

The effect of women's empowerment on child nutrition in rural Senegal

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Abstract

We examine how women's bargaining power affects child nutritional status using data from rural Senegal. In order to correct for the potential endogeneity of women's empowerment we use information on a mother's ethnicity relative to that of the community she resides in to construct an arguably exogenous instrument. While standard OLS suggests that if a mother has more bargaining power, her children will have a better nutritional status, our IV estimates indicate that the true impact is underestimated if the endogeneity of bargaining power is not taken into account.

Key words: Bargaining power, child nutrition, Instrumental Variable, Senegal, Africa.

1. INTRODUCTION

Since the Beijing conference on women in 1995 the increase in women's relative to men's power in the household, usually known as women's bargaining power, has become a primary policy goal in developing countries. This willingness to empower women in developing countries is based on the idea that social justice is an important aspect of human welfare and has been reinforced by the finding that an increase in women's power relative to men's confers benefits on child health (Hoddinott & Haddad, 1991; S. J. Lundberg, Pollak, & Wales, 1997; Thomas, Contreras, & Frankenberg, 1999; E. Duflo, 2000; Quisumbing & Maluccio, 2000; Maitra, 2004; Ahmed, 2006). Such a link is generally explained by several factors. First, as stated in Smith et al. (2003), women's power directly affects child health, as women are the child caregivers. One would then expect that in societies where women's health services are available, where they can decide to allocate their time and money in the most efficient way and have access to information, children should have better health since, according to UNICEF, child nutritional status is determined by food security, the quality of caring practices for children, and health environment quality. A second explanation that is valid in the absence of income pooling relies on the fact that men and women have distinct income allocations: men tend to use a larger proportion of income for production, household maintenance, social investment and personal consumption, while women's income is used more to meet daily consumption, such as food, clothing and health care (Lele, 1986; Blumberg, 1989).

Although, there is now a large literature indicating a positive effect of women's empowerment on child nutrition, much of the existing studies suffer from two potentially important weaknesses. Firstly, many studies rely on very indirect proxies of female empowerment. Indeed, an accurate measure of women's empowerment is difficult to obtain because of its context-specificity, multidimensionality, and the difficulty in measuring a "process" (Malhotra, Schuler, & Boender, 2002). In this regard, commonly used proxies have ranged from measures of woman's economic possessions, such as earned (Browning, Bourguignon, Chiappori, & Lechene, 1994) or unearned

income (Schultz, 1990; Thomas, 1990), inheritance (Quisumbing, 1994), assets brought into the marriage (Thomas, et al., 1999) and current assets (Quisumbing & De La Briere, 2000). However, such measures are also likely to capture other aspects of a household. For example, earned income inherently also reflects labour supply decisions (Lundberg & Pollak, 1996), while unearned income, such as pensions, unemployment insurance, or interest on earnings accumulated over the life cycle, is most likely related to past or present household behaviour (Lundberg & Pollak, 1996; Behrman, 1997) and may depend on tastes and labour market conditions (Quisumbing & Maluccio, 2000). Moreover, asset ownership might be correlated with other household choices, for instance, traditional households could at the same time prevent women from owning assets and have less healthy children (Behrman, Pollak, & Taubman, 1995 cited in ; Duflo, 2000). Finally, in the presence of assortative matching, a woman's asset level could affect child health through her spouse's characteristics (Duflo, 2000). For these reasons, more recent studies (Hindin, 2000; Elder & Rudolph, 2003; Mullany, Hindin, & Becker, 2005; Ahmed, 2006; Becker, Fonseca-Becker, & Schenck-Yglesias, 2006; Friedberg & Webb, 2006; Allendorf, 2007; Woldemicael, 2010) have relied on "direct evidence of power" indicators (Kishor, 2000) that capture the nature of decision-making or control of resources by each spouse in the household, when these are available. However, even when the researcher uses such direct proxies, there might be measurement error in women's bargaining power that could result in an attenuation bias. For instance, an important issue in correctly measuring women's empowerment might be whether the husband of non-powerful women was present during the interview and biased the responses of the woman.

