Health care, household wealth, maternal education and child nutrition outcomes in Indonesia.A micro-level perspective on the MDGs complementarities.

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Abstract

The study of linkages among various spheres of human development as those encapsulated in the Millennium Development Goals is clearly not new to the development literature even though- since there are complex interactions existing between inputs and outputs, relatively less light has been shed on the issue of complementarities between the goals and on their strength and direction. This paper provides an empirical analysis of the drivers of complementarities between the MDGs by focusing on a micro- level perspective. Relying on the Indonesian Family Life Survey, which is a broad-based and large-scale panel survey of households and individuals, and applying a consistent econometric technique this paper attempts to unravel the linkages between child nutrition, health care, household wealth and parental education in order to detect how transmission channels work and identify the factors that can interplay with them. Our approach which keeps its focus on child undernutrition largely relies on the Mosley-Chen analytical framework by looking at both the gross-effect of socioeconomic factors (i.e. household income and wealth, parents education and presence of health facilities) and at the direct effect of more proximate variables (i.e. maternal health, nutrition deficiency and environmental contamination). A key finding from our analysis is that that maternal education has a positive and long term effect on child health and that this effect is partly reflected in reproductive behaviour and partly conveyed to child health outcomes by child caring practices such as breastfeeding. Although we cannot rule out the existence of strong complementarities existing between household wealth or income and child health,the effect of positive changes in this variable appears to be delimited only in the short term. On the other hand, there are supply-side factors such as lack of sanitation and access to health facilities which also strongly affect children in terms of anthropometric shortcomings.

JEL Classifcation: I120, I30, O150

Keywords: Millennium Development Goals, Child undernutrition, Panel data, Mundlak model, Indonesia.

1 Introduction

The reduction of child malnutrition represents a key issue for the development community. The UN Summit held in 2010 under the high-level plenary meeting of the UN General Assembly, has strongly acknowledged that, indeed, in many developing countries, the prevalence of under-five mortality rates is mainly related to malnutrition and lack of access to adequate health care and infrastructure, such as clean water and sanitation. Hence, improvements in these indicators might be considered of particular importance as they would likely yield a double dividend and boost progress in a core set of development goals.

Child malnutrition has for long been considered a massive problem in the whole Asian region and particularly in Indonesia, a country that still struggles with impressively high rates of low birth-weight babies and underweight and stunted children. Therefore, our contribution aims to shed some light on the determinants of child health in this country and identify the most effective transmission channels for influencing child nutrition and so to see which of these are amenable to policy interventions.

Many empirical studies have been carried out to analyze these determinants using either a macro or micro-perspective. The studies relying on cross-country data provides us with a quite mixed evidence supporting the existence and strength of the complementarities between child health and other income and non-income related MDGs indicators such as education, improved water, sanitation facilities and access to health infrastructure (Fay et al. 2005; Potts and Foso, 2007; Lo Bue and Klasen, 2013). A plausible explanation for these mixed findings provided in the macro studies may be attributed to the fact that important child and household characteristics which represent actually the bulk of the models of child health are lost in the aggregation process to national level. On the other hand, a more insightful potential is embodied in the empirical analyses using data collected from household surveys. A long- standing number of such empirical studies, inspired by the pioneering article by Caldwell (1979), have extensively argued that there exists a positive correlation between maternal education and child health, as better educated mothers are supposed to be more able to earn money and might also be better able to process information and acquire skills to take care of the children.

On the other hand, income alone may play an independent role in enhancing child health as more resources available to a household should translate into higher expenditures on food and health. In poor environmental settings, lack of access to material resources and meager living conditions may actually represent the most important obstacle to be adequately nourished and healthy.

Nonetheless, the issue regarding the mechanisms laying behind the relationship that links child health, mother education and household wealth still remains an interesting field to explore as-up to date- there seems to be no clear consensus on the transmission channels which lead to better health outcomes. A number of studies (Alderman, 1990; Sahn, 1994; Thomas et al., 1996; Desai and Alva, 1998) indeed have failed to find a strong causal association between maternal education and child health outcomes. As discussed in Desai and Alva (1998), this weak evidence supporting the positive role of maternal education may be attributed to the fact that this variable is mostly a proxy for socioeconomic status and hence its effect vanishes once controlling for income.

In this article we argue that the complex essence of this relationship lays in a vast array of factors which are not often so easy to measure and whose effect may not be well captured in a static framework. Indeed, the vast majority of published studies on this issue has solely relied on cross-sectional data -which although being useful in providing information on the total effect of maternal education and income- arguably inform us on the pathways through which these variables operates. Repeated observations which are available in longitudinal data instead have the advantage of improving the efficiency with which the relationship between these key factors can be assessed as this data allows us to control for both the observables and the unobservables that often invalidate purely cross-sectional analyses. Moreover, longitudinal data give us more confidence in analyzing such a complex relationship as it enables us to better examine the effects of proximate determinants (i.e. personal illness control and use and access to health infrastructure) and other lagged health determinants (i.e. breastfeeding). Lastly, by relying on the dynamic essence of longitudinal data it is possible to account for the time-varying effects of explanatory variables and hence to follow he child over time. The econometric model that we use allows us to properly identify the effect of community level, household level and individual level variables to child health outcomes while accounting for household-level unobserved heterogeneity and -at the same time- considering the variation occurring between household.

In order to analyze the transmission channels we first estimate a simple linear probability model for breastfeeding which is unarguably considered as one of the most important proximate determinant of child health. Then-following Lay and Robiliard (2009) - we look at the gross effect of mothers education on child nutrition and lastly link the two approaches by setting a full model which includes both the socioeconomic and proximate determinants of child nutrition.

As the main focus of this study is on the dynamics of relationship that links child nutrition, household income poverty and female education, we also advance our understanding of the complementarities which exist at the household level between different Millennium Development Goals (or MDGs, hereafter). The MDGs, which undoubtedly encapsulate key human development aspects, have certainly been successful in kindling commitments, efforts and actions at both national and international level. Nevertheless, as up-to-date literature suggests, there is mixed progress towards achievement of these goals (see Camfield et al. 2013; Klasen, 2012; Fukuda Parr et al. 2012; Karver et al. 2012). If on the one hand, the reasons for the failures and successes of the MDG process are ascribable to different measurement and interpretation issues, on the other hand the current discussion on the MDGs post-2015 is ultimately concerned with what should be preserved and what should be renewed in the system. One of the possible challenges pertains to the number of the goals. Are the MDGs too many or too few to capture the breadth of the UN Millennium Declaration? Which are the MDGs that can be said to have a leading role in fuelling improvements in other goals? This paper also contributes to this debate by examining the complementarities between some of the MDG, while focusing on the determinants and transmission channels of child nutrition (MDG 1). The remainder of this paper is organized as follows: section 2 provides with the literature background of the determinants of child health, from both the theoretical and empirical perspectives. Section 3 describes the data and outlines the main trends in child health outcomes and in its determinants in Indonesia. In section 4 we first present a simple of model of the determinants of child health and proceeds by showing our empirical results. The fifth section concludes and points to research and policy issues which emerge from our findings.

