(4), 559-583.

McElroy, M. B., & Horney, M. J. (1981). Nash-Bargained Household Decision: Towards a Generalisation of the Theory of Demand. *International Economic Review*, 22(2), 333-349.

The Naandi Foundation (2011). *HUNGaMA: Fighting Hunger & Malnutrition –The HUNGaMA Survey Report - 2011* <http://www.hungamaforchange.org/> Accessed October 2012.

Park, C. (2007). Marriage Market, Parents' Bargaining Powers and Child Nutritional and Education. *Oxford Bulletin of Economics and Statistics*, 69(6), 773-793.

Shroff, Monal, Griffiths, Paula, Adair, Linda, Suchindran, Chirayath, & Bentley, Margaret. (2009). Maternal Autonomy is Inversely Related to Child Stunting in Andhra Pradesh, India. *Maternal & Child Nutrition*, 5 (1), 64-74.

Smith, Lisa C., Ramakrishnan, U., Ndiaye, A. Haddad, L., & Martorell, R. (Eds.) (2003). The Importance of Women's Status for Child Nutrition in Developing Countries. International Food Policy Research Institute (IFPRI), series 131.

Tarozzi, A., & Mahajan, A. (2007). Child Nutrition in India in the Nineties. *Eonomic Development and Cultural Change*, 55(3), 441-486.

Thomas, D. (1994). Like Father, like Son: Like Mother, like Daughter: Parental Resources and Child Height. *Journal of Human Resources*, 29(4), 950-988.

Verbeek, M. (1996). Pseudo Panel Data. In Matyas, L. & Sevestre, P. (Eds.), *The econometrics of panel data: A handbook of the theory with applications, second edition*, in *Advanced Studies in Theoretical and Applied Econometrics*, vol. 33. Boston and London: Kluwer Academic.

Verbeek, M., & Nijman T. E. (1992). Can Cohort Data Be Treated As Genuine Panel Data?. *Empirical Economics*, 17, 9-23.

WHO (1997). *WHO Global Database on Child Growth and Malnutrition*, Geneva: WHO.

WHO (2006). *Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development*, Geneva: WHO.

Table 1. *A summary of Effects of Bargaining Power of Mother on child malnutrition in Rural India (NFHS 1, 2 and 3) Table 1 A summary of Effects of Bargaining Power of Mother on child malnutrition in Rural India (NFHS 1, 2 and 3)*

	OLS			Quantile Regression							
				(1) Z score -4.0	(2) Z score -3.0	(3) Z score -2.0	(4) Z score -1.0	(5) Z score -0	(6) Z score 1.0	(7) Z score 2.0	(8) Z score 3.0
NFHS-1 Rural 1992-3											
	Height for Age			Height for Age							
[Mother's Schooling Yrs/ Father's Schooling Yrs]	0.0508			0.000238	0.122**	0.0750*	0.0442	0.00342	-0.0315	-0.0740	-0.179
(Bargaining)	(1.504)			(0.00364)	(2.755)	(2.127)	(1.235)	(0.0637)	(-0.397)	(-0.643)	(-1.523)
Average Education	0.0343+			0.0110	0.0402	0.0490*	0.0415+	0.0465+	0.0227	0.0576	0.0866
	(1.784)			(0.354)	(1.118)	(2.265)	(1.847)	(1.750)	(0.525)	(0.672)	(0.756)
	Weight for Age			Weight for Age							
[Mother's Schooling Yrs/ Father's Schooling Yrs]	0.0400+			0.0741	0.0672*	0.0406	0.0591*	0.00499	-0.00794	-0.0656	-0.127
(Bargaining)	(1.901)			(1.384)	(2.170)	(1.494)	(2.284)	(0.188)	(-0.241)	(-1.327)	(-0.550)
Average Education	0.0446**			0.0214	0.0435**	0.0505**	0.0544**	0.0613**	0.0597**	0.0684*	0.00818
	(3.676)			(0.768)	(2.598)	(3.337)	(3.692)	(4.005)	(2.994)	(2.334)	(0.0689)
	Weight for Height			Weight for Height							
[Mother's Schooling Yrs/ Father's Schooling Yrs]	-0.00508			-0.0830	-0.0387	0.0630	0.0173	4.13e-06	-0.0427	-0.0349	-0.0708
(Bargaining)	(-0.177)			(-0.919)	(-0.499)	(1.540)	(0.449)	(0.000145)	(-0.936)	(-0.431)	(-0.509)
Average Education	0.0381*			0.0661	0.0476	0.0548+	0.0319	0.0376+	0.0310	0.0565	0.0283
	(2.356)			(1.106)	(1.158)	(1.737)	(1.546)	(1.936)	(1.583)	(1.455)	(0.417)
	OLS	IV		Quantile Regression							
				(1) Z score -4.0	(2) Z score -3.0	(3) Z score -2.0	(4) Z score -1.0	(5) Z score -0	(6) Z score 1.0	(7) Z score 2.0	(8) Z score 3.0
NFHS-2 Rural 1998-9											
	Height for Age			Height for Age							
[Mother's Schooling Yrs/ Father's Schooling Yrs]	-0.00176	-0.000731	-0.00162	0.0277	0.0183	-0.00162	-0.00940	0.00407	0.00550	-0.0177	-0.0284
(Bargaining)	(-0.147)	(-0.0108)	(-0.125)	(1.035)	(1.189)	(-0.126)	(-0.677)	(0.259)	(0.228)	(-0.762)	(-0.632)
Average Education	0.0421**	0.0430	0.0424**	0.0416**	0.0551**	0.0490**	0.0470**	0.0398**	0.0310**	0.0175	0.0303
	(7.865)	(0.872)	(3.347)	(3.768)	(8.449)	(8.125)	(7.934)	(5.328)	(2.904)	(1.073)	(1.215)