The second major weakness in much of the existing literature is the failure to take account of the potential endogeneity of women's bargaining power in econometrically estimating its effect on child health. More specifically, even in the case where direct measures of women's power in the household are available, these are likely to be correlated with other unobservable (to the econometrician) variables that affect child health, and hence estimates of its effect may be biased. Of particular concern in this regard is unobserved parenting ability of the spouses. For instance, one could argue that women who have a greater bargaining power are likely to have better

intrinsic characteristics since they managed to achieve a greater power in the household thanks to their good maternal skills, but that these characteristics also result in greater health in their children. In contrast, one could argue that in countries where social norms dictate that males are the guarantors of the well being of the household members and in this respect, are expected to make decisions for their members, women who have a high bargaining power are more likely to belong to deviant households. Indeed, a woman could have a greater bargaining power as a result of the disengagement of her husband in household's decisions, which, in the Senegalese context may suggest that the husband does not invest his money and time towards his wife and his children. In this situation we would observe that women have greater bargaining power and children who do worse. Thus the endogeneity bias could, depending on the context, lead to an over- or an under-estimation of the effect of women's bargaining power on child malnutrition. To the best of our knowledge this issue has as of yet not been specifically examined.

In this paper we address these measurement and estimation concerns using the case study of Senegal. The choice of Senegal is motivated by a number of reasons. Firstly, chronic malnutrition (stunting) and acute malnutrition (wasting) affects 16% and 8% of the children under-5 and cause 31% of all deaths that occur among children under-5 (Demographic and Health Survey, 2006). Secondly, average Senegalese women's relative decision-making power is among the lowest in the world, well below the South Asian average (Smith, 2003).

Our data set consists of a rich sample of 505 farming households located in the Saint Louis region of Senegal. These data allows us to firstly, as do some of the more recent studies, focus on direct measures of female power as specifically incorporated in the questionnaire as shown in Appendix 1. To control for the potential endogeneity of our empowerment, we take advantage of the fact that for historical reasons, women of different ethnicities have different bargaining power and that the extent of this may depend on the ethnicity of the neighbourhood that they are living in, but that ethnicity, as we shall argue, is not directly related to children's nutritional status. Our econometric results indicate that women's bargaining power is a strong determinant of child nutrition. An increase in one standard deviation of the women's bargaining power index

improves the child Mid-Upper Arm Circumference (MUAC) z-score by 0.81 standard deviations after controlling for the endogeneity of women's empowerment.

The remainder of the paper is organized as follows. In the following section we outline our theoretical framework. The third section describes the Senegalese background, our data and the construction of variables used in our estimation. In Section 4, we outline our empirical specification and describe the econometric results of its estimation. Finally, concluding remarks are contained in the last section.

2. THEORETICAL FRAMEWORK

In order to demonstrate the potential importance of controlling for the endogeneity of bargaining power in estimating its impact on child health, we adapt to our context the non-unified preferences framework that determines the effect of a mother's bargaining power on malnutrition as proposed by Maitra (2004). Accordingly, changes in child health result not only from a change in the budget constraint but also from changes in the utility function due to relative changes in power inside the household. It is assumed that parents make decisions regarding the quality of child health attainment. More specifically, consider a general household's utility maximization problem where the two parents choose commodities purchased on the market (X) and non-market goods (Z) to maximize the difference between their utility level U and their reserve utility, (U^*), the latter of which represents the utility of each parent outside the union. We assume that this reserve utility depends on factors that affect bargaining power inside the union (φ), and here for convenience sake defined as the relative bargaining power of the mother. The bargaining power itself depends on each spouse's characteristics ($\mathcal{A}_{n=f, m}$), such as his/her ability on the labour market (productivity, occupation, educational attainment), his/her social status, the wife's rank in the household in the context of polygamy, extra-household environmental factors (E) that include marriage market characteristics, laws (e.g. labour laws, property rights and divorce law) and social norms in the neighbourhood, and a vector of prices (p). We also assume that bargaining power may be influenced by other potentially unobserved parenting ability, $\gamma_{n=f, m}$. In this regard one might be inclined to expect that mothers who have