2 The determinants of child health

2.1 General discussion

The purpose of this study is to provide an empirical analysis of the determinants of child health. In doing so, it makes the case that the interplay between both demand-side and supply side factors (which are themselves encapsulated in some of the MDGs) may go along several channels in order to affect child anthropometric developments.

Our approach largely relies on the analytical framework proposed by Mosley and Chen (1984). Although their approach is primarily concerned with child mortality, we broaden it to include other less severe aspects of child health. Even though child undernutrition is at a first glance- a biological event, it is not just merely determined by specific genetic endowments as there is a wide range of cultural, environmental, socio-economic and behavioural factors which all influence the likelihood of ill health in early childhood.

Mosley and Chen's study has so far been one of the most frequently referenced articles in all the subsequent literature which has attempted to investigate the determinants of child health and mortality. The framework which they design is indeed a useful tool which integrates research strategies employed by medical and social scientists while, at the same time, being closely connected to Caldwell pioneering theory on the role of maternal education for child health (Caldwell 1979).

The underlying idea of this framework is that the factors which may affect child health operate though different stages. The first stage is that of the so called proximate determinants which directly influence child health. They comprise maternal factors (such as age at birth, parity and birth intervals); environmental conditions (i.e. water contamination and other hygienic factors); nutrition deficiency; injury and personal illness control (use of preventive services, antenatal care, and use of curative measures for specific purposes).

This set of proximate determinants can be also depicted as a pass through which a second set of variables affect child health outcomes. These are the socio-economic determinants of child health which can be grouped at different levels. At the individual level (i.e. parental skills, health, time, values, beliefs and preferences); at the household level (income/wealth, intra-household decision power; quality of water supply, housing conditions) and at the community level where they range from ecological environment factors (i.e. climate, altitude, rainfall) up to health system variables and political economy variables (i.e. physical infrastructure, organization of food production).

In a similar fashion, Schultz (1984) provides a simple model in order to estimate the possible biological and behavioural relationships that influencing peoples opportunities and thereby their use of health related inputs- may affect child survival and health outcomes. Schultz provides an interesting framework that distinguishes independent or exogenous variables from the dependent or endogenous variables used in studies of child mortality determinants and identifying also their level of aggregation (household or community).

Schultz's model departs from the identification of a health production function in which child mortality or morbidity is a linear function of a vector of proximate biological inputs as well as of a vector of persistent biological endowments of the child. So it is assumed that mothers choose the intermediate inputs in order to minimize the risk of mortality and morbidity of their child and to achieve other goals given their resource constraints. Hence these intermediate health inputs will be influenced partly by child health endowment which are due to genetic or environmental conditions and are out of the control of the familys behaviour; and partly by the socio-economic endowment of the family (including human and non human capital) and by the community-level factors such as prices, programs and environmental constraints and parents preferences.

It is of crucial importance to note that household and individual characteristics not only interact with each other but also with external factors such as those linked to social norms, and traditions which can indeed influence directly parental decisions regarding, for example, nutrition choices and health practices for their offspring. On the other hand, the effect of some crucial community-level variables such as the availability of vaccines and the presence of health facility can be boosted or muffled by household and individual-level characteristics such as the willingness to use and the

ability to pay for health services.
Thus, this theoretical guide lead us to postulate the existence of strong complementarities in a core set of the MDGs: child morbidity and mortality (MDG 1 and 4); mothers education and their intra-household decision power (MDG 2 and 3); household wealth (MDG 1) and the presence of adequate sanitation infrastructure and health services (MDG 7).

2.2 Empirical evidence

A large number of studies have analyzed empirically the determinants of child health by means of relying on the Mosley and Chens analytical framework but along several different pathways (Hill, Bicego et al., 2001; Lay and Robilliard, 2009).
A first approach has linked the socio-economic factors to the proximate determinants of child health. This link has been explained for example by the strong interconnections existing between maternal education attainment and an increased ability to buy goods and services linked to health outcomes (Victora, Smith, Vaughan, 1986; Clealand and Van Ginneken, 1988; Defo, 1997).
Also, higher levels of household incomes were found to be significantly correlated with better housing conditions such as latrine facilities, piped water and electricity (Barret and Browne, 1996; Defo, 1997; Martin et al., 1983) and to better ability to buy nutritional food, medicines, warm clothing and health care services which impact childrens health.
Many other studies have linked maternal education and reproductive behaviours, finding significant associations between higher education and lower fertility, reproduction at low risk ages and longer birth intervals (Cleland and Van Ginneken, 1988).
Although this type of approach is able to give us a clearer picture on how strong the complementarities can be at the very first stage of the framework conceived by Mosley and Chen, it neglects how child health outcomes can be influenced by these factors.
A second approach has instead focused more on the relationship between child morbidity or mortality outcomes and their proximate determinants. Rutstein (2000) provides a cross-country analysis using household data from the Demographic and Health Surveys (DHS) which suggests that order of birth, maternal young age at birth, use of not clean drinking water are among the strong determinants of child mortality. Wang, 2003 combines data from DHS and World Development Indicators (WDI) and finds that higher rates of child mortality are significantly associated with lower vaccination rates and limited or no access to sanitation. Many other studies which rely more on household level data have confirmed the existence of a significant effect of water, sanitation, hygiene on child health (see, inter alia, Esrey et al., 1991).
On the other hand, another strand of the literature has attempted to include both socio-economic and proximate determinants in the estimation strategy. This approach appears to be more complete since it basically traces empirically all the links pointed out in the Mosley and Chen's theoretical framework. Nevertheless, as also pointed out in Lay and Robilliard (2009), in practice data availability constraints and measurement problems do not allow for a complete inclusion of all the possible determinants of child health. This is especially true in the case of some proximate determinants such as the biological endowment or the nutrition intake of the child. As Lay and Robilliard (2009) suggest the omission of such variables can be misleading when the coefficients on the socio-economic factors which are associated with these have to be interpreted.
Several studies found significant effects of birth intervals, breastfeeding, and birth order on child stunting once controlling for important socio-economic variables such as maternal education or household wealth (Sommerfelt and Stewart, 1994; Forste, 1998; Boerma et al., 1991). Nevertheless,

in many studies the variables associated with local health environment or any other kind of community level variables were not included. This may be one of the main reasons why as noted by Frost et al. (2005) - the arguments which have propped up the thesis that reproductive factors are the transmission channels linking socio-economic variables and child morbidity or mortality have found a quite mixed empirical support.