Whether a husband beats	0.000834	0.120		0.0290	0.0161	0.0128	-0.0168	0.0355	0.0620	-0.139	-0.474**
if a wife is unfaithful	(0.0243)	(0.0145)		(0.464)	(0.369)	(0.319)	(-0.416)	(0.688)	(0.844)	(-1.341)	(-2.693)
Whether a wife is allowed to go to market without permission from a husband	0.0353		-0.0518	0.0607	0.0701	0.0318	-0.00761	0.0725	0.0794	-0.0939	4.70e-05
	(0.937)		(-0.0144)	(0.918)	(1.425)	(0.800)	(-0.170)	(1.302)	(1.001)	(-0.798)	(0.000256)
	Weight for Age			Weight for Age							
[Mother's Schooling Yrs/ Father's Schooling Yrs]	0.0222*	0.0368	0.0231*	0.0649**	0.0364*	0.0272**	0.00654	0.0221	0.0118	0.00631	-0.0423
(Bargaining)	(2.327)	(0.483)	(2.263)	(3.157)	(2.384)	(3.150)	(0.637)	(1.422)	(0.612)	(0.197)	(-0.826)
Average Education	0.0448**	0.0549	0.0478**	0.0420**	0.0603**	0.0505**	0.0396**	0.0383**	0.0276**	0.0252	0.0291
	(10.39)	(1.075)	(3.616)	(3.826)	(8.692)	(7.981)	(8.392)	(7.278)	(3.249)	(1.639)	(1.197)
Whether a husband beats	-0.0369	1.670		-0.141+	-0.0290	-0.0317	-0.0124	0.00586	-0.0400	-0.0283	-0.0248
if a wife is unfaithful	(-1.322)	(0.190)		(-1.835)	(-0.678)	(-0.896)	(-0.352)	(0.175)	(-0.750)	(-0.267)	(-0.124)
Whether a wife is allowed to go to market without permission from a husband	0.0633*		-0.806	0.142+	0.124*	0.0672+	0.0382	0.0878*	0.0107	0.126	0.0989
	(2.119)		(-0.208)	(1.810)	(2.474)	(1.803)	(1.068)	(2.323)	(0.182)	(1.205)	(0.532)
				Weight for Height							
[Mother's Schooling Yrs/ Father's Schooling Yrs]	0.00592	0.175	0.0279	0.0324	0.0623**	0.0401*	0.0136	0.0201	0.00560	-0.0321	-
(Bargaining)	(0.415)	(0.289)	(0.648)	(0.863)	(2.655)	(2.394)	(1.140)	(1.412)	(0.260)	(-0.858)	-
Average Education	0.0194**	0.161	0.0557	0.0384**	0.0531**	0.0376**	0.0307**	0.0170**	0.00883	-0.00674	-
	(2.890)	(0.319)	(1.120)	(3.708)	(4.920)	(5.234)	(5.587)	(2.750)	(0.834)	(-0.651)	-
Whether a husband beats	-0.0698	24.81		-0.156+	-0.0631	-0.0380	-0.0782*	-0.0461	-0.0553	-0.0458	-
if a wife is unfaithful	(-1.617)	(0.280)		(-1.832)	(-0.815)	(-0.710)	(-2.508)	(-1.436)	(-0.773)	(-0.586)	-
Whether a wife is allowed to go to market without permission from a husband	0.126**		-9.118	0.188*	-0.0183	0.0746	0.0663+	0.105*	0.162*	0.104	-
	(2.645)		(-0.738)	(2.381)	(-0.243)	(1.328)	(1.710)	(2.331)	(2.405)	(1.471)	-
NFHS-3 Rural 2005-6											
	Height for Age			Height for Age							
[Mother's Schooling Yrs/ Father's Schooling Yrs]	-0.00427	0.0124	-0.00473	0.0688**	0.0306*	0.0104	-0.00604	-0.0175	-0.00783	-0.0199	-0.0669
(Bargaining)	(0.421)	(1.019)	(-0.216)	(4.810)	(2.307)	(0.991)	(-0.507)	(-1.127)	(-0.314)	(-0.614)	(-0.922)
Average Education	0.0283**	0.0162	0.0169	0.0381**	0.0428**	0.0399**	0.0345**	0.0277**	0.0140	-0.00199	-0.0425
	(5.610)	(1.485)	(0.561)	(3.030)	(5.700)	(6.956)	(7.304)	(3.999)	(1.553)	(-0.121)	(-1.395)