better intrinsic characteristics may be able to have greater power as husbands may feel less urgency to interfere in the child's upbringing. However, in the Senegalese context this is a priori not necessarily since "women should be submissive to male authority" (Sow, 1996).ⁱ Deviant, more independent behaviour on part of the mother may thus be associated with more bargaining power. Similarly, it might be that household heads who do not take their socially expected role as guarantor of the well-being of household seriously may also only allow greater power to the woman. In this case we would observe that children in those households could have poorer access to food, poorer care and a worse health environment. Thus, a priori, the relationship between good/bad parenting ability and bargaining power is not clear.

The two parents choose to maximize:

$$\text{Max } V = [U_f(X, Z) - U^*_f(A_f, E, p, \gamma)] \times [U_m(X, Z) - U^*_m(A_m, E, p, \gamma)] \quad (1)$$

Subject to the full income constraint $pX = w_m T_m + w_f T_f$, where w_n is the wage rate and T_n is the time endowment for parent n . As a solution to this maximization problem, one obtains a reduced form demand equation for child health (H), which depends on prices (p), the household efficiency parameter (Ω), unobserved parenting ability of the spouses, γ_n , and the factors determining bargaining power:

$$H = H(A_n, E, p, \gamma_n, \Omega) \quad (2)$$

Or alternatively, if one has some proxy of bargaining power:

$$H = H(p, \gamma_n, \Omega, \varphi) \quad (3)$$

Note that we continue to allow for a direct effect of parenting ability on child health, not just through bargaining power. If we also assume that child health may depend on exogenous child characteristics (I), household and parental characteristics (P), and community characteristics (S), as well as potentially on the unobserved, then (3) can be rewritten as:

$$H = H(p, \gamma_n, \Omega, \varphi, I, P, S) \quad (4)$$

The important stumbling block in terms of estimating the true causal effect of bargaining power on child health from (4) is the role of unobserved parenting ability, γ_n , which, as we assume, determines bargaining power of the woman as well as child health. As noted earlier, if greater female ability means that the husband allows her greater power, then one would expect an upward bias in terms of the estimated effect of female bargaining power, as one would if husbands who do not feel the pressure of being the dominant person in the household also feel less obligation towards maintaining its well-being. Thus this is an issue to be resolved empirically.

3. DATA, VARIABLES AND DESCRIPTIVE STATISTICS

3.1. Background

Senegal is a West African country with a population of approximately 12 million of which 7 million live in rural areas. According to the Demographic and Health Survey conducted in 2005, child malnutrition appears to be a major health concern as 16% of the children under-5 are stunted, 8% are wasted and 17% are underweight (Demographic and Health Survey, 2006). The traditional Senegalese family is made of a household head, his wives and the children of his wives. In the sample, 11.1% of the individuals are household heads and 13% are household head spouses. About half of the sample is made up of children of the head of the household and among these 2,123 children, 745 are less than five years old. Members who are not genetically affiliated to the household can also be household members; it is the case of the fostered children who represent 1.3% of the sample.

In the sample, 32% of married women have a co-wife. Polygamy is socially organized in Senegal in order to reduce conflicts and tensions within the household. In rural areas, co-wives live under the same concession, but are autonomous as each wife and her children have a space in the concession called “ròq”. Each household is thus made up of several wife-children nucleus and in order to reconstitute the wife-children nucleus, children were matched to their mother. Ròq

includes a personal kitchen and a small land area that is used to cultivate food for breakfast. Co-wives however maintain social interactions; they eat together, do collective chores and they keep company (Diop, 1985). The population in the sample is divided into two main ethnic groups: 57% are Wolof, 40% are Fula while only 2% are Moorish. Fula people are over-represented in the sample since they represent only 17% of the population in Senegal while 40% of Senegalese are Wolof. Wolof mainly live in the western part of Senegal, they are mainly farmers who grow rice, millet and groundnuts. Fula are found in different rural areas, mainly in Eastern Senegal; they are by tradition pastoral nomads but many Fula have now settled permanently in rural areas and live on agriculture. All of these ethnicities are Muslim and most of the Muslims (96%) belong to the Tijanyyah Muslim brotherhood in the sample. Figure 1 shows evidence that women's decision-power in Senegal is particularly low, since all the decisions except food based decisions are commonly made by the husband alone, even those related to wife outcomes.

