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ABSTRACT

Does Greater Autonomy among Women Provide the Key to Better Child Nutrition?*

We examine the link between a mother's autonomy – the freedom and ability to think, express, act and make decisions independently – and the nutritional status of her children. We design a novel statistical framework that accounts for cultural and traditional environment, to create a measure of maternal autonomy, a concept that has rarely been examined previously as a factor in children's nutritional outcomes. Using data from the Third Round of the National Family Health Survey for India, supplemented with our qualitative survey, and accounting for "son preference" by limiting analysis to first-born children under 18 months of age, we document that maternal autonomy has a positive impact on the long-term nutritional status of rural children. We find that one standard deviation increase in maternal autonomy score (i) is associated with a 10 percent reduction (representing 300,000 children) in the prevalence of stunting, and (ii) compensates for half of the estimated average decline in Height-for-Age Z-scores Indian children experience in the second six months of life. The findings underscore the importance of women's empowerment in improving children's nutrition during the critical first two years of life, a recognized "window of opportunity" for lifelong health and economic benefits.

JEL Classification: C38, I14, I18

Keywords: child nutrition, maternal autonomy, latent factor models, empirical Bayes, India, National Family Health Survey

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1. Introduction

Her son Imran was tiny and had the face of an old man, shrivelled and shrunk. His feet were so thin that we wondered if he would ever be able to walk. His head seemed too big for his small frail body. We assumed he was about eight months old.

'He is eighteen months old', Maimun Nisa said.

Beautiful Country: Stories from another India, (Hameed and Veda, 2012)

Not so long ago, India was characterised as an "economic powerhouse and nutritional weakling" (Haddad, 2009) because, while it had one of the world's highest economic growth rates, hunger and malnutrition remained stubbornly high. The critical importance of child nutrition cannot be overstated; undernourished children grow up to be malnourished adults with low productivity, aptitudes and skills - thus perpetuating the cycle of poverty over generations. In addition to playing a pivotal role in increasing childhood mortality, poor nutrition during childhood causes irreversible damage to cognitive development and future health (Saxena, (2011); Victora, *et al*., (2008); Dreze, (2004), Sumner, *et al.,* (2009)). For example, Victora, *et al*., (2008) found that child undernutrition was strongly associated with shorter adult height, less schooling, reduced economic productivity, lower adult body-mass index and mental illness. They concluded that damage suffered in early life leads to permanent impairment, and might also affect future generations. Thus, the prevention of undernutrition would bring about important health, educational, and economic benefits to the individual as well as to society.

Based on evidence that chronic and acute undernutrition are related to poor height and weight gain in children under 5 years of age, the World Health Organisation (WHO) conducted a multi-country growth study (WHO, 2006) to establish global standards. To assess the nutritional status of children in the world, WHO provided growth charts that serve as an essential component of the paediatric toolkit. The three most common anthropometric indicators that are derived from these growth charts, and are used to assess the nutritional status of children are: Height for Age Z-score (HAZ score), Weight for Height Z-score (WHZ score) and Weight for Age Z-score (WAZ score).[1] Children who are less than two standard

[1] The Z scores are the number of standard deviations above or below a set of standard deviation-derived growth reference curves by the Centre for Disease Control obtained from a reference population from the U. S.s National Centre for Health Statistics, as recommended by the WHO (2006). The recommendations are based on evidence that differences in "unconstrained growth" across children of different ethnic and racial background, socioeconomic status and feeding, are so minor for children under 5 years of age that it is appropriate to use a common reference.

deviations below the median are classified as: stunted (HAZ score less than -2), wasted (WHZ score less than -2) and/or underweight (WAZ score less than -2). Each index provides different information about the growth of a child. The HAZ score provides information about long-term nutritional status; it does not vary according to recent dietary intake. The WHZ score is an indicator of current nutritional status; a low WHZ score can indicate recent inadequate food intake, or a recent episode of illness. The WAZ score, which reflects body mass relative to chronological age, is a composite indicator.

The data we use are drawn from the most recent national survey (2005-06), which is the third round of the National Family Health Survey (NFHS3) (part of the Demographic Health Survey series). The survey provided information on the three nutritional status indicators (HAZ, WHZ, and WAZ), expressed in standard deviation units (Z-scores) from the median of the reference population (WHO standards). This survey found that 48 percent of children under 5 years of age in India are chronically malnourished (i.e., stunted); 43 percent are underweight (i.e. WAZ<-2 SD); and 20 percent are acutely malnourished (i.e., wasted) (IIPS and Macro International, 2007a, 2007b). Among some social groups the situation is worse. Stark differences emerge between rural and urban areas and across economic strata.

Of deep concern is not just the high level of malnutrition among young children but also the slow pace of its decline. The prevalence of undernutrition among children below 3 years declined by only 3 percentage points over a recent six-year period – that is from about 43 percent to about 40 percent from 1998-99 (NFHS-2) to 2005-06 (NFHS-3).[2] The lack of more meaningful progress raises questions about whether the United Nation’s related Sustainable Development Goals can be met - particularly in regard to Goal 2, which aims to end hunger and, by 2030, aims to “end all forms of malnutrition, including achieving by 2025 the internationally agreed targets on stunting and wasting in children under five years of age…” (https://sustainabledevelopment.un.org/).

As the world prepares to address the Millennium Development Goals that remain elusive in the wake of the project’s 2015 deadline, it is important to take stock of where we have erred, and what strategies are needed to achieve the targets. One truth now realised is

[2] Recent data from a nationwide survey (Rapid Survey on Children) conducted by the Government of India in 2013-14 suggests that undernutrition may have decreased a little further, with the proportion of stunted children going down to nearly 39 percent and the proportion of underweight children going down to 30 percent (http://wcd.nic.in/issnip/National_Fact%20sheet_RSOC%20_02-07-2015.pdf). However, the pace of decline was still not sufficient to meet the Millennium Development Goal to bring down the proportion of underweight children to 26 percent (MSOP, 2015). We do not use the Rapid Survey on Children because it did not collect information on variables that were of interest to us.

that the approach to deal with the problem of malnutrition has to be multi-sectoral in order to deal with the problems of pervasive poverty, inequality, social discrimination, water and sanitation, diets, disease, caring practices, and women's low status and lack of autonomy (Smith, et al. 2003).

This paper breaks new ground and bridges a major gap in research by focusing on what is perhaps the least-understood and most complex factor in this list of underlying causes of children's undernutrition: the role of maternal autonomy. We conducted small, quantitative and qualitative field surveys in both urban and rural areas to gain insights and answers to help us with the concept of 'autonomy', a latent trait based on cultural and traditional norms.[3] Informed by this, we define maternal autonomy on the basis of the woman's freedom and ability to think, express, decide, and act independently. By using this definition and by incorporating latent factor models, we create a new statistical framework to create a "maternal autonomy index" which we can use to assess the role of this variable in child nutrition.

Studies on maternal characteristics and their implications for children are on firm ground so long as the variables – such as education or health - are readily definable and easily measureable. However, many other factors that are less tangible nonetheless strongly influence behaviour. An attribute such as autonomy is a rather elusive and abstract concept that defies easy measure, and poses new methodological challenges. In fact, the difficulty of measuring a trait such as women's autonomy has long hampered our understanding of its role in shaping other indicators.

This paper's investigation, focused on the impact of maternal autonomy on children's nutritional status, addresses key aspects of these methodological challenges. We devise a rigorous set of measurements tailored to define maternal autonomy. In contrast to prevailing measures of women's autonomy in the literature that use the addition or the average of binary responses, or that rely upon principal component analysis, we undertake latent factor modelling to construct an index of autonomy that allows for socioeconomic factors to play their various parts according to their various degrees of influence. One advantage of our measure is that we are able to separate the direct effects of maternal and family characteristics in our model from their indirect effects, which work through the impact of these factors on

[3] The details of the field survey are given in Arulampalam, et al. (2016).

maternal autonomy. Another advantage of our methodology is that it allows autonomy to play different roles in explaining different indicators measuring freedom. This is in contrast to many studies that accord the same weights to all indicators. We then use this index to analyse the role of maternal autonomy in the nutritional status of children.

As pointed out by Barcellos et al. (2014) and Jayachandran and Kuziemko (2011), child health in India is likely to be affected by son preference, which can manifest itself in differential care and feeding practices, and, hence, in differences in the nutritional status. As son preference is likely to lead to endogenous composition of sex and birth order (Yamaguchi, 1989) among children - which in turn, could lead to a bias in our estimates of role of women's autonomy on child nutrition. We deal with this potential bias by exploiting the evidence that families do not generally sex-select their first-borns and use a sample of first-borns.[4,5] This is important because the anthropometric information routinely collected is on children born in the last few years, and this is the sample that is generally used by researchers. If families sex-select the second and subsequent children by using prenatal sex-selection, even the nutritional status of the first-borns will be affected by the presence of subsequent children in the families. We deal with this endogenous selection by restricting the sample to first-borns aged less than 18 months, and check for sensitivity of our results to different composition of children used in the analysis.[6]

Our main results indicate a significant beneficial effect of autonomy but only for rural children. For the subset of first-born children aged less than 18 months, autonomy is found to be positively associated with long-term child nutrition (i.e., HAZ score) and negatively associated with the probability of the child being stunted (i.e., HAZ score being less than -2 SD). In terms of magnitudes, a one SD increase in our autonomy score is expected to reduce the number of first-born aged less than 18 months and classified as stunted (2.1m) by 0.3m children (30.5 percent to 27.3 percent) – a 10 percent reduction. On average, Indian children experience a decline in HAZ scores in the second six months of life; our estimate implies that

4 The proportion of girls among the first-borns in our sample is approximately 0.5.

5 Barcellos et al (2014) use the first round (1992) of the same data source to look at the effect of child gender on parental investments. This round was used to avoid the issues related to sex selective abortions. Since it is assumed that there is no prenatal sex selection in the early '90s, their concern was regarding families possibly following a male-biased stopping rule. They address this by selecting a sample of last children aged less than 15 months at the time of the interview, assuming that the family has not had time to react to the gender composition of the existing children. For comparison with this set of results, we also provide estimates based on the sample of last-borns.

6 For example, Hu and Schlosser (2014) present some indirect evidence of possible pre-natal sex selection in India.

one SD increase in autonomy halves the decline predicted in this age group. These numbers indicate the importance of maternal autonomy on child nutrition. We did not find any differential effects of autonomy by sex of the child on child nutrition for our sample.

We find that when the estimation sample includes children of different birth orders, the estimated beneficial impact of autonomy is slightly reduced but still significant. As we have discussed, when there is a preference for a son, the gender of children born earlier and later could make an impact upon the care and resources received by a child as well as upon the chances of survival. Nonetheless, these results are important.

Our overall findings have important policy implications. The first two years of life provide a recognized “window of opportunity” to affect children’s nutritional status with lifelong health and economic benefits (UNICEF, 2013). The evidence that maternal autonomy has an impact on long-term nutritional status opens the gates for further, much required research on the pathways through which women's autonomy may work to influence child nutrition. In other words, we need to know what particular facets of women's autonomy influence children's nutritional status, and how they do so. Women's economic empowerment, health and education have been important areas of policy focus. For example, the Millennium Development Goal number 5 was specifically set up to address this: “Achieve gender equality and empower all women and girls”. It is important to note that empowerment is a process and autonomy is the outcome of the process. Our concern in this paper is with the outcome which determines women’s ability to make independent decisions. However, autonomy has never been an area of policy concern. In fact, very little is known about policies and interventions that may work to increase women's autonomy. Arriving at such policies would first require a great deal of research on what constrains women's autonomy, and how these constraints may be overcome. This paper attempts to begin that investigation.

The paper is organized as follows: The next section discusses the relevant literature for India. Section 3 describes probable pathways that lead from maternal autonomy to child health. Section 4 discusses the methodology while section 5 provides descriptive statistics. Section 6 presents results, and addresses the issue of sample selection in the presence of son preference. The final Section presents conclusions, including a discussion of the gaps revealed by the findings regarding policies regarding women's empowerment and child nutrition, and the possible measures that could be taken to address these gaps.