Other empirical approaches have instead linked the socio-economic factors and child health outcomes by focusing more on the role of certain mediating factors such as mothers health knowledge. As some research has indeed shown, there is a strong positive association between education and specific types of health knowledge (such as recognition of the importance of immunization or practices of hand washing, or of boiling water to prepare meals or sterilize tools). The underlying idea of this strand of the literature is that parents education influence child health not only because it may raise family incomes (either through higher wages or increased productivity in self employment) or change parents preferences (i.e. via reduction in fertility rates) but also because education (especially for mothers) may lead to a more efficient mix of health goods to produce child health. Hence, according to this idea, it is on the information processing channel which the analysis of the determinants of child health should mainly be focused.

Nevertheless because of problems of endogeneity which may arise when including health knowledge in the set of independent variables, health outcomes were not always successfully predicted. Thomas Strauss and Henriques (1991) find that when variables describing information processing activities (which are merely conceived as exposure to mass media) were included, the coefficient of mother schooling lose its statistical significance. Glewwe (1999) provides a more precise analysis by means of considering possible differences in the role of cognitive, numerical and language skills (acquired through schooling) and also by including variables which can proxy for women exposure to modern society (as this can make educated women more receptive to modern medical treatments). Moreover, Glewwe's analysis which is conducted on cross sectional household survey data applies instrumental variables techniques in order to address endogeneity problems. His findings suggest that mothers health knowledge plays an important role in determining child health and that this effect appears to be channelled by literacy and numeracy skills learnt in school.

Frost et al. (2004) attempt to reconcile the literature on the transmission channels linking maternal education and child health by modelling the effects of socioeconomic status, knowledge, modern attitudes about health care, autonomy and reproductive behaviour. Their analysis, which is based on DHS data from Bolivia, also tries to take into account the effect of local health environment by including variables related to geographic residence and region, although it lacks more precise measures for health services availability. Their findings suggest that about half of the effect of maternal education on child nutritional status is explained by socio-economic status and geographic residence while modern health care utilization and health knowledge account to a lesser extent for portions of the maternal education effect. Reproductive behaviours variables such as birth spacing and parity are found instead to show a strong independent influence on child anthropometric shortfalls.

3 Data

We examine the linkages which connect socio-economic factors and proximate supply-side variables to child health outcomes in Indonesia using longitudinal household data from the Indonesia Family Life Survey (IFLS). This data appears particularly appealing in terms of representativeness of the total population, as it represents about 83 percent of the Indonesian population, covers 13 major provinces out of a total of 33 provinces in Indonesia and also shows a relatively low rate of attrition

between waves (Strauss et al., 1997).
This survey suits well to our research questions as it contains a wealth of information collected at the household and community level, including indicators of socio-economic well-being (expenditure, assets, housing conditions, education) as well as information on fertility, anthropometric characteristics, immunization, health status, and access and use of health services.
Although the IFLS surveys were originally conducted in four waves i.e. 1993, 1997, 2000, and 2007, we restrict our analysis to a ten-years time period, using data from 1997 to 2007. These three waves of the survey span a period of several different events such as the dramatic economic and political upheavals in the late 1990s at the time of the Asian Crisis, and the natural disasters (i.e. the 2004 Indian Ocean tsunami) which remarkably affected the Indonesian population.
Since our main variable of interest is the nutritional status of children,we only keep observations for households with children aged 0-15 years and having their height for age z-score in the plausible range from -5 to 3 (as recommended in O ' Donnell et al. 2008). Hence, our (unbalanced) panel is restricted to 9691 households: 32.04 percent of the households were followed in all the three years; 39.85 percent in 2000 and 2007, 24.70 percent in 1997 and 2000 and 3.4 percent in 1997 and 2007. Original data from several IFLS files has been organized so that the level of observation in our panel is the individual child to which we link information on several household, community and individual characteristics[1]
Based on height and age data, our dependent variable is the child z-score. As also noted by Gillespie and Haddad (2001), this is a fine anthropometric measure to capture child nutritional status as it reflects pre and post-natal growth with its deficit (i.e. stunting)[2] showing the long-term, cumulative effects of inadequacies of nutrition and/or health.
Table 1 provide descriptive statistics for these anthropometric individual characteristics together with some information on the share of children (separately for boys and girls) who are stunting and extremely stunting (i.e. where the z-score is below -3 standard deviation of the height for age norm). Additionally, Table 1 shows figures on the weight for age z-score and on the percentage of children who are underweight and extremely underweight (i.e. weight for age z -score below - 2 and - 3 standard deviation from the median reference group).
Average height for age scores are low and close to the stunting threshold, confirming the findings of several studies on this issue for the whole South Asian region (see, inter alia, Klasen, 2008; Harttgen and Misselhorn, 2006, Gillespie and Haddad, 2000) which attribute high rates of undernutrition partially to measurement issues, and partially to genetic factors as they may reflect delayed impacts of past undernutrition (Klasen, 2008). Consistently with the findings provided in the empirical literature on child undernutrition (e.g. O'Donnell et al. 2008; Klasen, 1996), figure 1 (reported in Appendix) show that height-for-age scores decrease with increasing age of the child.
Also, the percentages of children who suffer from stunting seem to be quiet high especially for boys. This fact confirms the presence of a gender-bias (at boys' disadvantage) in anthropometric failures which characterizes the country (Ralston, 1997; Basune, 1989; Deolalikar, 1990). One of the possible reasons for this gap lay in the fact that -because of different activity patterns- male children may have a higher exposure to disease. Also (as hypothesized by Ralston, 1997), this nutritional bias can be attributable to parental preferences that evaluate female children of greater net value

[1]As we are mainly interested in the nutritional status of the child (given by her height for age, z-score), we are forced to keep observations in every year only for children younger than 15. Therefore, the same child can only be observed in only two or three years consecutively, depending on the age of that child in the first year he is observed.