Whether a husband beats	0.0455		-1.634	-0.0398	-0.0683	-0.0291	0.0448	0.0995+	0.188*	0.354**	0.365+
if a wife is unfaithful	(1.316)		(-0.358)	(-0.606)	(-1.351)	(-0.751)	(1.300)	(1.917)	(2.573)	(2.771)	(1.864)
Whether a wife is allowed to go to market without permission from a husband	0.0551+			0.0200	0.0568	0.0284	0.0604+	0.0247	0.0963	0.161	0.125
	(1.673)			(0.276)	(1.270)	(0.727)	(1.669)	(0.533)	(1.373)	(1.326)	(0.683)
Health Insurance Scheme	-0.0204	4.092		-0.232	0.132	0.0131	0.0413	-0.0936	-0.0103	0.127	-0.220
	(-0.220)	(1.254)		(-0.728)	(0.904)	(0.124)	(0.417)	(-0.463)	(-0.0596)	(0.397)	(-0.523)
	Weight for Age			Weight for Age							
[Mother's Schooling Yrs/ Father's Schooling Yrs]	0.00546	0.0155	0.0139	-0.0279	0.0208	0.00852	0.00418	0.00859	0.0252	-0.00790	0.00845
(Bargaining)	(0.668)	(1.526)	(0.878)	(-0.832)	(1.185)	(0.854)	(0.455)	(0.705)	(1.476)	(-0.272)	(0.124)
Average Education	0.0334**	0.0193*	0.0464*	0.0544**	0.0513**	0.0335**	0.0283**	0.0267**	0.0306**	0.00800	-0.0184
	(8.636)	(2.161)	(2.309)	(3.064)	(6.988)	(5.718)	(6.096)	(4.802)	(4.204)	(0.553)	(-0.926)
Whether a husband beats	0.0156		2.067	-0.0125	-0.0508	0.00442	0.0118	0.0350	0.0599	0.0742	-0.0836
if a wife is unfaithful	(0.604)		(0.701)	(-0.169)	(-1.018)	(0.121)	(0.399)	(0.880)	(1.178)	(0.711)	(-0.560)
Whether a wife is allowed to go to market without permission from a husband	-0.00379			0.0319	0.0383	0.0220	-0.0115	-0.0455	-0.0412	0.0202	0.201
	(-0.154)			(0.303)	(0.751)	(0.677)	(-0.413)	(-1.335)	(-0.657)	(0.240)	(1.210)
Health Insurance Scheme	0.0412	5.267+		0.0848	0.0214	-0.00635	0.0607	-0.0208	0.139	0.479	0.117
	(0.528)	(1.865)		(0.476)	(0.183)	(-0.0556)	(0.903)	(-0.151)	(0.670)	(1.324)	(0.247)
	Weight for Height			Weight for Height							
[Mother's Schooling Yrs/ Father's Schooling Yrs]	0.00891	0.0112	0.0198	0.0325	0.0241	0.00455	0.00215	0.00526	0.0233+	0.0170	0.0107
(Bargaining)	(0.972)	(1.110)	(1.045)	(1.218)	(1.428)	(0.313)	(0.184)	(0.446)	(1.940)	(0.744)	(0.284)
Average Education	0.0215**	0.0184*	0.0417	0.0384**	0.0552**	0.0392**	0.0190**	0.0162**	0.0141*	0.0188+	0.00877
	(5.149)	(2.473)	(1.523)	(3.135)	(4.158)	(5.476)	(3.526)	(3.347)	(2.453)	(1.708)	(0.442)
Whether a husband beats	-0.0512+		3.019	0.0999	-0.0823	-0.0542	-0.0771+	-0.0249	-0.0508	-0.158*	-0.319*
if a wife is unfaithful	(-1.850)		(0.789)	(1.150)	(-1.031)	(-1.210)	(-1.944)	(-0.798)	(-1.283)	(-2.167)	(-2.411)
Whether a wife is allowed to go to market without permission from a husband	-0.0467+			0.0509	-0.113	-0.0636	-0.0312	-0.0331	-0.0367	-0.0203	0.0734
	(-1.759)			(0.567)	(-1.532)	(-1.575)	(-0.963)	(-1.043)	(-0.918)	(-0.324)	(0.489)
Health Insurance Scheme	0.0245	1.224		0.578*	0.0378	-0.0464	-0.0182	0.0566	0.0103	0.0718	-0.272
	(0.309)	(0.558)		(2.333)	(0.270)	(-0.388)	(-0.146)	(0.613)	(0.0796)	(0.360)	(-0.827)