2. <u>Situation in India: an overview of literature and the data</u>

Though the image of undernourished, pot-bellied children is usually associated with the poor economies of sub-Saharan Africa, undernutrition afflicts a much larger proportion of children in India—a country that is economically much better off. In fact, half of the world's malnourished children live in just three countries of South Asia; Bangladesh, India and Pakistan. The higher rate of child malnutrition in South Asia compared to anywhere else in the world is what has been called the "South Asian Enigma" (Ramalingaswami, *et al*., 1996).

The issue of child malnutrition in India has received renewed attention in the wake of a firestorm of controversy provoked by an article by Panagariya (2013) asserting that the perception that India suffers from worse child malnutrition than sub-Saharan Africa is false. He argued that the extent of undernutrition in India is "purely an artefact of a faulty methodology that the World Health Organisation (WHO) has pushed and the United Nations has supported." Panagariya contends that the central problem with the current methodology is the use of common height and weight standards for estimating malnutrition. Thus, children who may be short in stature because of genetic factors will be categorized as malnourished under the WHO standards.

A swathe of analytically rich articles contested this assertion (Gillespi, (2013); Coffey, *et al.*, (2013); Gupta, *et al.,* (2013); Jayachandran and Pande (2013)). It was pointed out that the WHO reference standards were adopted following the WHO Multicentre Growth Reference Study (MGRS) (2006) involving 8,440 children drawn from six countries, one of which was India. The growth of Indian children in the sample matched that of children from Norway, the United States, Brazil, Ghana and Oman. On the question, "Is the Indian genetic makeup distinct?", Lodha, *et al*., (2013) argue that the available genome data do not suggest a unique genetic makeup of Indians. Consequently, Lodha, *et al*., (2013) support the use of a universal standard for comparing the extent of child nutrition across countries. Other studies show that the high burden of under nutrition in India is driven by a range of determinants that include poor diets, high incidence of disease and infections, wide prevalence of open defecation, poor health services and abysmal governance.

The nutritional status of children is strongly related to characteristics of the mother, as many studies have shown. Mother's education is associated with child survival (Murthi, *et al.,* (1995); Cleland, (2010)) and the nutritional status of children (Borooah, (2004); Frost, *et al.,* (2005)). According to Ramalingaswami, *et al.*, (1996) education of girls is the "key of keys." The mother's health also is reflected in health outcomes for children. At birth, one third of Indian infants are underweight, and 20 percent are stunted because of poor intrauterine growth (Mamidi, *et al.,* (2011); Ramachandran and Gopalan, (2011)). Low birth weight indicates that the mother was malnourished. The proportion of babies with low birth weight, therefore, reflects the condition of women - and particularly their health and nutrition not only during pregnancy but over the whole of their childhood and young lives (Ramalingaswami, *et al.,* (1996)). While these studies have looked at readily definable and easily measureable variables, such as education and health, our work seeks to examine the influence of other factors that are less tangible, but nonetheless strongly influence behaviour: the attributes that make up autonomy. Such elusive and abstract concepts are not easily amenable to measurement and pose new methodological challenges, which our paper addresses.

In recent years there has been a great deal of interest in looking at the impact of autonomy among women and its impact on child-related outcomes. Researchers have displayed great diversity in their choice of variables to measure autonomy and in the methodologies they adopted. Most often they have used the answers obtained on a set of questions and aggregated them to give an index of autonomy. These methodologies, however, fail to capture the essence of women's autonomy, and consequently also fail in understanding the impacts. The methodology here uses latent factor models to provide a more-revealing index of autonomy. The index is based on data from the third round of the National Family Health Survey (NFHS-3) for India, 2005 (IIPS and Macro International, 2007a). The NFHS is part of the Demographic and Health Survey (DHS) series conducted for about 70 low- to middle-income countries.[7] This survey collects extensive information on population, health, and nutrition, with an emphasis on women and young children. In addition, it gathers information concerning household decision making, as well as answers to some questions relating to the "autonomy" status of surveyed women.[8] To supplement NFHS information, and to understand the situations and facts behind these figures, rapid field surveys and focus group discussions with women were also carried out. These were conducted in three villages in rural areas of the Allahabad district in Uttar Pradesh, and with groups of women in urban areas in Pune in the state of Maharashtra.[9]

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7 The data are in the public domain and can be downloaded from http://dhsprogram.com.

8 As the NFHS is one of a series of fairly comparable Demographic Health Surveys (DHS), the ideas and methods introduced in this paper are immediately applicable to other regions.

9 Further details of the survey are given in Arulampalam, *et al.* (2015).

In these respects, this paper explores new ground, and attempts to bridge a major gap in research by studying the impact of maternal autonomy on the nutritional status of children in India. The wealth of information collected in our data has the potential to provide clues needed to effectively shape policy and to create initiatives that can successfully address persistent problem of children's malnutrition.

3. Autonomy and its links with children's health

One of the earliest studies by Dyson and Moore (1983) on kinship structures and women's autonomy, defined autonomy as the capacity to obtain information and make decisions about one's private concerns and those of one's intimates. In a similar vein, Saflios-Rothschild (1982) in the context of demographic change in the third world, defines autonomy as 'the ability to influence and control one's personal environment'. The essential elements of autonomy - namely the ability and capacity to make decisions in a way that can influence one's environment - is reflected in other definitions, such as that by Jejeebhoy (2000), according to whom, autonomy is the "extent to which women exert control over their own lives within the families in which they live at a given point of time." As stated by Agarwala and Lynch (2006), "These definitions assert a single construct that captures the multifaceted ability to gain control over the circumstances of one's life."

In essence, autonomy is latent and intangible and expresses itself in a number of ways, such as, for instance, having decision-making power; mobility; and command and control over resources. The enabling factors in exercising autonomy are education; position in the household; closeness to kin; economic status of the woman and her household; access and availability of infrastructure; and norms and attitudes of the larger community.

Autonomy has intrinsic relevance for a woman's own well-being. It determines to a large extent her ability to make effective choices, and to exercise control over her life. It also has instrumental value, in that the woman's autonomy contributes in large measure to enhancing quality of life for the family and for the community.

Women's autonomy has been examined in previous research in the context of several outcomes, but its effect on child health has been less studied. Comparability of results is problematic because definitions and variables employed by the authors, as well as the sources of data are very different. While the words "autonomy" or "child health" is used in several studies, there is little congruence in the definitions or measurements. Caldwell (1986) for instance defines opportunities for women to receive an education and work outside the home to proxy autonomy, while Mason (1986) uses control over household and societal resources to the same purpose.

Miles-Doan and Bisharat (1990) define autonomy as the mother's position in the household power relationship, and study the impact on the child's weight for age. Brunson, *et al.,* (2009) on the other hand, define autonomy as the ability to make decisions on one's own, to control one's own body, and to determine how resources will be used without needing to consult with another person. Nutritional status was determined by using short-term measures, namely Weight-for-Height Z scores (WHZ) for children in two age groups: 0-36 months and 36 months to 10 years. Using specially conducted survey among a traditionally nomadic population in northern Kenya, they do not find a significant relationship between women's autonomy and their younger children's WHZ scores, but the impact is positive and significant for older children. Also they find the relationship significant in some locations but not in others.

Roushdy (2004) identifies four indicators of women's status at the individual level (mobility, opinion towards domestic violence, women's control over cash, and their role in decision making related to children), and estimates their impact on the height-for-age of children less than 6 months. Roushdy finds that women's access to cash, and the role in decision making, which were expected to be significant, have the expected signs but are not significant. Durrant and Sather (2000) are also unable to find significant effects of women's mobility and decision-making autonomy in a child survival model. Moreover, most of the studies are located in very different country contexts.

For the few studies on the subject in the Indian context, a lack of comparability again surfaces. Imai, *et al.,* (2014), analyse empowerment by means of the relative bargaining index, defined as the share of the mother's schooling years over the father's schooling years. The study finds that it positively and significantly influences the Weight-for-Age z-scores (WAZ) and Weight for Height z scores (WHZ) of children. For the Height for Age z scores (HAZ), the authors find that the relative bargaining power of women impacts only at the low end of the conditional distribution of z score of those stunted.

Shroff (2011) examines maternal autonomy as a determinant of breast feeding and infant growth in young infants (3-5 months old). The data consisted of 600 mother-infant pairs in villages in the state of Andhra Pradesh, India. Maternal autonomy was defined on seven dimensions that included household decision making, child-related decision making, financial independence, mobility autonomy, actual mobility, non-acceptance of domestic violence, and experience of domestic violence. The results indicated that mothers with higher financial autonomy were more likely to breast feed their infants. Also, the infants of mothers with higher participation in household decision making were less underweight and less wasted.

What are the pathways?

As the primary caregivers of their child, mothers are thought to be not only responsible for but also best connected to children's needs - whether these be the need for food, water, liquids, health care, warmth, cleanliness or even affection. More autonomous women, i.e., women who can think, express, decide, and act independently, would be able to divert time and resources towards her children's health and well-being - as well as toward her own health and well-being. Since autonomy is a multi-dimensional construct, some of the pathways through which these dimensions are translated into outcomes are explored below.

Mobility

> *Women cannot go unaccompanied anywhere, not even to a doctor in our village. When my son was very unwell and was passing blood in his stools I asked my in-laws to take him to a doctor. They did not. When his condition became worse I pleaded with my brother-in-law. He took me and my son to the doctor on his cycle. When we came back there was aafat (big trouble). My sister-in-law accused me of stealing her husband. My in-laws were very angry, and I was beaten. They said that I had no izzat (honour). They said if I was going to be so independent, I should go back to my father. Two days later my father was called, and he took me home.*
>
> *Jamuna, Allahabad district field surveys*

This narrative of a woman who lives with her husband's family in an Uttar Pradesh village while her husband works in a city clearly demonstrates the links between women's restricted mobility and child health. Because villages typically are located some distance away from primary health centres and hospitals constraints on mobility are a huge barrier to access.

Decision making

Many aspects of autonomy may be important to the decision-making process; *inter alia*, these could be a woman's access to resources, freedom of movement, freedom from threat of violence, her education and skills, and so on. Because women are the primary caregivers for young children, their decision-making autonomy and skills, are important both in day-to-day situations (immunization, health check-ups, taking children to early child care) as well as in emergencies. As Desai and Johnson (2005) state, "If a Nepal woman must wait for her husband to return home before she can take a child suffering from seizure to a doctor, the likelihood of child survival will be lower than if she can independently make decisions regarding health care and immediately take the child to a doctor."

In their study spanning data from 12 countries, Desai and Johnson (2005) show that while women's decision-making authority does not affect health outcomes in all settings, in the two South Asian countries of Nepal and India there is a link. Even after controlling for education and wealth, women's decision-making authority does improve Height for Age z-scores of children 13-36 months in these countries.

Financial Autonomy

> *I never had any money. My husband sends money to my in-laws for our up-keep. If I asked them for money for medicines if my child was not well, they would say your husband sends money to feed you and your children, but not for your illness.*
>
> *When my husband came home, I forced him to send money to me as well. Since I started getting money in my own hand, I am not so helpless. When my son had fever, and no one accompanied me I went out on my own. I went through the back alleys where no one can see me. I met someone from the village on the highway crossing. He was kind and accompanied me. But when I came back I had to listen to the rebukes and taunts of my in-laws. In our village, when women venture out, they have to face a great deal of humiliation. They are told they have no izzat (honour).*
>
> *Sunita, Allahabad district field surveys*

The experiences of Sunita – who overcame mobility restrictions and acted in the interest of her sick child as the result of her access to and control over some money - illustrates how economic autonomy enables the exercise of autonomy in other spheres. All households, whether poor or rich, must decide how resources are spent. Members of the household determine the level of investments in children, whether on their education or health. Gender inequalities in the household shape what decisions are taken, and by whom. In families in which women play an important role in decision making the proportion of family resources devoted to children are greater than in families in which women play a less-decisive role (Desai and Johnson, 2005; Duraisamy and Malathy, 1991; Rodgers and Satija, 2012). In a study in Gujarat, about 50 percent of the women interviewed did not feel free to take a sick child to the doctor without the approval of their husband or parent-in-law (Visaria, 1993).

Clearly, autonomy has the potential to enable women to better take care of themselves and their children. The hypothesis that greater maternal autonomy leads to better child nutrition is based on the assumption that the woman is educated, aware about best child-care practices, and cares deeply about her child. Woman's autonomy is also often pegged to her employment and earnings. Therefore, in the absence of supporting infrastructural facilities for working women, autonomy may come at the cost of less time for child care. However, holding everything constant, increased income will have beneficial effects on child nutrition. What the overall effect of this trade-off is an empirical question.