[2]According to the National Center for Health Statistics/World Health Organization International Growth Reference, children whose z-score is two standard deviation below the median height-for age curve are classified as stunted (Dibley et al., 1987).

Table 1: Child health characteristics. Descriptive Statistics

Individual characteristics		Mean	1997	2000	2007
Height for Age z-scores		-1.61	-1.75	-1.63	-1.46
		(1.18)	(1.24)	(1.21)	(1.08)
	boys	-1.60	-1.76	-1.65	-1.45
		(1.22)	(1.30)	(1.24)	(1.12)
	girls	-1.61	-1.74	-1.63	-1.48
		(1.13)	(1.17)	(1.17)	(1.03)
Stunting (%)		37.30	42.76	38.99	30.88
	% of boys	38.25	44.66	49.97	31.37
	% of girls	36.29	40.87	37.94	30.34
Extreme Stunting (%)		11.15	14.35	12.01	7.57
	% of boys	11.55	15.28	12.58	7.52
	% of girls	10.73	13.43	11.41	7.62
Weight for Age z-scores		-1.32	-1.43	-1.26	-1.25
		(1.89)	(1.79)	(2.33)	(1.25)
	boys	-1.32	-1.44	-1.28	-1.24
		(1.89)	(1.23)	(2.31)	(1.31)
	girls	-1.31	-1.43	-1.24	-1.28
		(1.88)	(1.11)	(2.36)	(1.17)
Underweight (%)		29.48	31.28	28.73	28.28
	% of boys	30.70	32.57	30.14	28.88
	% of girls	28.13	29.94	27.17	27.50
Extreme Underweight (%)		7.06	7.47	7.21	5.68
	% of boys	6.95	7.45	6.99	5.81
	% of girls	7.20	7.48	7.46	5.50
Breastfed (%)		45.33	33.08	43.60	57.01
Born Home w/o assist. (%)		49.47	54.39	46.05	-
Vaccination (%)		72.03	49.83	69.29	99.92
Supplementary Food (%)		20.93	16.67	19.31	26.31
Vitamine A (%)		17.52	14.69	15.90	21.80

Sample Size: 9691 (unbalanced); Std. Dev. in parentheses; Source: own elaboration on IFLS data.

relative to male children as in Indonesia, families of male offspring must pay a brideprice to the bride's family.
As our analysis also aim to investigate the linkages between socio-economic factors and the proximate determinants of child health, we report in Table 1 the descriptive statistics relative to the percentage of children who were breast-fed, immunized, and given supplementary food and Vitamin A. As extensively confirmed by numerous medical research findings, breastfeeding is an important practice for the development of the child since the breastmilk contains several nutrients which make the child more resistant against disease. Although breastfeeding does not seem to be a common practice for the majority of the Indonesian mothers in our sample, vaccination rates (against BCG, polio, DPT and measles) appear relatively good and increasing over time.

Table 2 reports descriptive statistics relative to mothers' health and education. As the nutritional status of the mother is supposed to strongly affect the nutritional status of the child we include in our regressions a dummy variable indicating whether the body mass index of the mother was below the critical threshold of 18.5. Nevertheless the prevalence of mothers whose nutritional status is weak seems to be relatively low given the high prevalence of anthropometric shortfall for their children. Tetanus immunization and use of health facilities to get checkups during pregnancy have both improved over time covering a large share of the population examined. Some degree of improvement in educational achievement is also recorded in the higher levels of schooling (i.e junior and senior high school as well as university). We should note indeed that the intertemporal variation of these figures can be partially attributed to the unbalanced nature of our panel. Still, even if we look at the figures for the balanced sample we see a very similar picture suggesting a slight improvement in education achievement for these women. s the mothers interviewed were aged 15-49, it is likely that many of them were still in school and actually-as these descriptive statistics suggest- continued to go to school even while being mothers.

Table 2: Mothers' characteristics. Descriptive Statistics

Mothers health	Mean	1997	2000	2007
Mothers BMI$\leq$ 18.5(%)	7.30	8.39	7.87	5.67
Pregnancy checkups (%)	85.11	68.07	99.11	99.11
Tetanus Vaccination (%)	82.50	92.44	70.19	91.41
Mothers education				
No education (%)	4.51	5.49	4.16	4.20
Primary Education (%)	51.72	58.52	51.53	46.65
Junior High School (%)	16.66	14.35	17.21	17.74
Senior High School (%)	19.75	18.20	19.79	20.89
Higher Education (%)	7.36	3.44	7.30	10.51
Working (%)	53.79	39.84	53.76	64.76

Source: own elaboration on IFLS data.

Descriptive statistics for households and community level variables are given in Table 3. Ownership of proper sanitation facilities has increased over time while use of piped water remains at low levels as around 80 percent of these household were indeed lacking access to clean water. When we look at the figures corresponding to presence and access to health facilities we see that if on average access to health facilities seems not to be of particular concern and the number of health posts has improved,the standard deviation of these figures is particularly high suggesting that actually many families living in rural remote areas does not have adequate access to the health infrastructure. Table 3 also shows the average figures for household per capita expenditure (excluding expenses on medicine and health goods) which we use as a measure of wealth/income. Spending levels, indeed, are likely to more accurately capture levels of long-term economic resources than income, which fluctuates seasonally to a greater degree. It should be noted that as the data in real terms was available for all the waves except for 2007, we estimate the missing value by using the available data in nominal terms and taking into account changes occurred in price index over the last period in order to obtain the temporal deflator.

Table 3: Household and Community characteristics. Descriptive Statistics

Household characteristics	Mean	1997	2000	2007
Household Size	5.21	5.44	5.21	5.04
	(1.67)	(1.73)	(1.71)	(1.52)
Piped water (%)	23.92	24.53	24.57	22.58
Own Toilet (%)	68.82	61.66	65.84	78.25
Distance to health facility (avg time in min.)	13.33	13.09	13.93	12.70
	(6.18)	(5.92)	(6.62)	(5.69)
Log monthly per capita expenditure	12.269	12.202	12.204	12.463
	(0.66)	(0.67)	(0.66)	(0.63)
Community characteristics				
Number of Midwives	1.23	1.26	1.13	1.33
	(1.03)	(1.37)	(0.75)	(0.98)
Number of Health Posts	7.80	7.61	7.69	8.13
	(6.64)	(6.68)	(6.47)	(6.84)

Std. Dev. in parentheses; Source: own elaboration on IFLS data.