Insert Figure 1

3.2. Data

We collected data in the framework of the implementation of a health insurance project targeting farming households. Thanks to the presence of the Senegal River allowing the practice of irrigated agriculture a large share of the population located in the Saint Louis region lives on agriculture. Our study was conducted in Ross Béthio, Gaë and Guédé, i.e., three rural communities of the Saint-Louis region. Most of the 110,000 inhabitants of these rural communities derive their livelihoods from subsistence farming, with an annual adult equivalentⁱⁱ median household consumption expenditure of 848 USD, of which on average 3% is spent on health. Note that in this area 18% of the children under-5 are mildly wasted (z -score <-1) and 4% are moderately wasted (z -score <-2), where the low malnutrition rate in the Saint Louis region has been highlighted in the Enquête Sénégalaise Auprès des Ménages (Ministry of Economy and Finance, 2004) and may be explained by the lower poverty rate in the Saint Louis region (Dramani, 2011). However, the finding that women's power is extremely low in Senegal may not

vary much between regions. Indeed, cultural factors determining the low women's power such as the prevalence of Muslims and polygamy remain high and constant between and within Senegalese regions. In order to know how findings could be extended to regions with different levels of malnutrition, the paper looks if the effect of women's bargaining power on nutrition is linear within the distribution of children under-5.

The survey was carried out during May and June 2009, at the end of the dry and warm agricultural season. Note that in the survey area, nutritional situation appears to vary depending on the season and is found to deteriorate during the rainy season (Benefice, Chevassus-Agnes, & Barral, 1984). Given that there are seasonal differences in anthropometric indicators and that our study focuses on the dry season that lasts 9 to 10 months, our results may not be extendable to the rainy season. The survey targeted rural households, who live on agriculture and belong to a farmer organization; a local grassroots organization managed by an elected farmer. Farms are owned and run by families and most of the farmers in Senegal belong to a farmer organization, which appears to be a very important social structure in Senegal (DeJanvry & Sadoulet 2004). Farmer organizations aim to furnish technical assistance to farmers, help in the management of collective goods (rough grazing, water), help with training and information transmission, are involved in external representation and in the defence of the interest of their members, in this sense they act as labour unions. But most importantly, farmer organizations provide insurance and social cohesion to their members since the Senegalese Agricultural Development Bank (CNCAS) only allocates collective loans to finance agricultural inputs to farmer organizations' members. To sample the 505 households,ⁱⁱⁱ a two-stage stratified sampling procedure was used, where first 93 farmer organizations using the Probability-Proportional-to-Size (PPS) method were randomly selected and second households were randomly selected from the farmer organization, which ensures that each household has the same probability of inclusion in the sample. All the children under-5 of the households sampled are included in the analysis.

3.3. Dependent variable (*H*)

We measure child nutritional status by the MUAC that is the circumference of the left upper arm, measured at the mid-point between the tip of the shoulder and the tip of the elbow. Note that we received MUAC brassards as well as information on their use and on standardization methods from a Nutrition specialist of the UNICEF and this information was communicated to interviewers through training sessions. The MUAC is expressed in terms of z-scores from international references curves developed by the WHO/NCHS,^{iv} and is computed using the LSM method^v since anthropometric indicators are found to have a right-skewed distribution (Kuczmarski et al., 2000). One may want to note that the MUAC for age z-scores based indicator, which adjusts for age and sex, is arguably preferable over a single cut-off value for several reasons. Firstly, the use of a fixed cut-off may result in wasting being over-diagnosed among young children and under-diagnosed among older children (Briend, Wojtyniak, & Rowland, 1987; Hall, Chowdhury, & Bloem, 1993). Secondly, a single cut-off point for boys and girls may not be appropriate since there is a difference between their MUAC z-scores in WHO reference curves. Finally, there is still a debate on the appropriate cut-off points. More precisely, while moderate wasting is commonly defined as a fixed cut-off point of 12.5 centimetres and severe wasting is fixed at 11.5 centimetres (World Health Organization & UNICEF, 2009), the cut-off points may, however, change since they are generally calculated with respect to the mortality probability or in relation to another wasting indicator (generally, the weight-for-height indicator). One may also want to note that the MUAC for age is often preferred to the weight-for-height indicator in non-emergency situations (Chen, Chowdhury, & Huffman, 1980; Trowbridge & Sommer, 1981; Briend, et al., 1987; Van den Broeck, Eeckels, & Massa, 1996; Berkley et al., 2005) since it has been found to be a better predictor of child mortality in developing countries (Bairagi, 1981; Briend & Zimicki, 1986; De Onis, Yip, & Mei, 1997).