Thus, it seems the jury is still out on whether greater autonomy still translates to better nutritional status of children. For these reasons, this study holds special significance.

4. Modelling the main variables of interest

The Third Round of the National Family Health Survey of India (the source of data for our analyses) was conducted in 29 Indian states by the International Institute for Population Sciences and Macro International (2007a), which interviewed over 230,000 women (aged 15-49) and men (aged 15-54) during the period December 2005 to August 2006. As is common with the DHS, the Indian NFHS also elicited responses to certain questions that may be interpreted as providing information on various aspects of autonomy enjoyed by the women. All children who were aged less than 60 months and living in the household at the time of the survey were weighed, and their heights were measured.

The sample selected for the analyses was based on the following criteria: (i) currently married women who are 'usual' residents. (ii) mothers who had at least one child born in the past 60 months, and who had at least one child living at the time of the interview; (iii) had non-missing values for the main variables of interest.

4.1 Modelling nutritional status

The four outcome variables we consider are HAZ, WHZ, stunted, and wasted. The variables stunted (wasted) are defined as binary variables if the HAZ (WHZ) were less than -2 according to the WHO definition. All children in the family who were aged less than 60 months at the time of the interview, and who had valid measurements for these variables, form the main sample. As discussed below, the models are estimated using different sub-samples.

All equations are specified as a linear regression model and estimated by OLS with standard errors either clustered and/or bootstrapped where necessary.[10] We specify the equation for the measure of nutritional status y – HAZ, WHZ, Stunted, and Wasted as:

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[10] All standard errors are clustered at the Primary Sampling Unit level (PSU). Since the autonomy index is a generated regressor in most of the specifications, we also bootstrap the standard errors while clustering at the PSU level.

$$y_{ik} = x_{ik}^{'}\beta + z_i^{'}\gamma + \delta\eta_i + \varepsilon_{ik} \qquad i=1,..,n \text{ and } k=1,..,K \qquad (1)$$

where i and k are the mother and child indexes respectively. x_{ik} contains the child-specific characteristics such as age, birth order, gender, etc. z_i contains the mother, father and household characteristics, such as levels of education, religion, caste, wealth indexes, etc. η_i is the mother's autonomy trait, which is treated as a latent variable.

The latent characteristic (mother's autonomy) is expected to be highly correlated with the variables explaining the socioeconomic environment of the family. We discuss next how we proceed with the measurement and generation of this variable allowing for social and cultural environments to play a part.

4.2 Defining and measuring maternal autonomy

The first methodological challenge of dealing with the elusive concept of autonomy is the selection of appropriate indicators that capture the underlying latent trait. The second challenge is to find a way to combine the selected indicators into an index allowing this variable to be correlated to socioeconomic characteristics of the environment in which the woman lives.

Based on the earlier discussion of the published literature, we need measurements to capture the latent characteristic autonomy. We have chosen the answers given to the following questions in the DHS surveys as indicative of this trait. These measurements are based on variables which indicate the woman's "*autonomy*" to think, speak, decide and act independently.[11]

The following responses were all coded as binary indicators.

Responses Related to Physical Autonomy

m_1: is allowed to go alone to the market.

m_2: is allowed to go alone to the health clinic.

m_3: is allowed to go alone to places outside the community.

[11] See Arulampalam, et al (2015) for a discussion on the choice of measurements used for constructing this index. In that paper, we experimented with many more measurements and found the additional measures did not significantly add to the estimation of the autonomy index. The ranking of mothers in terms of their estimated autonomy status did not change with the addition of other measures.

Responses Related to Decision Making Autonomy

m_4 : decides alone on purchases for daily needs.

m_5 : decides alone or jointly with her husband on her own health care.

m_6 : decides alone or jointly with her husband on large household purchases.

m_7 : decides alone or jointly with her husband on when they could visit family and friends.

m_8 : decides alone or jointly with her husband what to do with husband's money.

Responses Related to Economic Autonomy

m_9 : has money of her own that she can decide how to spend.

We construct our index of autonomy distinguishing between rural and urban households.[12, 13]

Many scholars agree that all indicators are not of equal significance; for example the freedom to take decisions to buy sundry household items may not have as much significance for autonomy as the freedom to decide on the purchase of large household assets; the freedom to visit places outside the village may reflect on greater autonomy than freedom of mobility within the village. However, in most studies, same weights are accorded to all indicators in constructing the index, as we discuss later. This implies according the same significance to all kinds of freedom, and does not allow for differentiating between women who have more autonomy from those who enjoy less autonomy. As a result, the analyses based on these non-differentiated indicators may be misleading.

To address the above issue, we specify a latent factor model where the autonomy variable is specified as a random effect. Since all measurements (*j=1,.., 9*) are binary we use a logit model for woman *i* (conditional on her autonomy trait η_i) as

$$\Pr ob(m_{ij} = 1 | \eta_i) = \Delta(\delta_j + \lambda_j \eta_i) \tag{2}$$

with $$\eta_i = \theta' s_i + u_i \tag{3}$$

[12] We used gllamm in Stata 13 to estimate all the models (Rabe-Hesketh, et al.. (2004))

[13] We also allow for clustering at district levels in all our models, but do not show in the specifications to keep the notation uncluttered.

Δ is the logistic distribution function (CDF). Maternal autonomy variable η_i is specified as a random effect and δ_j and λ_j are the intercepts and factor loadings respectively. Equation (3) specifies the determinants of autonomy which include variables related to customs and traditions. All variables that are in *z* (equation (1)) and an additional variable that is the difference between the husband and wife are included in (3). Details of these are given in the next Section.

Identification of the parameters requires some normalisation of the coefficients in (2). We impose the restriction that the first loading is 1. This implies that all the other loadings are estimated relative to the first one. This also enables us to estimate the variance of the autonomy trait freely. The latent characteristic 'autonomy' requires a scale for measurement. We assume that it is centred at 0 and the variance is σ_η^2. The Model given by equations (2) and (3) are jointly estimated using maximum likelihood methods with the assumptions that η_i s are normally distributed (i.e $\eta_i \sim N(\theta' s_i, \sigma_\eta^2)$) and hence u_i is also normally distributed. We then use the estimated posterior conditional mean (also known as the Empirical Bayes estimator) $E(\eta_i$ |data) of the latent variable η_i to construct our index of autonomy for every woman in the sample.[14]

Three remarks are in order. First, it is assumed that the likelihood of a woman saying "yes" to one of the questions (called "measurements") is a sum of two variables: the latent 'autonomy' characteristic that has different effects on the measurements and an error orthogonal to the autonomy trait, which is assumed to be logistically distributed. This assumes that conditional on autonomy, the measurements are independently distributed. These important assumptions play a crucial role in most of the estimators used in the literature. If cultural norms play an important role in defining the autonomy a woman has, then equation (3) becomes crucial.[15, 16]

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[14] This is also known as the Bayesian shrinkage estimator, see Goldstein (2003). This method of estimating unobserved individual specific heterogeneity is equivalent to estimating taste parameters in mixed models of choice (Train, 2009: Chapter 11). Also see the recent literature on the estimation of 'Teacher Effectiveness' (Kane and Staiger, 2008; Chetty, et al. 2014a and 2014b). Simply put, this estimator is $E(\eta_{Fi} \mid m_{i1},\ldots,m_{i9}) = \int \eta_{Fi} f(\eta_{Fi} \mid m_{i1},\ldots,m_{i9}) d\eta_{Fi} = \dfrac{\int \eta_{Fi} f(m_{i1},\ldots,m_{i9} \mid \eta_{Fi}) f(\eta_{Fi}) d\eta_{Fi}}{f(m_{i1},\ldots,m_{i9})}$.

[15] Generally, the index of autonomy is either measured as the first principal component (Chakraborty and De (2011)) or as a simple average of the measurements (Jensen and Oster (2009)). Autonomy index is the dependent variable in Jensen and Oster (2009) and they were interested in looking at the effect of the introduction of cable TV on women's status (autonomy) using a panel data which sampled mainly rural households (plus Delhi) that included at least one woman aged 50 or older over three years: 2001-2003. The

Second, in the language of Item Response Theory (IRT), the intercepts δ_j are called item "difficulty" and factor loadings (i.e. slope coefficients) λ_j are called item "discrimination". Comparing two intercepts, the larger the intercept, larger the probability of saying yes to the question for the same autonomy measure. Hence the smaller intercept measurement is said to be a more "difficult" item. In terms of the factor loadings which are the slope coefficients, the probability of saying yes with the measurement that has a larger slope will be more sensitive to small changes in the autonomy trait compared to the one with the lower slope and hence said to be more discriminatory. Hence in our application, (i) a larger intercept implies that women are more autonomous in this particular dimension; (ii) the larger the slope, the better would be the measurement in distinguishing different autonomy traits. It is important to account for the differential role of autonomy on different dimensions. We let the data tell us whether this is the case.

Third, our model is a structural model since we are able to identify separately the effects of variables that are in *s* and *z* (socio-economic parent level variables) that have a direct effect on autonomy (equation 3) and also the effect of these variables on child nutrition conditional on autonomy (equation 1).

In order to assess the importance of the autonomy index in explaining the observed variations in the measurements, we use what is called a 'reliability' measure. This is given by

$$\hat{\lambda}_j^2 * v\hat{a}r(\eta_F) / \left[\hat{\lambda}_j^2 * v\hat{a}r(\eta_F) + v\hat{a}r(\textit{district-level unobservable}) + \pi^2 / 3 \right] \qquad (4)$$

This is the proportion of the total variance in that particular measurement that is attributed to the "unobserved autonomy" trait, i.e., a measurement with a larger "reliability" measure is able to explain larger proportion of the variability in the observed pattern of women's answers to that question relative to another measurement with a smaller reliability measure.

Full details of the variables and their definitions are given in Table 1 and a discussion is provided in Section 5.

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authors' definition of 'autonomy' is the average of answers given to six questions/measurements with some overlap with the measures we have used although the conversions into binary indicators differ somewhat from ours. Creating an index such as in Jensen and Oster (2009) is equivalent to using a woman specific 'fixed effect' in a linear model with measurements as the dependent variable which implies that all answers are equally weighted in the construction of the index. In our paper, the autonomy variable is treated as a latent characteristic which is difficult to shift in the short run, and the measurements are fallible measures of this trait. Also see the replication study by Iversen and Palmer-Jones (2015) and the response by Jensen and Oster (2014b).

[16] The estimates of our model using the indexes created as the first principal component and a simple average, produced an estimated effects of autonomy which were nearly a quarter of our estimates. The results are available from the authors on request.

5. Descriptive statistics of the variables

The anthropometric information was collected on surviving children who were under 5 years old at the time of the interview. Sample selection criteria used is provided in Section 4. Descriptive statistics for the variables used in the construction of the autonomy index as well as the analyses of the nutritional status, are given in Table 1.

Autonomy measurements: Unsurprisingly, urban women enjoy more autonomy compared to women living in rural areas (Panel [1]). The mean of each of the autonomy related measurements is slightly higher for urban women. Therefore a score created by summing all the means of the autonomy-related measures is also higher for urban women compared to rural women (5.18 vs 4.24). That is, on average, rural women only have autonomy in four dimensions compared to urban women who have slightly more autonomy.

A score has been created for each woman by adding up the responses to each of the nine autonomy related measures. The frequency distribution of the score is provided in Table 2. About 8 percent of rural women do not have any autonomy at all according to our chosen measurements. This is slightly lower at 4 percent among the urban women. Only a very small proportion of women (2.2 percent in rural areas and 4.3 percent in urban areas) have reported saying that they have full autonomy (i.e., value of all nine autonomy measures is 1).[17]

***Variables in the nutrition and autonomy equations (1) and (3) - Z and S*:** Panel [2] of Table 1 has the summary statistics for the variables that are common to equations (1) and (3). The average age of women in the sample is similar across both groups. With regard to caste, there are more scheduled tribe and schedule caste women in our rural sample. Also, there are relatively more Muslim women in our rural sample.

The women in our urban sample are more educated in general. They are also more likely to be staying at home which is not surprising given the presence of very young children in the family.