Table 2. *Effects of Bargaining Power of Mother on child malnutrition in Rural India (based on NCAER data)*

Explanatory Variables	(1)	(2)	(3)	(4)	(5)	(6)
		Quantile Regression[$]				
	OLS	Severely Malnourished	Acutely Malnourished	Slightly Malnourished	Malnourished	Normal
		-3.72(4.80)[a]	-2.41(15.1)[a]	-1.49(29.5)[a]	-0.55(49.5)[a]	1.22(80.2)[a]
NCAER data in 1993						
[Mother's Schooling Yrs] /[Father's Schooling Yrs]	0.00	-0.00	-0.01	0.01	-0.00	0.01
	[0.34]	[-0.23]	[-0.42]	[0.93]	[-0.08]	[0.45]
[Mother's Schooling Yrs] + [Father's Schooling Yrs]/2	0.02	0.03	0.00	0.01	0.03	0.04
	[1.71]+	[1.56]	[0.23]	[0.52]	[1.87]+	[2.36]*

Explanatory Variables	(1)	(2)	(3)	(4)	(5)	(6)
		Quantile Regression[$]				
	OLS	Severely Malnourished	Acutely Malnourished	Slightly Malnourished	Malnourished	Normal
		-3.72(4.80)[a]	-2.41(15.1)[a]	-1.49(29.5)[a]	-0.55(49.5)[a]	1.22(80.2)[a]
NCAER data in 1993						
[Mother's Schooling Yrs/Father's Schooling Yrs]	0.00	-0.00	-0.01	0.01	-0.00	0.01
	[0.34]	[-0.23]	[-0.42]	[0.93]	[-0.08]	[0.45]
[Mother's Schooling Yrs] + [Father's Schooling Yrs]/2	0.02	0.03	0.00	0.01	0.03	0.04
	[1.71]+	[1.56]	[0.23]	[0.52]	[1.87]+	[2.36]*

Table 3. *Summary of Results of OLS, IV and Quantile Regressions (QR) based on NFHS and NCAER Data*