As a potential source of concern for the robustness of our estimates lays in the fact that expenditure might be endogenously determined, we have also constructed with principal component analysis an indicator of household wealth which includes information on household ownership of durable goods and household dwelling conditions. As the signs of the scoring coefficients suggest, higher values of the index correspond to lower values of household wealth (see Table 4).

Table 4: Scoring Coefficients for asset index (PCA)

	1997	2000	2007
Car	-0.24	-0.23	-0.26
Low roof material	0.22	0.18	0.18
Low floor material	0.27	0.28	0.25
Low wall material	-	-	0.24
Electricity	-0.33	-0.31	-0.27
Piped drinking water	-0.24	-0.23	-0.11
Well water w/pump	-0.21	-0.22	-0.22
Well water (no pump)	0.17	0.28	0.25
Spring and surface water	0.32	0.17	0.22
Own toilet	-0.48	-0.51	-0.51
Public toilet	0.06	0.10	0.20
Out defec.	0.06	0.48	0.44

Source: own elaboration on IFLS data.

4 Estimation strategy and results

The empirical approach followed in this paper is based on the Schultz model (1984) in which utility depends on the health and nutrition of each household member as well as on consumption of several goods.[3]

The household behaves as if it maximizes a long run utility function which has as argument the health (or nutrition) of each household member given by the standardized anthropometric measurement of the height-for-age for individual i (H_i) and consumption of private and public goods (C_i) as well as leisure (L_i):

$$U = f(H_i,\ C_i,\ L_i) \tag{1}$$

The health status of each household member results as the outcome of a production function which can be formalized as:

$$H_i = f(E_i,\ PD_i,\ SE_i,\ b_i) \tag{2}$$

where E_i is the local health environment where the child lives including also exogenous supplied health inputs at the community level (i.e. availability of health posts), b_i is the biological endowment of the child (proxied by father's height), SE_i is a vector of the socio economic determinants of child health. These variables are set at the household level and include parental level of education (i.e. years of schooling); household income (or wealth). It is important to note that whether household wealth or income contribute directly to enhance child health outcomes as they imply higher expenditures on food and health goods, mothers or father education can exert a direct role (as it is translated into better skills and knowledge on child caring practices) as well as an indirect role as it is translated into higher incomes.

PD_i is a vector of proximate determinants of the health status of the child which are both at the household level (I_{hi}), i.e. access to piped water, sanitation, maternal health and at the individual level (I_i), i.e. breastfeeding. As it can be assumed that the effect of the SE is channelled by the I_i vector, we will also consider the following function:

$$I_i = f(E_i, SE_i) \tag{3}$$

Hence, in a first step we will estimate the effect of the socio-economic factors on the probability of being breastfeed (Table 5). Second, we provide an empirical assessment of the gross-effect of the socio-economic determinants by excluding from (2) the child-related variables which can be influenced by the parents (Table 6). Lastly we estimate (2) in order to assess the relative importance that transmission channels have in mediating the effect of maternal education on child nutritional status and also consider the contribution of the supply-side factors at both the household and community level(Table 7).

In order to obtain consistent estimates of the effects of our explanatory variables we need to take into account the fact that there might be a correlation between the unobserved variables and the

[3]The underlying assumption here is that health and consumption enter separately in the utility function because good health has an intrinsic value and food is consumed only partly for its nutritive intake.

observed ones. More specifically, household-level variables such as parent education and income might be correlated with household level factors (i.e. culture, beliefs, preferences) which are unobserved in the data. If this is the case, pooled ordinary least squares models and random effect models will yield biased estimates.

A possible solution would hence that of using household-level fixed effects which -by controlling for unobserved heterogeneity within household- would sweep out the bias. Unfortunately, there are two important limits entailed in the household fixed effects specification. First: when the ratio of within- to between-person variance declines to 0 fixed effects methods cannot estimate coefficients for variables that have no within-subject variation, implying that household-level variables that do not differ by child and are time-invariant are eliminated by that procedure. Second, fixed effects methods completely ignore the between-household variation and focus only on the within-household variation. Neglecting the variation that occurs between households, however, may not be desirable option from both an econometric and economic perspective. The econometric reason is that this procedure can yield standard errors that are considerably higher than those produced by methods that look at both the within and the between variation. In a panel with large N and small T, the fixed-effects model has few degrees of freedom and so cannot provide reliable estimates. From an economic perspective, even if we recognize the importance of controlling for unobserved heterogeneity within household, we are interested in capturing the variation occurring between households as it is exactly in there that the very bulk of heterogeneity takes place. Yet, the choice of the appropriate econometric model for our analysis is anchored to an arbitrary decision on the nature of the effect that we want to estimate and the type of inference that we want to obtain as with the fixed effect model we are able to make inference which is conditional on the effects that are in the sample only.

Hence, in our approach-by using the Mundlak model- we opt for a "compromise" between the fixed and the random effect models.

The Mundlak model (1978) indeed relaxes the assumption of no correlation between the observed and unobserved variables by exploiting the knowledge that the only portion of the time constant variation in the explanatory variables that can be correlated with the error term must be correlated only with the time average values of these explanatory variables for each individual (or household). For comparison purposes in all the specified models we will provide estimates obtained with pooled ordinary least squares and with the Mundlak approach. A second issue that deserves some discussion pertains the potential endogeneity of the income variable. To address this problem, many authors have indeed use instrumental variable techniques to estimate 2SLS or 3SLS models. Nevertheless, given the limit of data availability, we couldn't find any good instrument for expenditure and -as it is widely recognized- the use of instrumental variables may also lead to biased estimates when the fit of instrumenting is poor.

However, it should be noted that as we are using panel data and as our dependent variable is actually a measure of the long-term nutritional deficiencies, it might be the case that current income is unlikely to be endogenous. Moreover, it seems improbable that poor household with stunted children have much scope to adjust their income upwards through allocating additional labor to income earning activities as in very poor setting areas there are many binding constraints which actually prevent people from having higher paying.

Nevertheless, we try to tackle any possible problem of endogeneity in the expenditure variable by: a) excluding expenses in medicines and other health goods and b)consider an alternative specification with household wealth (measured by an household asset index) to replace household expenditure. Lastly, in order to reduce any possible bias streaming from the fact that real per capita expenditure was only indirectly estimated for the last year, we will include a third specification with expenditure per capita in nominal terms and interactions effects between time and provincial dummies in order to capture any possible difference in the level and changes of prices in different provinces.