***Variables in the autonomy equation (3) alone – S*:** We assume that the difference in age between the partners only acts on the autonomy trait and not on nutritional status conditional

[17] The number of individuals who have said yes (no) to all questions matter for the estimation of the unobserved autonomy trait as the mothers will be estimated to have a very large positive (negative) value in order ensure that the probability of saying yes is very nearly 1 (0). Too many mothers in the tail area will not fit the model very well.

on autonomy. The summary statistics for this is provided in Panel [3] of Table 1. The age differences between the partners are very similar across both rural and urban women. In nearly 50 percent of the families, the husband is three to five years older than the wife.

Variables in the nutrition equation (1) alone: The summary statistics for the child-specific and mother-specific covariates that enter the nutrition equation alone are provided in Panel [4] of Table 1.

Nutritional status variables: Panel [5] in Table 1 provides some summary statistics for the nutritional status variables. In terms of the two indexes (HAZ and WHZ), urban children are doing slightly better than the rural children on average. A very large 48 percent (37 percent) of rural (urban) children are stunted according to the WHO definition. This is very large compared to the predicted proportion of children who would be classified as stunted according to the WHO distribution.[18] The plots of the HAZ (WHZ) scores along with the standard normal density (which would be what one would expect according the WHO measures), separated by rural and urban children are provided in Figures 1a and 1b (4a and 4b). The smoothed HAZ (WHZ) scores varying by age in months are provided in Figures 2a and 2b (5a and 5b). Finally, figures 3a and 3b (6a and 6b) plot the probability of being stunted (wasted) by age. Four points are noteworthy here. First, the distributions of HAZ and WHZ are shifted to the left relative to the WHO distributions, with the distribution of HAZ scores much worse than the distribution of WHZ scores. Second, HAZ scores deteriorate at a faster pace with age compared to the WHZ scores, but stabilize after the child reaches approximately 2 years of age. Third, the proportion of children classified as stunted also rapidly increases with age but, the proportion of children classified as wasted hardly changes with age. Fourth, urban children fare slightly better relative to the rural children.

6. Results

6.1 Autonomy index

The results from the estimation of equations (2) and (3) are presented in Tables 3 and 4. We first discuss the results of equation (3) presented in Table 4.

[18] Since the WHO distribution is approximately standard normal, one would expect to find approximately 3 percent of the children in the population to have a HAZ score that is less than -2, and, therefore, to be classified as stunted.

Interestingly, household wealth is found to be negatively associated with autonomy.[19] This negative association may be due to the fact that wealthier families in India usually employ workers in the household who will take them around, do the daily shopping, etc. As expected, living within a nuclear family appears to have a significant positive impact. In a nuclear family, there would often be no option but for women to step out and go alone to places such as the market and health care facility. Women's autonomy is found to be positively and significantly associated with their age. This is interesting because it points to the fact that with age, women tend to become more autonomous.

Compared to women of the "general caste", women's "Scheduled Tribe" status appears to have a significantly positive impact on women's autonomy in the urban areas. Scheduled Tribe women move around a lot, and they would therefore be expected to have more autonomy. Also, patriarchy is not so deeply embedded among most Scheduled Tribes as it is among the general castes. There is a significantly negative association between "Other Backward Caste" (OBC) status and autonomy in rural areas. One explanation for this is that unlike the Scheduled Tribes, most OBCs are embedded within the religious and caste systems, and hence imbibe the patriarchal systems they propagate. Religious status of women also has a significant impact on autonomy; and the direction of impact is along anticipated lines. Compared to Hindu women, Christian women enjoy more autonomy. Muslim religious status is found to be associated with lower autonomy in the rural areas.

Women's education level, as expected, has a very significant positive impact on their level of autonomy. A steeper gradient is found for the rural women. What is interesting is that it appears that partner's educational status is found to be associated negatively with rural women's autonomy.

Surprisingly, women whose partners are older than them by two years or more are found to have more autonomy – mainly in the rural areas. This is extremely surprising. One would expect that if husbands are older, they would be exercising greater control over the lives of woman.

As expected, exposure to media has a significant impact upon autonomy in both rural and urban areas.

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[19] The wealth index is a factor score constructed from a combination of thirty three household assets and housing characteristics such as ownership of consumer items, type of dwelling, source of water, and availability of electricity (IIPS 2007b).

Working women have more autonomy, relative to non-working women. Employment not only allows her more freedom to move around, but also provides opportunities for meeting other people and interacting with them. Most importantly, work provides her with an income, which boosts her feelings of self-worth and helps her to deal with her circumstances.

A great degree of the variation in women's autonomy cannot be explained by any of the above socioeconomic or demographic factors, but by historical, traditional, political, institutional and cultural factors which vary enormously across states in India. To capture this variation, state dummies were included in the model. The reference state is Uttar Pradesh (UP), the largest state in the country comprising of over 16 percent of the country's population. The largest positive state effect is for Mizoram in the Rural Sample. This is followed by Meghalaya. The situation is very different for urban areas. The largest state effect is for the state of Assam followed by Mizoram. These findings support beliefs about North Eastern states that are home to most of the rare matriarchal and matrilineal communities in India; culturally and historically, these states assign much greater value and power to their women than most other states in India. The worst state effect is for Jammu and Kashmir followed by West Bengal - which corroborates the generally patriarchal image of these states.

State-level analysis is not within the scope of this paper, but it is clear that historical and cultural factors as well as governance, policies, institutions and other state-level effects have an impact on autonomy among women.

We now turn to the discussion of the estimated factor loadings, given by equation (2) and presented in Table 3.

The estimation of the model requires a normalization and the factor loading related to whether the woman is allowed to go to the market alone is normalized to 1.[20] In terms of the discriminatory power of the measurements (higher factor loadings), the decision-making measurements have high discriminatory power relative to the reference case (i.e., they have a factor loading that is larger than 1). Another way to say this is that a small change in the autonomy trait will have a larger increase in the probability of saying "yes" to these questions relative to other measurements.

The "reliability" measure (equation (4)) is reported at the bottom of Table 3. This is calculated as the proportion of variance explained by the autonomy index in the total variation

[20] We chose to normalise on this factor loading since we expect autonomy to have a non-zero effect on this measurement.

of the measures (m1-m9) individually.[21] The latent autonomy trait is able to explain more than 60 percent of the variations in the observed measures related to whether the woman has a role in the decisions concerning large household purchases, and on visiting family and friends; the latent autonomy trait also explains over 40 percent of the variations in the woman's participation in decisions regarding her own health care. Unequal factor loadings estimated in this model reiterate the importance of allowing for different dimensions of autonomy to play a different role; thus, they illustrate why an index derived by simply averaging the measures would be problematic.[22]

6.2 Nutritional status

We estimate a series of linear regressions explaining child nutritional status measured as (i) the Height for Age Z (HAZ) score; (ii) Stunted: an indicator for whether the child is "stunted" according to the WHO (2006) definition where the HAZ score is less than -2; (iii) Weight for Height (WHZ) Z score; (iv) Wasted: an indicator for whether the child is "wasted" according to the WHO (2006) definition where the WHZ score is less than -2.[23]

If a child has died in the past because of severe malnutrition, then the sample of surviving children for whom we have a valid measurement of nutritional status is an endogenously selected sample. In the absence of plausible instruments to account for this selection, we have included in all our regressions an indicator variable that accounts for whether the mother has experienced child death in the past. The effect of this variable was never significant in any of the regressions except in the most simplest of the specification where no covariates were included in the nutrition equation.

As discussed in the Introduction, son-preference is likely to lead to differential care and feeding practices, and, hence, to differential nutritional outcomes. That is, nutritional outcomes would significantly depend not only upon the gender of the child, but also upon the gender composition of existing children, and how this compares with parents' desired number of boys and girls.

The data on child nutrition were collected for children born within the last five years at the time of the interview. Panel [1] of Table 5 shows the frequency distribution for the

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21 See equation (4).

22 Detailed discussion about the other methods of capturing "autonomy", the ranking of mothers under different methods and the estimated effects of autonomy on nutritional status for our preferred specification, can be obtained from the authors.

23 All models are estimated using OLS but allows for clustering at the PSU level with standard errors bootstrapped with 500 replications.

number of children who are born within five years of the interview date, and contributing to the sample per mother. The data indicate that 64 percent of rural mothers and 71.4 percent of urban mothers only have one child born during this time interval. The higher proportion of mothers with one child in urban areas is also consistent with urban mothers having longer birth intervals between births. About 96 percent to 97 percent of mothers only contribute one or two observations to the sample.

There are two ways in which son preference may cause this sample to be endogenously selected. First, son preference may lead to sex-selective abortion, which may lead to a lower proportion of girls at birth. Second, son preference is likely to have an impact on birth intervals and fertility choices. Parents may use a stopping rule for their fertility choice that depends on the number of girls and boys they already have (Barcellos et. al. 2014). Additionally, the birth-intervals between children also might depend on the sex of the previous child if the mother tries to conceive faster in the hope of having a boy after a girl (Jayachandran and Kuziemko, 2011). Both these practices would imply that the number and gender of children in the sample are not randomly determined but depend upon various other observed and unobserved factors - thereby causing estimators to be biased.[24]

We first address the issue of possible sex selection through abortion of female foetuses by studying the distribution of birth orders of the children (see Panel [2] of Table 5). Among all children, except for the first-borns, the sex imbalance is exacerbated. We cannot reject the null of equality of proportion of boys and girls among the first-born children - implying that parents generally do not sex-select their first child. Based on this evidence, we choose to only use the first-borns for further investigations.

The other issue (i.e., son preference affecting birth spacing, stopping rules, and care and feeding practices) is more complicated. If the first-born is a girl child, the family would try to conceive faster in the hope of having a boy. This would reduce the amount of time that the child can receive undivided care and attention (and, especially, breast milk) (Jayachandran and Kuziemko, 2011). Further, the availability of care and attention after the birth of the second child might depend upon the gender of the second child. If the first-born is a boy, and the second child is a girl, the first-born may continue to receive care, attention and greater

[24] The survey collected information on what the ideal number of boys and girls the woman would like to have. We created a binary indicator for women who stated that they preferred a higher number of boys than girls. When this was included in our previous Model 1, this variable was not significant. We do not use this variable because of the possibility of this variable being highly correlated to the number of children already in the family and their sex composition.

resources. On the other hand, if the first-born is a girl and the second born is a boy, the amount of care and resources available for the first child may reduce drastically affecting her health and nutrition. Therefore, nutritional status of the first-born depends upon the parents' attitude (i.e., their son preference) as well as upon the birth interval, and the sex of the second child. In order to address this problem, we restrict our sample to those first-borns who are less than a certain age threshold, i.e., who are young enough that they are unlikely to be affected by the birth (and hence sex) of the second child. We have elected to restrict our sample in this way rather than choosing those eldest children without a younger sibling because the choice of the "only child" as a sample group will lead to endogenous selection if mother conceives sooner after a girl (Barcellos et al. (2014)).

Panel [3] of Table 5 describes how many first-born children were observed with a second-born by the birth-year of the first-born. We find that 34.2 percent (29.2 percent) of rural (urban) first-borns have a second sibling in the sample. The older the first-born, the higher the chances of observing a second child in the sample. Since this pattern is dictated by the birth intervals, selecting a sample of first-borns without a sibling, will not deal with the problem of endogeneity caused by son preference as discussed earlier. This can be illustrated with an example. If a woman has a girl for a first child, then she may have the second child quickly in hope of having a boy. On the other hand, if the first child is a boy, the woman may delay the second pregnancy to allow the boy to receive full care and attention. Thus, if we use this criterion, i.e., first-borns without a sibling, boys may have a higher probability of inclusion into the sample.

We therefore explore if and how we can select a sample of children, based on their birth order and age, in order to reduce the endogeneity problem caused by son preference. A calendar-year based criterion is likely to be more "objective", and therefore provides a sample selection that is less likely to favour either boys or girls. In order to create the most objective sample, we study the distribution of children in the sample when different combinations of age (children below a certain age), birth order (first or last born) and date of birth (children born after 2003 or after 2004) are applied. Below we describe some descriptive statistics when these age, birth-order and date-of-birth criteria are applied.