3.4. Measure of women's bargaining power (ϕ_j)

The data set includes several questions that aim to measure women's empowerment; details of which are presented in Appendix 1. Broadly these ascertain who takes decisions concerning the wife's health, the children's health, the schooling of the children, daily expenditures, large

expenditures, food cooked, visits to the wife's relatives, and whether the wife can go out without the permission of the husband. Based on this set of questions, we construct a direct multidimensional measure via Multiple Correspondence Analysis (MCA) by using the Burt matrix approach on four categorical variables describing who made the decision (the woman alone, her husband alone or both spouses). More specifically, MCA indicated that questions concerning the labour market status and the health of the respondent, visits to the respondent's relatives, and the ability to leave the house without permission (Q1, Q4, Q10 and Q11) best captured common features across these questions. Indeed, this may be explained by the fact that the bargaining power of the respondent would be very low if she cannot decide on outcomes that directly affect her well-being.

Weights and contribution of the different variables included in the MCA are presented in Appendix 2. The constructed summary variable *Multidim_wom* provides our base indicator of women empowerment, although we also experiment with other indicators in order to check the robustness of the results.

3.5. Child Characteristics (*I*)

In Sub-Saharan African countries it has been found that young boys are more likely to suffer from malnutrition than young girls (Svedberg, 1990; Henry Wamani, Astrom, Peterson, Tumwine, & Tylleskar, 2007) while the opposite is found in Asia because of the high discrimination against girls (Monica Das Gupta, 1987), and we thus include a gender dummy in our analysis. We also control for child's age. Child rank or birth order has also been discovered to affect child health in that it can determine the amount of resources allocated relative to siblings (Gupta, 1990). However, since children with a high rank necessarily belong to larger households, one needs to purge family size effects from any measure of birth order. The method employed here to determine the relative rank of child among siblings follows Booth and Kee (2009) and consists of dividing the birth order by the average birth order. Importantly the consideration of gender in addition to the birth order effect can bring additional information on parental preferences. For instance, Pande (2003) showed that in India the preference for sons explains

why girls born after multiple daughters are more likely to be severely undernourished and less immunized, while boys who were born after multiple daughters have significantly better health outcomes. To control for the gender of siblings, we thus include the number of brothers and sisters. Since the number of brothers and sisters is added at the child level, the number of other individuals in the household also needs to be included in order to take account of total household size. One might also expect that children who are not children of the head of household will receive fewer resources, so a binary variable is included to control for this. Finally, we also control for the health insurance status of the children. This variable is not a choice variable since 89% of the children who have a health insurance are covered by a compulsory scheme because one of their parents is working in the formal sector.