The estimates that link the socio-economic determinants (i.e. mothers' years of education and household expenditure or wealth) to breastfeeding rely on a linear probability model and are reported in Table 5 . Breastfeeding is coded as a dichotomous variable indicating whether the child was ever breastfed. The right-hand side variables include also sex and rural dummies as well as a community level variable that informs on the availability of midwives. Indeed, in this way, we account for the fact that health professionals who are involved in the prenatal care and delivery of babies can influence their patients to practice breastfeeding. Although we fail to find a statistical significant effect for this variable, the positive sign of the estimated coefficients confirms our initial expectations.

When we look at the socio-economic variables, we see a positive and highly significant effect of mother education which give us a first proof for the existence of a transmission channel. Once controlling for the household-average-fixed effect in the Mundlak approach, our estimates confirm the existence of a positive independent role of maternal education as this effects significantly explains the bulk of the between household variation in breastfeeding.

Before discussing the results for the full specified model for child nutrition, we present in Table 6 an empirical assessment of the "gross-effect" of the socio-economic determinants. A first specification of these regressions (Col. 1, 6) include only child characteristics which don't depend on parental choices and behaviour (i.e. gender, genetic endowment) and mother education. Subsequently, we add father education and household expenditure or wealth to see the extent to which part of the maternal educational effect is actually absorbed by the income variable.

The OLS regressions suggest that mother education has a significant large, positive and independent effect on child health (measured in terms of height-for age z-scores) even though the effect of expenditure or wealth appears larger in magnitude. These results are confirmed after controlling for household-level average fixed effect. These Mundlak regressions also suggest that maternal education exerts a long term effect on child health whereas, if we look at both the magnitude and statistical significance of variables such as household wealth or income, this is mainly a short term effect. In other words, if income poverty is important in preventing parents to adequately care and nourish children as less resources can be devoted to them, maternal education appears to yield a double dividend as it is partially reflected in the better capacity to earn higher wages in the long term but still- its significant and positive sign suggest us that this long term effect may work also though other channels which can only be captured in a full specified model.

The theoretical expectation from this full-specified model is that the coefficient on the maternal education should be not significantly different from zero as, by definition, all variation in child nutrition status should be captured by the proximate determinants. Even after controlling for household-average fixed effects, we see (Table 7) that the positive effect of mothers education is indeed basically reflected in their reproductive behaviour (proxied by mother age at birth) and channeled through child health seeking practices such as breastfeeding. On the other hand, the significant coefficient on household expenditure and wealth confirms the previous results from the gross-effect estimates that income alone has a strong independent role in determine child health in the short-term. Moreover, from this table we can confirm the presence of strong complementarities existing between maternal and child health and a separate strong and robust effect of the supply-side variables-at both the community and household level- such as the number of health posts and access to improved sanitation facilities and safe drinking water sources. Children living

in households that have access to piped water are significantly better off than those one without by 0.19 height-for -age z-scores whereas, an improvement in the hygienic conditions at the household level (i.e. using of own toilet instead of public latrines or other outdoor devices) would contribute to reduction in child malnutrition by around 0.13 height for age z-scores. From this last finding the provision of such basic infrastructure is confirmed to be as as essential complement to the availability of food in preventing child malnutrition as it reduces the risk of of bacterial infections and diarrheal diseases which hamper the intake of calories and micro-nutrients.
As it may be already inferred from Fig.1 (reported in Appendix) and as also suggested by some related literature (i.e. in Sahn and Aldermann, 1997) there might be some specific age effects which can drive parts of the results. Pathogen exposure as well as as the importance of mother's care and nurturing have both specific age dimensions so that the effect of breastfeeding or access to health facilities may be expected to differ for children in different age-groups. Hence in order to control for this child age effect, age dummies coded in months (not shown in the Table) are included in all the specifications.

Table 5: Determinants of Breastfeeding

Dep.Var.: Breastfeeding	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) Mundlak	(6) Mundlak	(7) Mundlak	(8) Mundlak
Nr Midwives	0.0111	0.00870	0.0162*	0.00829	0.00543	0.00368	0.00950	0.00243
	(0.00773)	(0.00792)	(0.00982)	(0.00785)	(0.00740)	(0.00780)	(0.00805)	(0.00842)
Male	0.0336*	0.0346*	0.0272	0.0337*	0.0355**	0.0363**	0.0243	0.0334**
	(0.0196)	(0.0202)	(0.0182)	(0.0191)	(0.0141)	(0.0146)	(0.0152)	(0.0140)
Rural	0.00279	0.00782	-0.0527***	0.00174	-0.000539	0.00506	-0.0725***	0.00475
	(0.0200)	(0.0207)	(0.0194)	(0.0206)	(0.0199)	(0.0204)	(0.0214)	(0.0207)
Mother education ^{a}	0.00829***	0.00712***	0.00839***	0.00796***	0.000290	-0.000591	0.00888**	-0.00309
	(0.00170)	(0.00181)	(0.00168)	(0.00176)	(0.00296)	(0.00326)	(0.00353)	(0.00302)
Mother education ^{b}					0.0101***	0.0114***	0.00108	0.0130***
					(0.00354)	(0.00387)	(0.00409)	(0.00368)
Ln nom.expenditure pc^a				-0.0231				-0.0359**
				(0.0146)				(0.0168)
Ln nom.expenditure pc^b								0.0278
								(0.0198)
Ln real expenditure pc^a		0.00134				0.0617***		
		(0.0145)				(0.0193)		
Ln real expenditure pc^b						-0.0945***		
						(0.0273)		
Asset index ^{a}			0.00192				-0.0339***	
			(0.00576)				(0.00996)	
Asset index ^{b}							0.0460***	
							(0.0126)	
Constant	0.332***	0.304*	0.244***	0.689*	0.342***	0.718***	0.295***	0.303
	(0.0262)	(0.174)	(0.0256)	(0.384)	(0.0270)	(0.232)	(0.0280)	(0.272)
Time*Prov.dum.	NO	NO	NO	YES	NO	NO	NO	YES
Observations	4,940	4,558	3,644	4,910	4,940	4,558	3,644	4,910
R^2	0.010	0.008	0.017	0.053	0.111	0.010	0.019	0.0538
Number of hid					1,618	1,516	1,537	1,611

Note: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1. ^{a} short term or within effect, ^{b} long term or between effect

Table 6: Determinants of Child Nutrition. "Gross-effect"