The age distribution of the first-borns is provided in Panel [4]. Over 50 percent of the children in the sample are aged 24 months or more, and approximately 30 percent to 35 percent of children are under 18 months old. In terms of the age distribution of last-borns given in Panel [5], approximately 27 percent to 31 percent are aged less than 15 months. This is the sample used in Barcellos, et al. (2014) drawn from first round of the same survey we use (third round). If the families did not sex-select using pre-natal diagnostic tools but perhaps used birth-spacing to achieve the desired target for the number of boys, choosing a sample of last-borns who are less than 15 months would mitigate the endogenous selection somewhat. About 18 percent of the rural children who are first-borns are also the last one to be observed in the sample (Panel [6]). The figure is higher (26 percent) among the urban children. These figures reflect the fact that the birth intervals are shorter in rural families.

We next look at the age distribution among our first-borns who were born after 2003 (Panel [7]). The age of children born in the same month may also vary at the time of the interview due to the interviews taking place sometime between 2005 and 2006. Among this group of children, about 65 percent of rural children and 62 percent of urban children are aged less than 17 months.

This analysis allows us to understand the distribution of children in different cuts of the sample when different selection criteria based on age, birth order and date of birth are applied.

We next summarize the estimates of the effects of our autonomy variable on nutritional status by different cuts of the sample used in the estimations in Table 6. As discussed earlier, we only report the results for the rural sample of children and also only for the long-term nutritional status indicators given by the HAZ score and an indicator "stunted"' for whether the child is below -2 SD of the HAZ distribution according to WHO.[25] An additional interaction term between the autonomy variable and a girl child was included in the model to assess whether female children benefit more than male children when the mother is more "autonomous", ceteris paribus. However, the interaction term was insignificant in all of the regressions using either the first-borns or the last-borns.

The most crucial finding is that maternal autonomy has a significant positive impact on HAZ, and a negative impact upon stunting irrespective of the sample used. We defer discussions on the magnitudes of these estimates until later on in this section. Here we summarise the main results:

(i) Maternal autonomy is positively associated with HAZ score. One SD increase of the autonomy index is estimated to increase HAZ score by around 0.04-0.05 for children

[25] The results for the other nutritional status measures (WHZ, 'wasted') and also all results for the urban samples are available on request from the authors. These are not reported due to the insignificant effect of autonomy on child nutrition.

aged 0-59 months, regardless of whether the sample contains all children or just the first or the last-borns only (Panels [1] and [5]).

(ii) In terms of the first-born sample, the estimated effect of autonomy is much larger than the estimates obtained using the full sample of children aged 0-59 months. A one SD increase in autonomy is estimated to be associated with an increase of about 0.11 to 0.16 in the HAZ score, depending on how we cut the sample. The magnitude was not sensitive to whether we select children aged less than 15 months or 18 months. The lowest estimate of 0.11 was obtained when the sample is extended by including children born during 2004. That is, extending the sample to situations in which more children might be present in the family reduces the effect of autonomy on long-term nutritional status.

(iii) As discussed earlier, prevalence of son preference in India can lead to families engaging in pre-natal sex selection, and/or endogenously choosing birth-spacing to obtain the desired sex composition of the family's children. Generally, the estimated effects of autonomy are lower when the sample of last-borns is used compared to the estimates from the sample of first-borns. This is not surprising because the nutritional status of last-born children may be affected by the presence of older children in the family.

(iv) The estimated effect of autonomy for the sample of children aged 0-59 months is about a quarter of the estimates obtained for the sample of only the first-borns who are less than 18 months old.

The beneficial effect of autonomy on the probability of stunting wanes when older children are included, regardless of their birth orders. One SD increase in autonomy is estimated to decrease the probability of stunting by 0.035 among younger children, but only by about 0.015 when older children are included, regardless of their birth-order. For our first-born sample aged less than 18 months, a one SD increase in autonomy is associated with approximately 0.032 point reduction in the probability of stunting. The discussion of this magnitude is deferred until the next subsection.

We therefore conclude that there is a positive association between the long-term nutritional status of the first-born and maternal autonomy. The investigations we have carried out suggest a positive association even for older children under the age of 5.

It is well known that the first two years of life are considered to be the most important "window of opportunity" to make a long-term impact upon children's nutritional status (UNICEF, 2013), and their lifelong health and well-being. Thus, the finding that more autonomous mothers are able to contribute to better health for their children specifically during this key window of time is very crucial for policy purposes.

We next turn to the estimates of the full set of covariates for both the HAZ and stunted regressions for the rural sample of children aged less than 18 months – presented in Table 7. As seen in the figures earlier, relative to the HAZ scores of children younger than 6 month of age, the HAZ scores of older children become worse as they grow older; the probability of being stunted increases as well. These findings are reiterated in our estimates. A 6-11 month old child is estimated to have a HAZ score of about 0.3 SD lower than that of a child aged less than 6 months, *ceteris paribus*. This even deteriorates for a child who is between 12 and 17 months old. Relative to boys, girls have a better nutritional status. Mother's nutritional status also plays a very important role. Interestingly, we find that most of the parental and family characteristics are important determinants of autonomy. However, we do not find significant effects of these variables on child nutrition once we control for autonomy. Relative to the children of a mother without any education, the children of mothers who have completed primary school have a lower probability of being stunted. Muslim children also have a lower probability of being stunted, *ceteris paribus*.

We have included both the work status and the occupational status of the mother because these categories can capture different aspects of autonomy and child nutrition. For example, effect of work status can pick up some of the effect of autonomy that is manifested via the degree of freedom the woman has to physically move around. On the other-hand, the occupational status will act as an enabling factor in the woman's autonomy because it serves as a good proxy for educational status of the woman. The interpretation of these effects has to be made taking both effects into account. Although these variables were not significant in the HAZ regressions, they were found to have opposite effects on the probability of stunting, but giving a total effect of approximately zero.

Interpretation of the magnitude of impact of autonomy

We next turn to the interpretation of the estimated effect of autonomy on the HAZ score, and the probability of stunting as reported in Table7. As we saw earlier in the figures, as children age, their HAZ scores deteriorate. The average HAZ score and the proportion who are classified as stunted, for the sample of first-borns aged less than 18 months are -1.15 (SD 1.72) and 0.31, respectively. Hence, one SD higher autonomy index is associated with an increase in the HAZ score of 0.09 (0.161/1.72) giving a new HAZ score of -1.06 and the new probability of stunting of 0.28. In terms of the WHO distribution of HAZ scores, this is equivalent to a shift of a child from the 13th to the 15th percentile position. Interestingly, the effect of a change in 1 SD of our autonomy index both in our HAZ and stunted regressions is about half the age effect for 6-11 month old children and about 15 percent for 12-17 month old children, relative to those aged less than 6 months. An estimated 22 million children aged less than 18 months live in rural India (Census of India, 2011). Using the sample proportion (30 percent), an estimated 6.6 million children are first-borns in this age group; among them, approximately 2.1 million children (30.5 percent) would be classified as stunted. A one SD increase in autonomy would be expected to lead to 300,000 fewer cases of stunting among first-*born children aged less than 18 months* (as evidenced by a decline from 30.5 percent of this population to 27.3 percent). As this group of children age from the birth-to-5-month age group to 6-11 month age category, this level of increase in maternal autonomy would effectively halve the average deterioration in HAZ scores experienced.

7. Discussion and Conclusion

Demystifying the South Asian Enigma

The study helps to fill several gaps in our understanding of an extremely important issue facing developing countries, particularly the South Asian countries of India, Pakistan and Bangladesh. The study helps to unravel the "South Asian Enigma" of how countries such as India, which are more economically developed than many Sub-Saharan African nations, nonetheless have higher rates of under-nutrition than many poor nations.

Developing a better measure of Autonomy

Maternal autonomy is a latent trait which is based on cultural and traditional norms that are difficult to shift in the short run. The difficulty of measuring such a trait has for long hampered our understanding of its role in shaping other indicators. We suggest the use of latent factor modelling to construct an index of autonomy allowing for socioeconomic factors to play a part. This is in contrast to the use of other measures in the literature such as those constructed using adding up of binary responses, averaging binary responses, or using principal component analysis. Although not provided here, the results these alternative measures produced estimated effects that are approximately about one fourth of what we find here with our latent factor modelling measure. One advantage of our measure is that we are able to separate out the direct effects of maternal and family characteristics on child nutrition conditional on autonomy from the indirect effect coming through their affect on autonomy.

Pathways from Greater Autonomy to Better Nutrition

Analysis of NFHS data helps us to understand that greater autonomy leads to better child nutrition. However, due to the limitations of the survey, understanding of how and why greater autonomy leads to better child nutrition remains limited. We are still left with questions: What decisions do sufficiently autonomous mothers make that improve the nutritional outcomes of their children? Are these decisions related to feeding, hygiene, preventive health care, treatment of illnesses, or are they just environmental factors? To gain insights and answers, we conducted small, quantitative and qualitative field surveys in both urban and rural areas in two states in India, Maharashtra and Uttar Pradesh. The findings of the field survey revealed very interesting and unexpected pathways. The most important impacts of greater maternal autonomy are delayed marriage and pregnancies, fewer children, and appropriate birth spacing. These are found to be *highly* significant factors in explaining children's nutritional status. Qualitative interviews of women with young children showed that women desired delayed pregnancies, fewer children, and larger gaps between births. Many women mentioned that they "longed" to take care of their children and breastfeed them until they reached 3 years of age. However, interviews revealed that a number of prevailing beliefs hampered the goals of young mothers: others in the family, including the husband, mother in law and even the woman's mother, would convince the woman to have children immediately in succession after marriage. There was a common belief, especially among poor families, that women should get married at an early age in order to circumvent the prospect that, as she grows older she might fall in love with a man and run away with him. Once she gets married, she should fulfil her marital responsibility of producing children in quick succession. This was important for many reasons, including to prove, the man's sexual potency – for "if a woman does not produce babies soon after birth, people would doubt if the man is 'manly' enough." Producing children in quick succession ensures that women can fulfil their reproductive responsibilities "at one go". This reduces the age gap between children and ensures that child care is a one continuous phenomenon which lasts a relatively shorter period. It also ensures that children grow up with one another, and hence can keep each other company. In light of these commonly held beliefs, young mothers who wanted to delay their first pregnancy, wait longer between pregnancies and have fewer children, nonetheless faced pressure from others in the family, including the husband, mother in law and even the woman's own mother, to have children immediately and in quick succession after marriage. Greater autonomy among women would enable women to override these longstanding cultural perceptions, and to adopt fertility practices which are much more conducive to better child nutrition, with long-term health and economic benefits for the next generation.

These findings from the field study offer significant help in understanding how maternal autonomy can play a role on children’s health and nutrition.

Policy relevance of this finding

The finding that higher maternal autonomy leads to better long-term nutritional status among children living in rural areas is an important finding and has policy implications. It is well known that the 0-2 year age group presents the most important “window of opportunity” for making a long-term impact upon children’s nutritional status (UNICEF, 2013), and with lifelong consequences that are likely to benefit the generation beyond. Greater autonomy is found to be related to better nutritional status among children in precisely this age group. Greater autonomy therefore is an important requirement to ensure India achieves a reduction in the massive rates of undernutrition. This requires policies and programmes specifically aimed at improving autonomy among women.

These findings also reveal the gaps in existing government programmes in tackling the core issues that underlie undernutrition. Existing programs for women and child development focus on nutrition, education, livelihoods (largely through self-help group formation) and reducing the medical complications and death rates associated with pregnancy and childbirth. More recently, programs have begun to focus on ensuring women's rights over property (such as the Sukanya Samriddhi Yojana); and providing families with financial support that begins with the birth of a daughter and continues until she reaches age 18 so long as she remains unmarried (such as the Rajiv Gandhi Scheme for Empowerment of Adolescent Girls). These programs have the potential to go a long way toward making women much more autonomous. However, limited funding and limited outreach of these programs make any significant impact upon women's status in India nearly impossible.

Second, while these policies are useful, they do not strike at the heart of cultural biases that constrain women's autonomy and prevent her from making important decisions that might benefit her children. Media campaigns that encourage women to be autonomous, and highlight the positive outcomes that come from greater autonomy for women should be firmly on the agenda. This study has helped us understand the widely and firmly held beliefs that constrain women's autonomy to make decisions that have an enormous impact upon children's health and nutrition. Dedicating campaigns to target beliefs about age of marriage, age at pregnancy, spacing, sex composition of children, and number of children (on the lines of the

Swachh Bharat Abhiyaan) would go a long way toward making women more autonomous, and would enable them to raise healthier and better nourished children – thus leading to a healthier and, likely, more economically prosperous generation for India in the future.