	NFHS-1 (1992/3)						NFHS-2 (1998/9)						NFHS-3 (2005/6)						NCAER-1994		NCAER-2005	
	HAZ*[1]		WAZ*[1]		HWZ*[1]		HAZ*[1]		WAZ*[1]		HWZ*[1]		HAZ*[1]		WAZ*[1]		HWZ*[1]					
VARIABLES	OLS/IV	QR	OLS/IV	QR	OLS/IV	QR	OLS/IV	QR	OLS/IV	QR	OLS/IV	QR	OLS/IV	QR	OLS/IV	QR	OLS/IV	QR	OLS	QR	OLS/IV	QR
Child Characteristics																						
child_male	-	-M		-MN		-MN	-	-	-	-M	-	-MN	-	-MN	-	-N		-MN	-	-		
age	-	-	-	-			-	-	-	-	-	-M	-	-	-	-		+M -NO			-	-N
age2	+	+	+	+	+	+NO	+	+	+	+	+	+MN	+	+	+	+		-M +O	-	+M -N		
second child		-N	-	+M/- N		+O	-	-MN		-N		-N			-	-M	-	-NO			*NA* *NA*	
third child		-O	+	-O		-N	-	-MN	-	-MN	-	-N		-MN	-	-MN	-	-N		-N	*NA* *NA*	
forth more	-	-NO	-	- NO	-	-NO	-	-MN	-	-MN	-	-N	-	-MN	-	- MN		-N		-N	*NA*	
Bargaining																						
Schooling_Ratio		+ M	+	+ M					+	+M		+M		+M								
AV_Schooling Yrs	+	+ MN	+	+	+	+N	+	+MN	+	+ MN	+(ols)	+MN	+	+	+	+	+	+	+	+M		
beat_unfaithful				*NA*				-O				-M		+NO			-(ols)			*NA*		
allow_market				*NA*						+M	+(ols)	+MN	+(ols)	+N	+(iv)		-(ols)			*NA*		
Policy																						
health_scheme				*NA*					*NA*						+(iv)					*NA*		
Environment																						
time_water		-N	-N						-(ols)	-M						-N		-MN	-	-N		+N
electricity			+	+ MN	+	+N			+	+M		+M			-	-NO	+	-NO	*NA*	*NA*	*NA*	*NA*
Household Composition Characteristics																						
mother_age	+	+ NO	+	+	+	+N	+	+MN	+	+MN	+(ols)	+N	+(iv)	+	+	+MN		-O		+N		
mother_age2		+NO	-	-	-		-	-MN	-	-MN	-(ols)	-N	-(iv)	-	-	- MN		+O		-N		
hhsize								-MO					-				+(ols)	+MN				
child5_share				-O	-	-NO				+O	+		-	-			+	+N	+	+N		
radio		+ M	+	+ MN	+	+MN										-O			*NA*	*NA*	*NA*	*NA*
TV	+	+ M		+ M			+	+MN	+	+MN		+MN							*NA*	*NA*	*NA*	*NA*
fridge										+M	+(ols)		+	+	+	+N			*NA*	*NA*	*NA*	*NA*

bicycle									-N						+M		-NO		-		-NO				
flushtoilet			+M				-O		+		+		+ NO				+		-MO					+	+M
wealth_index					NA						NA				+		+		+			+		+	+N
Income pc					NA						NA						NA						+	+	
Income pc*Toilet					NA						NA						NA							+M	
hh_SC			+ N				-	-N	-	-MN	-	-MN		-M	-	-MN	-		-MN					+M	
hh_ST								-N	-	-NO	-	-MN		-MN	-	-M	-		-MN		-	-N		+N	-N
hh_Other	-				-M		+	+MO	-(ols)	+N	-(ols)	-MN	-(ols)	-MN	-	-MN	-(iv)								
Hindu			+O					-M				-MN	-(ols)		+(ols)	+NO							+	+N	-	-N
Muslim										+O	-(ols)			-M	+(ols)	+NO							+	+N		-N
Christian									+(ols)	+NO		+O											+	+N		-N
Sikh												-		-MN		+N							+	+		+M
Regional Dummies																										
BIMARU									-(iv)	-M +O		-	+(ols)		-	-	-			-(ols)					-	-
South					+ N										-	+	-		+M			-MN	-	-	-	-
East			- O	-											-(ols)	+	-						-	-M	-	-
West	+		+ MO	-			-	-NO	-(iv)		-	+M -O				-MN			-N							
Price																										
Food Price	-		- M		- N			+M -NO	+(ols)	+NO	+(ols)		+(ols)					*NA*						*NA*		
Sugar Price					NA						NA				-	-NO	-		+			+N			-	-
Egg Price					NA						NA				-(ols)		-					+NO				
Cereal Price					NA						NA						-(iv)						+	+M	-	-N

*1 HAZ: Z score for Height for Age; WAZ: Z score for Weight for Age; WHZ: Z score for Weight for Height.