Dep.Var: HAZ	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) Mundlak	(7) Mundlak	(8) Mundlak	(9) Mundlak	(10) Mundlak
Father height	0.0202***	0.0199***	0.0226***	0.0167***	0.0194***	0.0103***	0.0102***	0.0121***	0.0108***	0.00947***
	(0.00269)	(0.00266)	(0.00288)	(0.00253)	(0.00257)	(0.00154)	(0.00155)	(0.00185)	(0.00154)	(0.00152)
Male	0.00595	-0.00148	-0.0124	0.000624	-0.00955	-0.00265	-0.00612	-0.0133	-0.0109	-0.00946
	(0.0313)	(0.0314)	(0.0325)	(0.0320)	(0.0307)	(0.0249)	(0.0250)	(0.0261)	(0.0248)	(0.0246)
Rural	-0.339***	-0.322***	-0.281***	-0.268***	-0.243***	-0.291***	-0.278***	-0.246***	-0.202***	-0.224***
	(0.0313)	(0.0315)	(0.0327)	(0.0330)	(0.0331)	(0.0346)	(0.0349)	(0.0378)	(0.0367)	(0.0364)
Mother education [a]	0.0273***	0.0179***	0.00924***	0.0146***	0.00958***	0.00892	0.00627	0.000602	-0.00151	0.00116
	(0.00280)	(0.00327)	(0.00339)	(0.00329)	(0.00327)	(0.00543)	(0.00568)	(0.00612)	(0.00571)	(0.00613)
Mother education [b]						0.0254***	0.0178**	0.0138*	0.0160**	0.0185**
						(0.00647)	(0.00722)	(0.00783)	(0.00733)	(0.00747)
Father education [a]		0.0147***	0.00704**	0.00902***	0.00893***		-0.000894	-0.00271	-0.00673	0.00188
		(0.00302)	(0.00316)	(0.00306)	(0.00302)		(0.00538)	(0.00562)	(0.00542)	(0.00567)
Father education [b]							0.0160**	0.0102	0.0165**	0.00609
							(0.00681)	(0.00729)	(0.00692)	(0.00698)
Ln nom.expenditure pc[a]					0.271***				0.173***	
					(0.0251)				(0.0283)	
Ln nom.expenditure pc[b]									0.0803**	
									(0.0405)	
Ln real expenditure pc[a]			0.269***					0.189***		
			(0.0254)					(0.0306)		
Ln real expenditure pc[b]								0.0832		
								(0.0507)		
Asset index [a]				-0.0953***						-0.0454***
				(0.0112)						(0.0167)
Asset index [b]										-0.0659***
										(0.0226)
Constant	-4.951***	-4.963***	-8.574***	-4.403***	-8.591***	-3.410***	-3.469***	-6.985***	-7.127***	-3.247***
	(0.435)	(0.429)	(0.547)	(0.410)	(0.543)	(0.251)	(0.251)	(0.553)	(0.720)	(0.247)
Time*Prov.dum.	NO	NO	NO	NO	YES	NO	NO	NO	YES	NO
Observations	8,321	8,220	7,426	5,858	8,163	8,321	8,220	7,426	8,163	5,858
R^2	0.078	0.081	0.095	0.110	0.127	0.074	0.077	0.092	0.123	0.107
Number of hid						2,333	2,327	2,266	2,325	2,218

Note: Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1. [a] short term or within effect, [b] long term or between effect

Table 7: Determinants of Child Nutrition. Full Model

Dep.Var:HAZ	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) Mundlak	(8) Mundlak	(9) Mundlak	(10) Mundlak	(11) Mundlak	(12) Mundlak
Father Height	0.0214***	0.0215***	0.0206***	0.0218***	0.0205***	0.0179***	0.0117***	0.0122***	0.0119***	0.0131***	0.0123***	0.0118***
	(0.00273)	(0.00282)	(0.00277)	(0.00327)	(0.00274)	(0.00270)	(0.00173)	(0.00173)	(0.00175)	(0.00201)	(0.00175)	(0.00178)
Breastfeeding	0.0982***	0.0780**	0.0653*	0.0941**	0.0411	0.106***	0.139***	0.0823***	0.0722**	0.0818**	0.0260	0.107***
	(0.0348)	(0.0354)	(0.0356)	(0.0386)	(0.0393)	(0.0368)	(0.0293)	(0.0311)	(0.0314)	(0.0336)	(0.0337)	(0.0313)
Household size[a]	-0.0484***	-0.0635***	-0.0575***	-0.0395***	-0.0317***	-0.0591***	-0.0201	-0.0225	-0.0229	-0.0146	0.00110	-0.0308*
	(0.00999)	(0.0106)	(0.0108)	(0.0113)	(0.0112)	(0.0112)	(0.0152)	(0.0155)	(0.0158)	(0.0176)	(0.0166)	(0.0173)
Household size [b]							-0.0190	-0.0408*	-0.0318	-0.0168	-0.0349	-0.0273
							(0.0203)	(0.0211)	(0.0215)	(0.0231)	(0.0223)	(0.0226)
Piped water [a]	0.0732**	0.0618	0.0590	0.0222	0.0360		-0.0505	-0.0446	-0.0390	-0.0444	-0.0814	
	(0.0373)	(0.0378)	(0.0382)	(0.0395)	(0.0394)		(0.0556)	(0.0562)	(0.0568)	(0.0605)	(0.0579)	
Piped water [b]							0.194**	0.175**	0.157**	0.123	0.181**	
							(0.0765)	(0.0769)	(0.0775)	(0.0813)	(0.0797)	
Sanitation[a]	0.219***	0.198***	0.151***	0.115***	0.124***		0.138***	0.125***	0.131***	0.124***	0.0800*	
	(0.0323)	(0.0327)	(0.0335)	(0.0347)	(0.0337)		(0.0430)	(0.0438)	(0.0445)	(0.0477)	(0.0459)	
Sanitation[b]							0.134**	0.122*	0.0355	0.00434	0.0816	
							(0.0654)	(0.0658)	(0.0680)	(0.0709)	(0.0699)	
Male	0.0103	0.0160	0.00309	-0.0127	-0.0110	0.00301	-0.00582	-0.00166	-0.00916	-0.0181	-0.0164	-0.0133
	(0.0328)	(0.0330)	(0.0332)	(0.0341)	(0.0327)	(0.0345)	(0.0259)	(0.0260)	(0.0262)	(0.0270)	(0.0261)	(0.0265)
Rural	-0.223***	-0.217***	-0.188***	-0.180***	-0.171***	-0.187***	-0.203***	-0.199***	-0.167***	-0.169***	-0.144***	-0.162***
	(0.0355)	(0.0356)	(0.0361)	(0.0373)	(0.0375)	(0.0378)	(0.0403)	(0.0405)	(0.0410)	(0.0430)	(0.0421)	(0.0422)
Nr Health Posts	0.0157***	0.0155***	0.0147***	0.0140***	0.0120***	0.0131***	0.0132***	0.0127***	0.0113***	0.00967***	0.00825**	0.0118***
	(0.00252)	(0.00254)	(0.00254)	(0.00268)	(0.00283)	(0.00276)	(0.00296)	(0.00297)	(0.00301)	(0.00331)	(0.00333)	(0.00307)
Moth.age birth		0.0121***	0.0133***	0.0115***	0.0101***	0.0105***		0.0160***	0.0173***	0.0154***	0.0115***	0.0143***
		(0.00298)	(0.00299)	(0.00308)	(0.00299)	(0.00309)		(0.00290)	(0.00293)	(0.00305)	(0.00303)	(0.00292)
Moth.low BMI		-0.263***	-0.285***	-0.235***	-0.269***	-0.260***		-0.214***	-0.258***	-0.227***	-0.237***	-0.230***
		(0.0617)	(0.0629)	(0.0651)	(0.0631)	(0.0637)		(0.0591)	(0.0604)	(0.0625)	(0.0602)	(0.0682)
Moth.education[a]			0.00762**	0.00347	0.00513	0.00571			0.000926	-0.00429	-0.00285	-0.00251
			(0.00347)	(0.00358)	(0.00352)	(0.00353)			(0.00596)	(0.00643)	(0.00603)	(0.00648)
Moth.education[b]									0.0111	0.0122	0.0118	0.0117
									(0.00770)	(0.00819)	(0.00778)	(0.00802)