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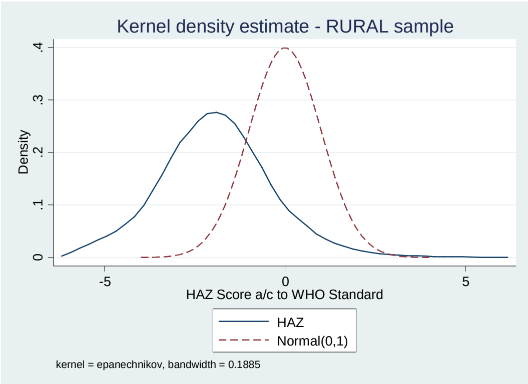
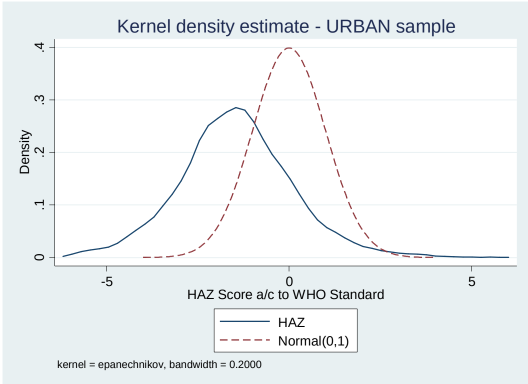
HAZ scores – children aged 0-59 months

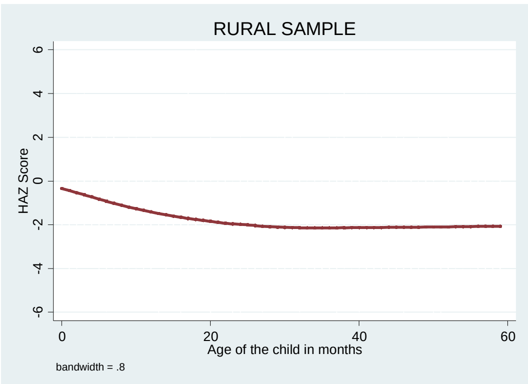


Rural Sample – Figure 1a

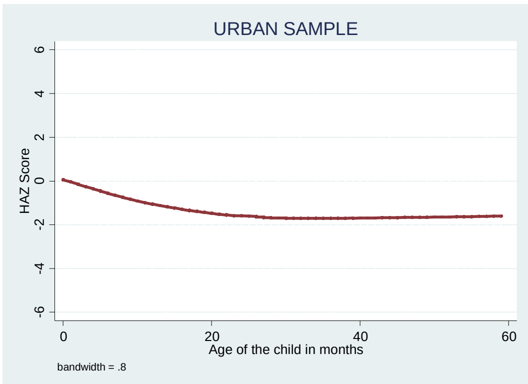


Urban Sample – Figure 1b

Smoothed Plots of HAZ by Age in Months – all chdilren

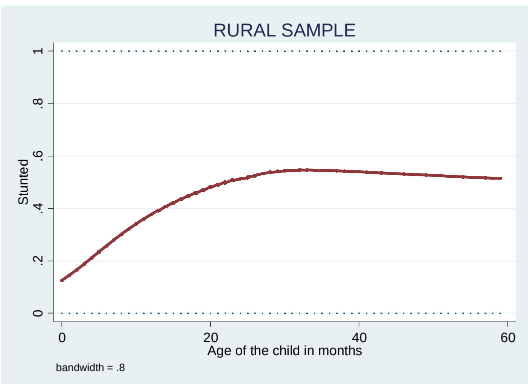


Rural Sample – Figure 2a

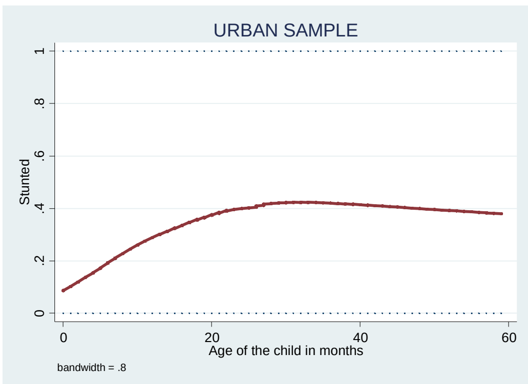


Urban Sample – Figure 2b

Proportion of children who are classified as 'stunted' by Age in Months (smoothed plots)

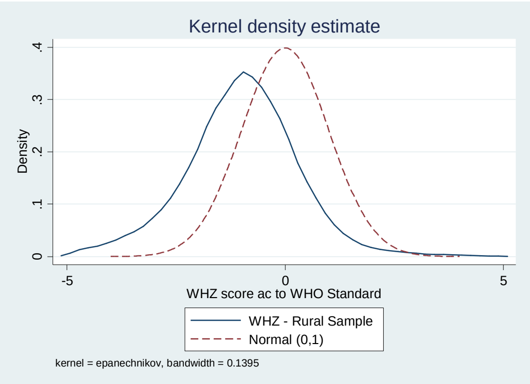


Rural Sample – Figure 3a

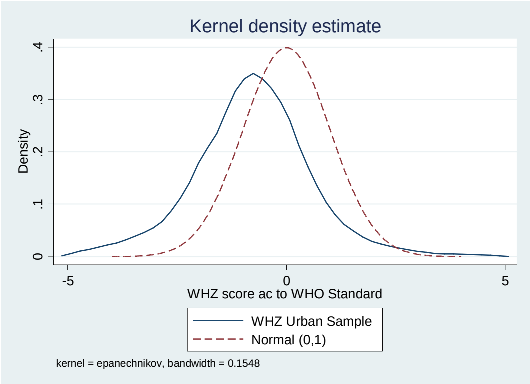


Urban Sample – Figure 3b

WHZ scores – children aged 0-59 months

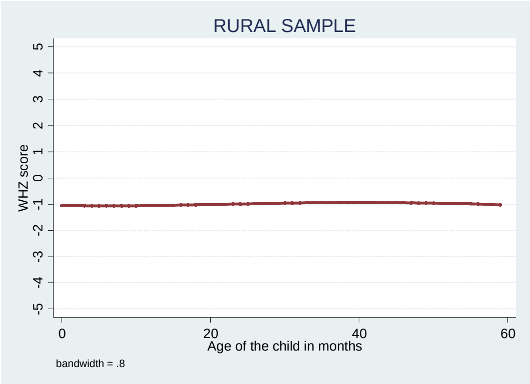


Rural Sample – Figure 4a

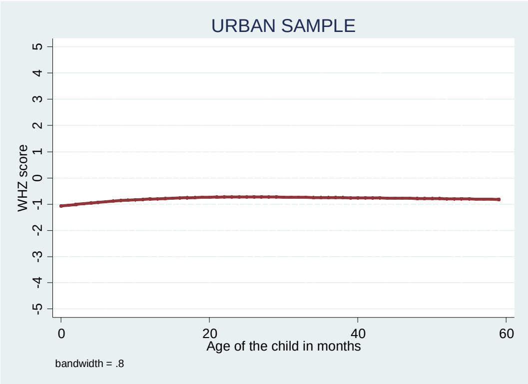


Urban Sample – Figure 4b

Smoothed Plots of Average WHZ by Age in Months

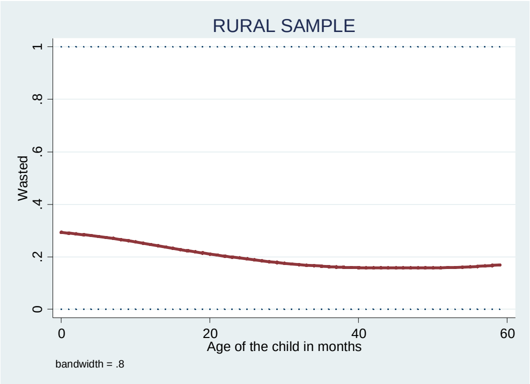


Rural Sample – Figure 5a

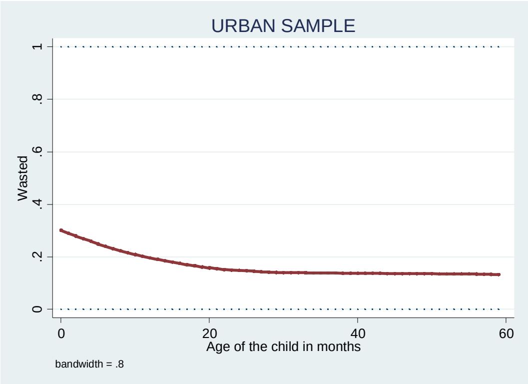


Urban Sample – Figure 5b

Proportion of children who are classified as 'wasted' by Age in Months (smoothed plots)



Rural Sample – Figure 6a



Urban Sample – Figure 6b

Table 1– Descriptive Statistics (mean (S.D))

	Rural [1]	Urban [2]
PANEL 1: MEASUREMENTS USED IN THE CONSTRUCTION OF THE AUTONOMY INDEX		
Woman is allowed to go to the:		
market alone (m1)	0.48	0.66
health facility alone (m2)	0.45	0.60
places outside the community alone (m3)	0.36	0.42
Woman has the final say alone on purchases for daily needs (m4)	0.29	0.36
Woman has the final say together on: own health care (m5)	0.61	0.70
large household purchases (m6)	0.50	0.60
visiting family and friends (m7)	0.58	0.69
what to do with husband's money (m8)	0.62	0.67
Woman has money for her own use (m9)	0.36	0.48
Average Score (Std Dev)	4.24 (2.48)	5.18 (2.39)
Mean of the Average Scores	0.47	0.58
Median of the Average Scores	0.44	0.56
PANEL 2: VARIABLES IN THE NUTRITION AND AUTONOMY EQUATIONS (1) AND (3) - *Z* and *S*		
Wealth index factor score/100000	-0.58 (0.78)	0.49 (0.87)
Family is a nuclear family	0.47	0.49
Mother's characteristics		
Current Age in years	27.03 (5.8)	27.28 (5.12)
Caste		
'general' caste (used as the base category in the analysis)	0.25	0.40
Schedule caste	0.18	0.16
Schedule tribe	0.20	0.09
OBC (Other Backward Caste)	0.33	0.32
Caste information is missing	0.05	0.04
Religion		
Hindu (used as the base category in the analysis)	0.74	0.68
Christian	0.10	0.09
Muslim	0.13	0.19
Other Religion	0.03	0.04
Education		
No education or primary not completed (used as base category)	0.57	0.29
Completed primary	0.36	0.45
Completed secondary	0.03	0.09
Completed higher education	0.03	0.17
Woman's Occupation		
No occupation (base category)	0.55	0.78
Professional, Technical, Managerial; Clerical, Sales, Services	0.04	0.12
Agricultural employee	0.33	0.03
Skilled and Unskilled Manual	0.08	0.07
Woman's working and earning status		
Not working (base group)	0.54	0.78
works all year for cash	0.11	0.15
works all year for non-cash (not paid, paid in kind)	0.13	0.02
seasonal or occasional work	0.22	0.05
Media Exposure		
Woman reads newspapers or watches TV or listens to the radio	0.51	0.84

Table 1– Descriptive Statistics (mean (S.D)) - continued

	Rural [1]	Urban [2]
Partner's Education		
No education (used as the base category in the analysis)	0.46	0.25
Completed primary	0.45	0.50
Secondary or higher education	0.02	0.02
Education information missing or not known	0.07	0.22
Partner's Occupation		
Skilled and Unskilled Manual (base category)+ a handful of 'unemployed'	0.38	0.45
Professional, Technical, Managerial	0.05	0.13
Clerical	0.03	0.07
Sales	0.09	0.22
Agricultural employee	0.40	0.05
Services	0.05	0.08
URBAN - binary indicators		
Large city (used as the base category)		0.33
Mega city		0.11
small city		0.16
large town		0.08
small town		0.32
State/Union Territory		
Jammu and Kashmir	0.03	0.01
Himachal Pradesh	0.03	0.02
Punjab	0.03	0.03
Uttaranchal	0.03	0.02
Haryana	0.03	0.02
Delhi		0.04
Rajasthan	0.05	0.03
Uttar Pradesh (used as the base state)	0.13	0.10
Bihar	0.05	0.03
Sikkim	0.02	0.01
Arunachal Pradesh	0.02	0.01
Nagaland	0.04	0.04
Manipur	0.04	0.05
Mizoram	0.02	0.02
Tripura	0.02	0.01
Meghalaya	0.02	0.01
Assam	0.04	0.02
West Bengal	0.05	0.05
Jharkhand	0.04	0.02
Orissa	0.05	0.03
Chhattisgarh	0.04	0.02
Madhya Pradesh	0.05	0.07
Gujarat	0.03	0.03
Maharashtra	0.03	0.10
Andhra Pradesh	0.03	0.07
Karnataka	0.04	0.03
Goa	0.02	0.03
Kerala	0.02	0.02
Tamil Nadu	0.03	0.05