*2 "+" or "-" is shown in the case where the coefficient estimates are statistically significant. In the case of Quantile Regression (QR), M stands for 'Malnourished'. That is, "+M" means "positive and statistically significant only for malnourished children. Similarly, N stands for Normal and O stands for Over-nourished. We put M (or N, O) if we find any sub-group for which a coefficient estimate is statistically significant. A full set of results are given in Appendix Tables A2- Appendix Tables.

Table 4. *Pseudo Panel for Z Score of Children, NFHS*

VARIABLES	(1) Height for Age	(2). Weight for Age	(3). Weight for Height	(4). Height for Age	(5). Weight for Age	(6). Weight for Height
Fixed or Random	Based o NFHS 1, 2 and 3			Based on NFHS 2 and 3		
Effects Model	FE	RE	FE	FE	FE	FE
Schooling_Ratio	0.0432	0.197**	0.280**	0.0601	0.243**	0.281*
	(0.476)	(3.372)	(3.451)	(0.497)	(3.047)	(2.484)
AV_Schooling Yrs	0.0143	0.00645	-0.0354	0.0353	0.0231	-0.0298
	(0.367)	(0.316)	(-1.012)	(0.814)	(0.809)	(-0.736)
beat_unfaithful	-	-	-	0.388	0.376*	0.260
				(1.451)	(2.140)	(1.040)
allow_market	-	-	-	0.453+	0.342*	0.136
				(1.946)	(2.230)	(0.627)
	(0.437)	(-0.407)	(0.728)	(-1.037)	(0.946)	(2.321)
child5_share	-0.485	-0.381+	0.0672	-3.348**	0.398	2.541*
	(-1.521)	(-1.885)	(0.235)	(-3.012)	(0.544)	(2.448)
child_male	-0.0312	-0.156	-0.400*	-0.174	-0.292+	-0.468*
	(-0.145)	(-1.043)	(-2.076)	(-0.735)	(-1.876)	(-2.123)
age	-0.218**	-0.0760*	-0.0785+	-0.149**	-0.0675+	-0.0722
	(-4.153)	(-2.103)	(-1.670)	(-2.654)	(-1.823)	(-1.374)
age2	0.00357**	0.00182*	0.00208+	0.00194	0.00133	0.00198
	(2.752)	(2.030)	(1.792)	(1.396)	(1.454)	(1.531)
second child	0.566	-0.213	-0.472	0.829+	0.0624	-0.890*
	(1.401)	(-0.776)	(-1.306)	(1.813)	(0.207)	(-2.084)
third child	0.354	-0.368	-0.427	1.072+	-0.167	-0.909+
	(0.781)	(-1.194)	(-1.053)	(1.920)	(-0.454)	(-1.745)
forth more	0.480	-0.721**	-0.844*	1.122*	-0.0291	-1.041*
	(1.132)	(-2.694)	(-2.222)	(2.347)	(-0.0923)	(-2.331)
mother_age	0.0259	0.124**	0.115*	-0.0730	0.0263	0.113+
	(0.412)	(2.979)	(2.040)	(-1.029)	(0.564)	(1.710)
mother_age2	-0.000351	-0.00173**	-0.00158*	0.000809	-0.000455	-0.00148
	(-0.405)	(-2.982)	(-2.030)	(0.824)	(-0.705)	(-1.614)
flushtoilet	0.949**	0.654**	-0.647*	0.374	-0.0266	-0.688*
	(3.274)	(4.184)	(-2.495)	(1.024)	(-0.111)	(-2.017)
time_water	0.00188	-0.00105	-0.01000**	0.00276	0.00300	-0.00894*
	(0.468)	(-0.404)	(-2.772)	(0.627)	(1.035)	(-2.175)
electricity	0.349	-0.0861	-0.463+	0.296	-0.169	-0.447
	(1.273)	(-0.638)	(-1.890)	(0.988)	(-0.858)	(-1.595)
radio	0.400	0.237	-0.324	-0.0536	0.0240	-0.251
	(1.533)	(1.492)	(-1.390)	(-0.181)	(0.123)	(-0.907)
TV	0.00482	0.165	0.767**	0.752*	0.675**	0.914**
	(0.0163)	(0.905)	(2.893)	(2.155)	(2.939)	(2.803)
fridge	0.311	0.0471	0.0649	0.0581	0.371	-0.0460
	(0.814)	(0.203)	(0.190)	(0.119)	(1.155)	(-0.101)
bicycle	0.363	0.161	-0.112	-0.0972	0.215	-0.137
	(1.534)	(1.302)	(-0.528)	(-0.354)	(1.187)	(-0.535)
hh_SC	-1.191**	-0.699**	-0.499+	-1.402**	-1.036**	-1.000**
	(-3.884)	(-3.731)	(-1.819)	(-3.845)	(-4.318)	(-2.937)
hh_ST	0.378	-0.00342	-0.0479	-0.217	-0.382	-0.427
	(1.078)	(-0.0197)	(-0.153)	(-0.502)	(-1.344)	(-1.059)
hh_Other	-0.137	0.129	0.388+	-0.129	0.112	0.110
	(-0.522)	(0.895)	(1.658)	(-0.422)	(0.556)	(0.385)
Hindu	-0.389	-0.431+	0.157	-0.592	0.118	0.185