3.6. Household and Parental Characteristics (*P*)

In terms of household characteristics, given its well established relationship with child nutrition, income is captured through the logarithm of monthly total household expenditure in adult equivalents. Since the method to collect expenditure data may affect the expenditure level (Beegle, De Weerd, Friedman, & Gibson, 2011), one has to consider several elements when computing expenditure index. Firstly, concerning the recall period, the index was computed by using a one-month recall period since we assume that memory lapse is more likely to be an issue than telescoping bias. Secondly, concerning the item included in the expenditure index we followed the recommendations of Deaton and Zaidi (1999) who suggest to exclude lumpy expenditure that do not contribute to household wealth and to consider consumption in reference to a “usual month” recall. Since farming households were self-employed, consumption expenditure also includes the value of self-consumed food. Regarding non-food items, the index includes the amount spent on clothing, transports, communication, energy and education as well as remittances. Finally, the expenditure index was deflated by the household size and household composition (Deaton & Zaidi, 1999). The relative cost of a child relative to that of an adult was set at 0.3 and the extent of economies of scale at 0.8.^{vi}

Rather than using a socio economic index that may capture both income and housing quality simultaneously, we instead control for income and housing quality directly. We use a summary variable *Housing* for the latter as created by using a factor analysis based on household characteristics (access to electricity, the type of facilities and the type of energy used for cooking). One may want to note that the correlation between the income and housing variable is low (coefficient correlation=-0.06), so the two variables are likely to capture different things and can be included together. In order to control for the preference for health of the household, the percentage of monthly health expenditure in total monthly expenditure is also added as a control. We expect that children in households who allocate a higher proportion of their budget towards health will be more likely to have a greater MUAC for age z-score.

In terms of parental characteristics, spouses' age, spouses' education and the rank of the mother among other wives are likely to matter. More specifically, spouses' age can positively influence health status as experience and information may be lacking among youngest parents. But the effect of age on malnutrition may also depend on the assumption that parents may rely on their children for old age support and we do not know if younger or older parents may have a stronger utility in relying on their children for old age support.

The effect of parent's education is also undetermined a priori. In some papers, women's education is found to affect positively child nutrition through the use of preventive and curative modern health care (Glewwe, 1999) and the better use of information received by reading newspapers, listening to a radio or watching TV (Thomas, Strauss, & Henriques, 1991). Nevertheless, since education is also a proxy of the socio-economic status and geographical location of the household, it is hard to conclude that there is a causality link between educational attainment and child health (Desai & Alva, 1998). Indeed, economic improvement associated with education, such as the use of drinkable water, latrine facility and housing quality, affects child health. There could also be a heterogeneous effect of parent's education on child nutrition depending on the child's sex (Thomas, 1994). To capture educational attainment of the mother and father, we include a categorical variable of their ability to write a letter.

In the area of the survey divorce and separation are extremely rare, i.e., only 1% of the sample is divorced or separated. In contrast, polygamy is fairly common, where 32% of married women are in a polygamous union in our data. As a matter of fact, Senegal has the second highest rate of polygamy in Western Africa after Guinea (Daltony & Leung, 2011) and most polygamous males follow the Islamic and legal rules that limit the number of wives to four. It is suspected that resources might be scarcer when the child lives under a polygamous union, although it is not clear in the literature if they do better than those under monogamous unions. For instance, Gibson and Mace (2007) found in Southern Ethiopia that children of the first wives in polygamous unions have a better nutritional status than those in monogamous unions and explain this by the possibility that older wives may benefit from polygamy by “exploiting junior co-wives or experiencing a long period of monogamy with a high status male, consequently maximize both offspring quality and quantity”. Amankwaa (1996, 2001) also found that polygamy enhanced child survivorship through longer breastfeeding patterns, inter-birth interval, and co-wives’ cooperation. In contrast, in Ghana Giymah (2003) discovered that children in polygamous unions were more likely to have diarrhoea than their monogamous counterparts. Strassman (1997) found among Dogon in Mali that the odds of childhood deaths were 7-11 times higher in groups with polygamy and suggests that this may be due to lower paternal investment towards each child when the number of children increases. Similar conclusions were found by Giymah (2009), Gage (1997), Ntozi and Nakanabi (1997) and Brhambhatt et al. (2002).