Table 1– Descriptive Statistics (mean (S.D)) - continued

	Rural [1]	Urban [2]
PANEL 3: VARIABLES ONLY IN THE AUTONOMY EQUATION (3) - *S*		
Partner's age-woman's age (binary indicators)		
Age difference between the woman and her partner < 3 years (used as the base category in the analysis)	0.12	0.12
Age difference between the woman and her partner 3-5 years	0.47	0.47
Age difference between the woman and her partner 6-10 years	0.30	0.32
Age difference between the woman and her partner > 10 years	0.11	0.09
PANEL 4: VARIABLES ONLY IN THE NUTRITION EQUATION – *Z*		
CHILD COVARIATES		
Girl	0.48	0.48
Age in months	30.2 (17.0)	30.8 (16.7)
Part of a multiple birth	0.01	0.01
Birth Order 1	0.27	0.36
2	0.26	0.32
3	0.18	0.15
4	0.11	0.08
5 or more	0.18	0.09
Preceding birth interval		
< 18 months	0.08	0.08
18-24 months	0.15	0.12
25-36 months	0.51	0.54
>36 months	0.27	0.27
MOTHER SPECIFIC COVARIATES		
Child had died in the family	0.20	0.12
Whether the mother is anaemic i.e. haemoglobin<11gm/dl	0.40	0.49
Mothers height less than 145cm	0.10	0.10
Mother has low BMI i.e. BMI<18.5	0.14	0.23
BMI missing	0.14	0.01
PANEL 5: NUTRITION EQUATION DEPENDENT VARIABLES		
HAZ – Height for Age Z scores	-1.86 (1.66)	-1.48 (1.63)
WHZ – Weight for Height Z scores	-0.99 (1.30)	-0.77 (1.35)
WAZ – Weight for Age Z scores	-1.76 (1.23)	-1.38 (1.24)
Binary Indicators		
Stunted (HAZ<-2)	0.48	0.37
Wasted (WHZ<-2)	0.19	0.17
Stunted but not wasted	0.39	0.32
Not stunted but wasted	0.11	0.10
Neither stunted nor wasted	0.41	0.53
Stunted and wasted	0.09	0.05
Number of mothers	17,749	11,187
Number of Children	23,878	14,186
Proportion of Mothers with one child in the sample	0.59	0.51

Notes: (i) Sample is the women who had children who were less than 5 years old at the survey time and thus contributed to the 'nutrition' analyses. See text for further details; (ii) The nutritional status variable definitions are based on the World Health Organisation standards; (iii) The Rural sample excludes Delhi; (iv) All variables are binary except when a SD is indicated in parenthesis.

Table 2

Frequency distribution of the sum of the measurements (m1-m9) used in the construction of the autonomy index

	Rural			Urban		
Sum	# of women	%	Cumulative %	# of women	%	Cumulative %
0	1,454	8.2	8.2	473	4.2	4.2
1	1,729	9.7	17.9	623	5.6	9.8
2	1,589	9.0	26.9	634	5.7	15.5
3	1,976	11.1	38.0	952	8.5	24.0
4	2,800	15.8	53.8	1,463	13.1	37.1
5	2,355	13.3	67.1	1,549	13.9	50.9
6	1,784	10.1	77.1	1,498	13.4	64.3
7	2,103	11.9	89.0	1,871	16.7	81.0
8	1,564	8.8	97.8	1,642	14.7	95.7
9	395	2.2	100.0	482	4.3	100.0

Notes: (i) See Table 1 for the definitions of the measurements. (ii) Number of women in the rural sample=17,749 and urban sample=11,187; (iii) Sample averages are: Rural=4.2 and Urban=5.2.

Table 3 Estimates of Equation (2) Parameters (Standard errors)

(Impact of Women's Autonomy on Probability of Positive Response to the Measurement Question)

	RURAL		URBAN	
	FACTOR LOADING	INTERCEPT	FACTOR LOADING	INTERCEPT
MEASUREMENTS (binary indicators)	**[1]**	**[2]**	**[3]**	**[4]**
woman is allowed to go to market alone – intercept constant	1	-1.407***	1	-0.380***
		(0.082)		(0.093)
woman is allowed to go to health facility alone	0.886***	-0.005	0.874***	-0.168***
	(0.026)	(0.046)	(0.037)	(0.054)
woman is allowed to go to places outside community alone	0.894***	-0.484***	0.816***	-0.965***
	(0.028)	(0.050)	(0.038)	(0.060)
final say alone on purchases for daily needs	0.745***	-0.653***	0.828***	-1.295***
	(0.030)	(0.060)	(0.044)	(0.068)
final say together on own health care	2.171***	-0.682***	2.153***	-0.919***
	(0.081)	(0.097)	(0.100)	(0.112)
final say together on large household purchases	2.877***	-2.420***	3.404***	-2.903***
	(0.119)	(0.150)	(0.172)	(0.213)
final say together on visiting family and friends	2.959***	-1.815***	3.827***	-2.469***
	(0.115)	(0.151)	(0.197)	(0.244)
final say together on what to do with husband's money	1.463***	0.170***	1.566***	-0.562***
	(0.055)	(0.065)	(0.074)	(0.079)
woman has money for her own use	0.023	0.758***	0.160***	0.138
	(0.020)	(0.085)	(0.029)	(0.091)
Estimated variance of woman level heterogeneity	0.815***		0.571***	
	(0.023)		(0.042)	
Estimated variance of district level heterogeneity	0.748***		0.513***	
	(0.015)		(0.027)	
'RELIABILITY' MEASURE[+] (percentage)				
woman is allowed to go to market alone	16.8		13.1	
woman is allowed to go to health facility alone	13.8		10.3	
woman is allowed to go to places outside community alone	13.8		9.1	
final say alone on purchases for daily needs	10.2		9.3	
final say together on own health care	48.7		41.0	
final say together on large household purchases	62.6		63.5	
final say together on visiting family and friends	63.9		68.7	
final say together on what to do with husband's money	30.1		26.9	
woman has money for her own use	0.0		0.4	
Maximised log likelihood value	-90899		-57546	

(i) ***, **, * p-value<0.01, 0.05 and 0.10 respectively.

(ii) There were not enough women in the rural sample living in Delhi and these women were dropped from the rural analyses.

(iii) The 'reliability' measure provides the percentage of variation attributed to the autonomy variable in the total variation observed in that **particular** measurement. See equation (4).

(iv) This and the estimates reported in Table 4, are from the model jointly estimated (see equations (2) and (3)).

Table 4 – Estimates of Equation (3) Parameters (Standard errors)
(Determinants of Women's Autonomy Index)

	RURAL	URBAN
Wealth index factor score/100000	-0.043***	-0.079***
	(0.017)	(0.018)
Family is a nuclear family	0.454***	0.384***
	(0.021)	(0.024)
Woman's characteristics		
Age in years	0.028***	0.027***
	(0.002)	(0.002)
Caste: base case is 'general'		
Schedule Caste	0.027	-0.026
	(0.026)	(0.030)
Schedule Tribe	-0.009	0.121**
	(0.032)	(0.052)
Other Backward Caste	-0.080***	0.025
	(0.024)	(0.025)
Caste missing	-0.004	-0.003
	(0.047)	(0.057)
Religion: base case is 'Hindu'		
Christian	0.086*	0.211***
	(0.049)	(0.053)
Muslim	-0.132***	-0.029
	(0.030)	(0.027)
Other	-0.042	0.059
	(0.046)	(0.051)
Education: base is no education		
Completed primary or incomplete secondary	0.125***	0.120***
	(0.021)	(0.026)
Completed secondary education	0.277***	0.164***
	(0.049)	(0.042)
Higher education	0.348***	0.298***
	(0.057)	(0.044)
Media Exposure		
Listens to either radio or watches television or reads newspapers at least once a week	0.045**	0.117***
	(0.019)	(0.029)
Woman's Occupation – base: no occupation		
Professional, Technical, Managerial; Clerical, Sales, Services	0.068	-0.049
	(0.162)	(0.145)
Agricultural employee	-0.126	-0.159
	(0.157)	(0.153)
Skilled and Unskilled Manual	-0.102	-0.148
	(0.159)	(0.149)
Woman's working status in the last 12 months – base: not working		
works all year for cash	0.261*	0.381**
	(0.159)	(0.149)
works all year for non-cash (not paid, paid in kind)	0.214	0.357**
	(0.158)	(0.139)
seasonal or occasional work	0.244	0.240
	(0.158)	(0.149)

Table 4– Continued

	RURAL	URBAN
Partner's Characteristics		
Education: base is no education		
Completed primary or incomplete secondary	-0.051***	0.001
	(0.019)	(0.026)
Completed secondary education	-0.093	0.082
	(0.058)	(0.066)
Higher education	-0.080**	0.040
	(0.040)	(0.039)
Occupation – Base: Manual		
Professional, Technical, Managerial	0.102**	0.029
	(0.041)	(0.035)
Clerical	-0.025	0.032
	(0.048)	(0.040)
Sales	0.005	-0.045*
	(0.029)	(0.025)
Agricultural employee	-0.031	0.008
	(0.019)	(0.045)
Services	0.087**	-0.001
	(0.039)	(0.036)
Age difference between the partners		
Base: less than 2 years		
Husband older by 2-5 years	0.008	0.064**
	(0.025)	(0.030)
Husband older by 6-10 years	0.053*	0.053
	(0.027)	(0.032)
Husband older by more than 10 years	0.074**	-0.006
	(0.034)	(0.042)
URBAN – base: large city		
Mega city		-0.009
		(0.055)
small city		-0.115***
		(0.035)
large town		-0.098*
		(0.050)
small town		-0.098***
		(0.033)
State/Union Territory (base: Uttar Pradesh)		
Jammu and Kashmir	-0.352***	-0.686***
	(0.065)	(0.096)
Himachal Pradesh	0.238***	-0.115
	(0.063)	(0.083)
Punjab	0.397***	0.085
	(0.070)	(0.073)
Uttaranchal	-0.015	-0.068
	(0.059)	(0.082)
Haryana	0.440***	0.389***
	(0.063)	(0.097)
Delhi	+++	0.149*
		(0.077)
Rajasthan	-0.266***	-0.148*
	(0.051)	(0.077)
Bihar	-0.029	-0.140**
	(0.046)	(0.066)

Table 4 - Continued

	RURAL	URBAN
Sikkim	0.813***	0.631***
	(0.093)	(0.128)
Arunachal Pradesh	0.717***	0.162
	(0.084)	(0.114)
Nagaland	1.042***	0.709***
	(0.080)	(0.085)
Manipur	1.079***	0.599***
	(0.076)	(0.075)
Mizoram	1.315***	0.736***
	(0.127)	(0.127)
Tripura	0.052	-0.072
	(0.070)x	(0.121)
Meghalaya	1.132***	0.163
	(0.097)	(0.114)
Assam	0.999***	0.766***
	(0.071)	(0.093)
West Bengal	-0.116**	-0.353***
	(0.048)	(0.055)
Jharkhand	0.280***	-0.091
	(0.056)	(0.074)
Orissa	0.358***	0.110
	(0.051)	(0.081)
Chhattisgarh	0.173***	-0.085
	(0.053)	(0.073)
Madhya Pradesh	-0.101**	-0.244***
	(0.048)	(0.050)
Gujarat	-0.129**	-0.273***
	(0.057)	(0.065)
Maharashtra	0.415***	0.265***
	(0.061)	(0.049)
Andhra Pradesh	0.043	-0.230***
	(0.061)	(0.050)
Karnataka	-0.208***	-0.089
	(0.053)	(0.066)
Goa	0.483***	0.078
	(0.085)	(0.078)
Kerala	0.634***	0.410***
	(0.071)	(0.083)
Tamil Nadu	0.427***	0.144**
	(0.066)	(0.070)
Number of Mothers	17.749	11,187

Notes: (i) ***, **, * p-value<0.01, 0.05 and 0.10 respectively. (ii) All are binary indicators except the Wealth score variable and the woman's age variable. (iii) +++ There were not enough women in the rural sample living in Delhi and these women were dropped from the rural analyses.