	(-0.538)	(-1.648)	(0.243)	(-0.740)	(0.224)	(0.248)
Muslim	-1.140	-0.380	0.111	-1.674*	-0.350	-0.0777
	(-1.529)	(-1.406)	(0.166)	(-1.983)	(-0.630)	(-0.0986)
Christian	-1.190+	-0.245	0.161	-1.242+	0.309	0.385
	(-1.925)	(-0.999)	(0.292)	(-1.910)	(0.723)	(0.634)
Sikh	-2.442*	-0.375	1.871*	-2.605*	0.0285	2.176*
	(-2.344)	(-1.033)	(2.007)	(-2.377)	(0.0396)	(2.125)
rural	-	-0.629	-	-	-	
		(-0.906)				
BIMARU	0.392	-0.310**	1.169**	0.526	0.716*	1.316**
	(0.968)	(-3.831)	(3.229)	(1.229)	(2.544)	(3.295)
South	-0.819*	-0.199*	-0.00629			0.329
	(-2.463)	(-2.537)	(-0.0212)			(0.960)
East	-0.440*	-0.296**	-0.201	-0.505*	-0.581**	-0.286
	(-2.447)	(-3.893)	(-1.249)	(-2.553)	(-4.468)	(-1.551)
West		-0.255**		0.570	0.0563	
		(-3.078)		(1.551)	(0.233)	
Food price	-0.000239	-0.00124	0.00242	0.00420	0.00625*	0.00640
	(-0.0941)	(-1.377)	(1.065)	(0.875)	(1.978)	(1.427)
D_1998	0.0809	0.461+	2.054+			
	(0.0631)	(1.736)	(1.791)			
D_2005	0.523		1.900	1.688	1.917*	1.039
	(0.258)		(1.050)	(1.210)	(2.089)	(0.798)
Constant	-0.211	-1.728	-3.896	0.706	-4.204	-4.172
	(-0.0939)	(-1.852)	(-1.935)	(0.344)	(-3.118)	(-2.191)
Observations	390	419	390	338	338	338
R-squared	0.377		0.486	0.408	0.404	0.498
Number of state	29	29	29	29	29	29
Hausman Test	$Chi^2(29)=$	$Chi^2(30)=$	$Chi^2(29)=$	$Chi^2(30)=$	$Chi^2(30)=$	$Chi^2(31)=$
	93.17**	19.23	280.85**	59.79**	138.07**	66.55**
Prob>chi^2	0	0.935	0	0.001	0	0.0002
Chosen Model	FE	RE	FE	FE	FE	FE
Fixed or random-effects						

t-statistics in parentheses (** p<0.01, * p<0.05, + p<0.1).

FE stands for Fixed-Effects Model and RE random effects model.