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Fath.education [a]			0.00867***	0.00289	0.00491	0.00665**			-0.00462	-0.00386	-0.00708	-0.000930
			(0.00319)	(0.00330)	(0.00321)	(0.00326)			(0.00553)	(0.00567)	(0.00560)	(0.00586)
Fath.education [b]									0.0138*	0.00624	0.0138*	0.00721
									(0.00713)	(0.00742)	(0.00722)	(0.00735)
Exp.pc real[a]				0.197***						0.136***		
				(0.0281)						(0.0350)		
Exp.pc real[b]										0.0672		
										(0.0543)		
Exp.pc nom.[a]					0.196***						0.167***	
					(0.0283)						(0.0316)	
Exp.pc.nom[b]											-0.0199	
											(0.0428)	
Asset index[a]						-0.0826***						-0.0503***
						(0.0121)						(0.0176)
Asset index [b]												-0.0467*
												(0.0241)
Constant	-5.483***	-5.693***	-5.728***	-8.251***	-7.988***	-4.633***	-4.017***	-4.344***	-4.507***	-7.092***	-6.077***	-3.769***
	(0.455)	(0.473)	(0.461)	(0.637)	(0.644)	(0.447)	(0.302)	(0.309)	(0.313)	(0.600)	(0.582)	(0.313)
Time*Prov.dum.	NO	NO	NO	NO	YES	NO	NO	NO	NO	NO	YES	NO
Observations	6,943	6,807	6,676	6,242	6,644	4,800	6,943	6,807	6,676	6,242	6,644	4,800
R^2	0.114	0.120	0.126	0.133	0.157	0.116						
Number of hid							1,931	1,912	1,904	1,850	1,904	1,781

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

[a] short term or within effect, [b] long term or between effect.

Age dummies not shown. Real and nominal per capita expenditure are measured in logarithims.

5 Conclusion

This study aims to ascertain patterns of complementarities between the MDGs by focusing on the determinants of child nutrition in Indonesia over the period 1997-2007.
In doing so, we explore possible pathways and transmission channels which may affect achievements in child health.
Following the Mosley and Chen theoretical framework, we have also tested for the existence of powerful transmission channels connecting socio-economic factors to child health outcomes.
After a critical review of the literature pertaining to the determinants of child health, we outline and estimate a simple model for analyzing the pathways to child health outcomes using household surveys longitudinal data. The use of such data enables us to go beyond the limits imposed by traditional cross-sectional regressions as the relationship between our key variables can be determined with more efficiency. Moreover,the novelty of this analysis also lays in the methodology applied as by relying on the Mundlak approach of household-average fixed effects we are able to obtain robust and unbiased estimates while distinguishing the short-term or within household effect from the long-term or between household effect.
A key finding in this analysis is that there exist strong and long-lasting complementarities between maternal education and child health and that this effect is largely conveyed by health care giving practices such as breastfeeding. As our results suggest, the bulk of the variation of child malnutrition between households is indeed driven by differences in the level of maternal education achievements.
Although we cannot rule out the existence of strong complementarities existing between household wealth or income and child health, the effect of positive changes in income or wealth appear to be delimited in the short term, meaning that although more material resources undoubtedly help to provide sufficient food and alleviate the expenditure constraints that many household face, they must be complemented by other factors in order to exert a long lasting effect on child health conditions. Interestingly, the supply side level factors (such as sanitation and health infrastructure) and mothers health status also significantly and robustly account for shortages in child health anthropometric outcomes.
The provision of sanitation appears indeed to be an essential complement in the availability of food in preventing child malnutrition, suggesting that the rise in the availability of these services may also have spill-over effects to other households in the neighborhood as the probability of cross-infections from bacterial diseases caused by lack of hygiene will fall. On the other hand, our results also suggest that as much of the variation in child health is significantly explained by the number of health posts, investments in such basic infrastructure will contribute to reduce child malnutrition.
Overall, our key findings suggest that income poverty-alleviating policies complemented with investment in basic health infrastructure might strongly contribute to the improvement of health conditions of the Indonesian children. One of the greatest challenge for the country is given by the heterogenous conditions in the regions as our results the presence of big disparities existing in the level of nutrition in different regions and between rural and urban areas as well as in the access to proper infrastructure. Expanding the coverage or improving the quality of such infrastructure would contribute effectively to improve the health conditions of children, particulary of those living in most remote areas. On the other hand, as the linkages between maternal education, child nurturing practices and child health are found to be particularly strong, policies which are aimed to enhance quality in education can improve remarkably the nutritional status of children.

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Appendix

Figure 1: Mean Stunting z-score by age (three-month interval)