Table 5 – Sample Characteristics

	PANEL [1]: Number of Mothers Contributing (# children)							
Number of children	**1**	**2**	**3**	**4**	**Total (#)**			
RURAL (%)	63.9	32.1	3.9	0.12	15,669			
URBAN (%)	71.4	25.8	2.7	0.05	10,235			
	PANEL [2]: Distribution of Birth Order							
	1	**2**	**3**	**4**	**5**	**6**	**7 or more**	**Total**
RURAL: Girls (col %)	49.4	48.2	46.5	48.4	47.8	49.4	46.7	48.2
Boys (col %)	50.6	51.9	53.5	51.6	52.2	50.7	53.3	51.8
Total (number)	6,434	6,312	4,219	2,682	1,758	1,078	1,395	23,878
Total (%)	26.9	26.4	17.7	11.2	7.4	4.5	5.8	100
URBAN: Girls (col %)	49.2	46.8	46.2	45.5	53.2	50.0	44.4	47.71
Boys (col %)	50.9	53.2	53.8	54.6	46.8	50.0	55.6	52.29
Total (number)	5,125	4,530	2,153	1,133	571	314	360	14,186
Total (%)	36.1	31.9	15.2	8.0	4.0	2.2	2.5	100
	PANEL [3]: % of FIRST-BORNS with SECOND-BORN in the sample by Year of Birth of First-Born							
	2001	**2002**	**2003**	**2004**	**2005**	**OVER-ALL**	**TOTAL #**	
RURAL	70.4	62.6	43.5	14.6	0.9	34.2	2,199	
URBAN	58.4	50.4	36.5	11.0	1.0	29.2	1,498	
	PANEL [4]: Age in Months of FIRST-BORNS at the time of the interview (%)							
	0-15	**16-17**	**18-23**	**24+**	**TOTAL(#)**			
RURAL	26.4	3.8	10.2	59.7	6,434			
URBAN	23.2	3.8	9.9	63.1	5,125			
	PANEL [5]: Age in Months of LAST-BORNS at the time of the interview (%)							
	0-15	**16-17**	**18-23**	**24+**	**TOTAL(#)**			
RURAL	31.0	4.4	11.6	53.0	16,026			
URBAN	27.4	4.3	11.4	56.9	10,416			
	PANEL [6]: Age in Months of FIRST-BORNS who is also the LAST-BORN at the time of the interview (%)							
	0-15	**16-17**	**18-23**	**24+**	**TOTAL(#)**			
RURAL	40.2	5.4	14.0	40.4	4,202			
URBAN	32.6	5.1	12.8	49.5	3,628			
	PANEL [7]: Age in Months of FIRST-BORNS with birth-year>2003 at the time of the interview (%)							
	0-15	**16-17**	**18-23**	**24+**	**TOTAL(#)**			
RURAL	57.2	8.1	22.2	12.5	2,964			
URBAN	53.4	8.8	22.9	14.9	2,223			

Table 6 – HAZ & 'Stunted' regressions – Rural sample
Coefficient Estimate (std error)

VARIABLES	**HAZ**	**'STUNTING'**	**HAZ**	**'STUNTING'**
	[1]	**[2]**	**[3]**	**[4]**
PANEL [1]	**ALL BIRTH-ORDER AGE 0-59 months**		**FIRST-BORNS AGE 0-59 months**	
Autonomy	0.038**	-0.015**	0.046*	-0.012
	(0.015)	(0.004)	(0.025)	(0.008)
Constant	-0.953***	0.254***	-1.469***	0.446***
	(0.086)	(0.026)	(0.173)	(0.052)
R-squared	0.170	0.129	0.181	0.142
Number of Children	23,788	23,788	6,413	6,413
PANEL [2]	**FIRST-BORNS AGE<15 months**		**FIRST-BORNS AGE<18 months**	
Autonomy	0.146**	-0.029*	0.161***	-0.032**
	(0.061)	(0.015)	(0.051)	(0.014)
Constant	-1.218***	0.325***	-1.441***	0.382***
	(0.377)	(0.098)	(0.364)	(0.088)
R-squared	0.139	0.133	0.176	0.157
Number of Children	1,571	1,571	1,931	1,931
PANEL [3]	**FIRST-BORNS Birth Year >2003**		**FIRST-BORNS Birth Year >2004**	
Autonomy	0.108***	-0.035***	0.162***	-0.033**
	(0.041)	(0.011)	(0.055)	(0.015)
Constant	-1.248***	0.376***	-1.109***	0.299***
	(0.265)	(0.077)	(0.393)	(0.093)
R-squared	0.195	0.169	0.151	0.133
Number of Children	2,956	2,956	1,640	1,640
PANEL [4]	**LAST-BORNS AGE<15 months**		**LAST- BORNS AGE<18 months**	
Autonomy	0.097***	-0.028***	0.093***	-0.029***
	(0.034)	(0.009)	(0.033)	(0.008)
Constant	-0.543**	0.143***	-0.741***	0.210***
	(0.208)	(0.051)	(0.184)	(0.049)
R-squared	0.122	0.098	0.150	0.126
Number of Children	4,594	4,594	5,668	5,668
PANEL [5]	**LAST-BORNS AGE 0-59 months**		**LAST- BORNS Birth Year >2004**	
Autonomy	0.053***	-0.020***	0.110***	-0.031***
	(0.016)	(0.005)	(0.033)	(0.009)
Constant	-0.882***	0.224***	-0.500***	0.169**
	(0.101)	(0.029)	(0.208)	(0.053)
R-squared	0.180	0.138	0.129	0.105
Number of Children	15,963	15,963	4,785	4,785

Notes: (i)The regressions contain the variables listed in Table 7 ; (ii) age dummies (0-5 (base), 6-11, 12-17, 18-23, 24+) as well as birth order dummies were included where appropriate.

Table 7 – Estimates of Equation (1) Parameters (Standard errors)
First-born rural children aged<18 months

	HAZ	'Stunted' [binary]
Maternal Autonomy –z score	0.161***	-0.032**
	(0.051)	(0.014)
Child Characteristics		
Age in months – binary – (base <6 months)		
6-11	-0.318***	0.058**
	(0.100)	(0.025)
12-17	-1.032***	0.237***
	(0.099)	(0.027)
Girl	0.178**	-0.039**
	(0.071)	(0.019)
Part of multiple birth	-2.392***	0.630***
	(0.442)	(0.162)
Family Characteristics		
Wealth index factor score/100000	0.210***	-0.067***
	(0.072)	(0.020)
Family is a nuclear family	-0.082	0.015
	(0.106)	(0.026)
Mother's characteristics		
Age in years	0.042***	-0.010***
	(0.013)	(0.003)
Whether the mother is anemic i.e. hemoglobin<11gm/dl	-0.006	-0.005
	(0.080)	(0.021)
Mothers height less than 145cm	-0.630***	0.132***
	(0.121)	(0.036)
Mother has low bmi i.e. bmi<18.5	-0.340***	0.098***
	(0.080)	(0.022)
Caste: **base case is 'general**		
Schedule Caste	-0.120	0.041
	(0.122)	(0.034)
Schedule Tribe	0.024	-0.020
	(0.148)	(0.037)
Other Backward Caste	-0.119	0.067**
	(0.099)	(0.029)
Religion: base case is 'Hindu'		
Christian	-0.078	0.062
	(0.219)	(0.048)
Muslim	0.224	-0.079**
	(0.146)	(0.039)
Other	0.018	0.014
	(0.188)	(0.048)
Education: **base is no education**		
Completed primary or incomplete secondary	0.114	-0.065**
	(0.090)	(0.027)
Completed secondary education	0.032	-0.047
	(0.182)	(0.045)
Higher education	0.258	-0.028
	(0.193)	(0.051)
Media Exposure		
Listens to either radio or watches tv or reads newspapers at least once a Week	-0.058	0.018
	(0.088)	(0.025)
Woman's Occupation – base: no occupation		
Professional, Technical, Managerial; Clerical, Sales, Services	-0.663	0.294**
	(0.933)	(0.118)
Agricultural employee	-0.525	0.314***
	(0.919)	(0.115)
Skilled and Unskilled Manual	-1.020	0.422***
	(0.948)	(0.125)

Table 7– Continued

	HAZ	'Stunted' [binary]
Woman's working status in the last 12 months – base: not working		
works all year for cash	0.738	-0.321***
	(0.955)	(0.120)
works all year for non-cash (not paid, paid in kind)	0.755	-0.364***
	(0.912)	(0.114)
seasonal or occasional work	0.506	-0.298**
	(0.941)	(0.118)
Partner's Characteristics		
Education: base is no education		
Completed primary or incomplete secondary	0.082	-0.019
	(0.096)	(0.028)
Completed secondary education	0.421**	-0.088
	(0.204)	(0.058)
Higher education	0.153	-0.016
	(0.170)	(0.045)
Occupation – Base: Manual		
Professional, Technical, Managerial	-0.067	-0.005
	(0.177)	(0.044)
Clerical	0.188	-0.059
	(0.198)	(0.054)
Sales	-0.198	0.014
	(0.143)	(0.035)
Agricultural employee	-0.098	0.023
	(0.091)	(0.025)
Services	0.122	-0.029
	(0.178)	(0.045)
State/Union Territory (base: Uttar Pradesh)		
Jammu and Kashmir	0.317	-0.046
	(0.276)	(0.076)
Himachal Pradesh	0.148	-0.028
	(0.259)	(0.066)
Punjab	-0.125	0.037
	(0.265)	(0.068)
Uttaranchal	-0.461*	0.089
	(0.257)	(0.068)
Haryana	-0.236	0.023
	(0.233)	(0.066)
Rajasthan	0.219	-0.063
	(0.210)	(0.060)
Bihar	0.317*	-0.141**
	(0.184)	(0.061)
Sikkim	0.561	-0.049
	(0.386)	(0.075)
Arunachal Pradesh	0.092	0.041
	(0.397)	(0.106)
Nagaland	0.268	-0.153**
	(0.367)	(0.076)
Manipur	0.540**	-0.056
	(0.239)	(0.059)
Mizoram	-0.078	0.076
	(0.400)	(0.118)
Tripura	0.200	-0.096
	(0.257)	(0.072)

Table 7 - Continued

	HAZ	'Stunted' [binary]
Meghalaya	-0.011	0.005
	(0.439)	(0.106)
Assam	0.032	-0.006
	(0.229)	(0.064)
West Bengal	0.293	-0.025
	(0.213)	(0.060)
Jharkhand	0.251	-0.050
	(0.307)	(0.077)
Orissa	0.190	-0.073
	(0.210)	(0.055)
Chhattisgarh	-0.330	0.093
	(0.221)	(0.069)
Madhya Pradesh	0.387*	-0.119*
	(0.225)	(0.062)
Gujarat	-0.041	0.022
	(0.243)	(0.076)
Maharashtra	0.064	0.017
	(0.239)	(0.059)
Andhra Pradesh	0.593*	-0.239***
	(0.305)	(0.066)
Karnataka	0.440*	-0.132**
	(0.243)	(0.058)
Goa	0.115	-0.031
	(0.239)	(0.081)
Kerala	0.002	-0.013
	(0.249)	(0.063)
Tamil Nadu	0.240	-0.061
	(0.264)	(0.065)
Intercept	-1.441***	0.382***
	(0.364)	(0.088)
R-squared	0.176	0.157
Sample average of the dependent variable (SD)	-1.15	0.31
	(1.72)	
Number of Children	17.749	11,187

Notes: (i) ***, **, * p-value<0.01, 0.05 and 0.10 respectively. (ii) All are binary indicators except the Wealth score variable and the woman's age variable. (iii) +++ There were not enough women in the rural sample living in Delhi and these women were dropped from the rural analyses.