Table 5. *Pseudo Panel for Z Score of Children (Weight for Height), NCAED data*

Explanatory Variables	(1) FE	(2) RE
Mother's Education/Father's Education	0.38	0.09
	(2.77)**	(1.26)
(Mother's Education + Father's Education)/2	0.11	0.13
	(0.99)	(2.07)*
Child's Sex (Male)	-0.01	-0.15
	(-0.01)	(-0.35)
Child's age	-0.36	-0.16
	(-1.36)	(-1.07)
Child's age Squared	-0.01	0
	(-0.13)	-0.09
Household Size	0.34	0.22
	(3.03)**	(3.87)**
Share of kids less than 5 years in a household	-4.66	-2.2
	(-1.71)+	(-1.50)
BIMARU[1]	-	-0.44
	-	(-1.90)+
South	-	-0.21
	-	(-1.05)
East	-	-0.43
	-	(-1.85)+
Price of Sugar	0.00	0
	(0.65)	(-1.05)
Price of Eggs	0.02	-0.01
	(0.87)	(-1.47)
Price of Cereals	0	0
	(-1.37)	(-0.91)
Hindu	0.28	1.05
	-0.12	-0.59
Muslim	-1.16	0.26
	(-0.45)	-0.15
Christian	-1.12	0.59
	(-0.29)	-0.25
Sikh	-3.9	1.2
	(-1.05)	-0.61
Distance to Water	-0.05	-0.01
	(-3.56)**	(-1.37)
Household owns toilet	-4.46	-7.24
	(-0.63)	(-1.57)
Log of per capita income	0.13	0.5
	-0.36	(2.21)*
Log of per capita income * Toilet	0.71	0.89
	-0.88	(1.68)+
Scheduled caste	2.69	0.99
	(3.16)**	(2.17)*
Scheduled tribe	2.12	1.72
	(1.91)+	(2.72)**
Constant	-3.52	-6.24
	(-0.76)	(-2.20)
N	266	266
Adj. R^2	-0.593	-
F-statistics	3.82	-
F-test (Unobserved=0)	-	-
Hausman test	40.50(0.00)	

t statistics in brackets ----- + p<.10, * p<.05, ** p<.01; [1] Base reference for location is North.
FE stands for Fixed-Effects Model and RE random effects model.

NOTES

[1] BRIC comprises the contemporarily economically fast growing countries of Brazil, Russia, India and China. SAARC stands for The South Asian Association for Regional Cooperation.

[2] Aturupane et al. (2008) applied QR to estimate the determinants of weight (as well as height) for age and found that mother's education is important in reducing underweight at higher percentiles.

[3] The health production approach could be incorporated in non-unitary or bargaining household models (Thomas, 1994).

[4] Maitra (2004) assumes that parents bargain over the use of health care (e.g. prenatal care and hospital delivery) and examines the effects of health care on child mortality. To avoid complication in the empirical model, we assume that parents can directly bargain over child health and nutritional status where the bargaining coefficient captures both direct effects of bargaining and indirect effects through the use of health care.

[5] See http://www.nfhsindia.org/index.html for the detailed description of NFHS.

[6] See Gaiha and Kulkarni (2005) for further details of NCAER data for the year 1994.

[7] Variance should be clustered at the household level, but as *Stata 11.0* does not allow clustering for QR or IV regressions, we take account of the clustering effects only for OLS. But in case of OLS, once we introduce the heteroscedasticity-robust estimator, 'clustering' cannot be corrected. However, we find (in case of OLS) that clustering at household or at community level does not change the results significantly and so given the large sample size, we present the case where only heteroscedasticity is adjusted by a robust estimator.

[8] BIMARU stands for the states of Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh.

[9] A full set of results will be furnished on request.

[10] In the first stage, the instrument is significant with a t value of 3.12. While over-identification is ruled out (the equation is exactly identified), the results of under-

identification and weak identification tests imply that the excluded instruments are correlated with the endogenous regressors and the correlation is not weak.

[11] Because the pseudo panel model involves averaging the values for each cohort, interpretation of the coefficient estimate is not straightforward. However, it appears that the marginal effect is not large since a one unit increase of 'beat_unfaithful' (equivalent to 100% increase in the probability of a wife being allowed to go to the market without permission of her husband) only increases z score of height-for-age by 0.453 (0.342 for weight-for-age).

[12] However, in case of NCAER data, coefficients for SCs and STs are positive and significant. A plausible reason may be due to the fact that 'weight-for-height' is sensitive to changes or measurement errors in two factors (weight and height) rather than one. Our preferred measures using the NFHS data are, therefore, 'height-for -age' and 'weight-for-age'.