The effect of a wife’s rank on child outcome also remains inconclusive in the literature. With regard to the context of polygamous unions, some studies claim that there is equality in treatment between wives (Mulder, 1989), while others found that senior wives receive higher contributions than junior wives (Gibson & Mace, 2007; Munro, Kebede, Tarazona-Gomez, & Verschoor, 2010). In Senegal, first wives and last wives have specific roles in the household. First wives are recognized to have a higher social status than other wives, where their role is to serve as an example to other wives. Although there is a difference in status and role between first and other wives, there should not be any difference in treatment in Muslim societies. Nonetheless, we want to allow for the possibility that, first, children under polygamous unions are treated differently

than children under monogamous unions and, second, if under polygamous unions they are treated differently depending on their mother's rank. In the sample, only 2 children are the children of a middle wife, which is due to the fact that the percentage of children under-5 who have a father married to three wives is very low. Since the middle and last wives both joined a polygamous union, the middle wives' children are considered as last wives' children. The variable *Rank of the wife* is coded 0 for children whose mother is in a monogamous union (reference category), 1 for children whose mother entered a monogamous marriage but became a first wife when her spouse remarried an additional wife, and 2 for children whose mother is the last wife. There are nevertheless 9% of the children who cannot enter in any of the previous categories since they belong to households whose male head has no wife, either because the head is a woman or because the children are not the children of the head.^{vii} For this reason, the variable rank of the wife will be coded -1 for such children.^{viii} The rank of the wife is entered at the child level, where in our sample 9 % of the children have a mother who is the first wife and 13% are the children of the last wife. Finally, 69% of the children live under a monogamous union. To control for the fact that women might be more autonomous when the husband does not live in the household; the sex of the household head was also added as a control variable.

3.7. Extra-household Environmental Factors, Community Characteristics, Household Efficiency, and Prices (E, S, Ω, p)

In order to control for extra-household environmental factors and community characteristics we include a set of 16 community dummies controlling for extra-household environmental factors that vary across communities. For relevant prices, such as the price of food and medical services, we assume, which seems reasonable given that all our surveyed community lie within the same region that these are homogenous and are captured by the constant. Finally, we make the assumption that household efficiency does also not differ across households in our survey so that this is similarly captured by the intercept.^{ix}

3.8. Final Sample

The dataset consists of information on 742 children aged between 91 and 1856 days.^x Among these 641 were measured, where the loss is commonly due to an error from the interviewer. More precisely, only rarely were there missing cases due to the absence of the mother's consent to measure her children either because she refused, she was absent, or the absence of the child the day of the interview. Among the 641 children, 591 were matched to their mother, where missing values are due to the absence of the mother either because the mother was dead or because the child was not the child of the head of household (e.g., foster children). Finally, of the remaining sample the mother's bargaining power information was non-missing for 578 children. Descriptive statistics of our variables are provided in Table 1. Descriptive statistics indicate that on average in the sample, children have a MUAC z-score of 0.09 standard deviations, 18% are mildly wasted (z-score<-1) and 4% are moderately wasted (z-score<-2). The minimum z-score is -5.6 standard deviations and the maximum +4 standard deviations.

Insert Table 1

4. ESTIMATION

4.1. Empirical model

Following equation (4), child health is assumed to depend on:

$$H_{ijkl}^* = \beta_0 + \beta_1 \varphi_{jkl} + \beta_2 P_{jkl} + \beta_3 I_{ijkl} + \beta_4 V_l + e_{ijkl} \quad (5)$$

where H is the nutritional status of child i of woman j in family k in community l measured by the MUAC z-score. φ is a measure of the endogenous bargaining power of the mother, P is a vector of parental and household's characteristics, I is a vector of child's characteristics, V is a set of dummy variables meant to capture community characteristics, β_0 is a constant across all observations capturing, amongst other common factors, prices, household efficiency, and e is a standard error term. The error term is assumed to be uncorrelated with all regressors except φ ,

which leads to an inconsistent estimator of β_l . For instance, a high women's bargaining power could be associated with a positive health context for the child if mothers with better intrinsic characteristics are found to be more powerful. In this case there will be a positive bias in the estimated β_l and regression estimates will overstate the positive effect of women's bargaining power on child nutrition. On the contrary, if it is assumed that 'neglected wives' are more autonomous, a high bargaining power would be associated with a negative context for child nutrition and regression estimates will underestimate the positive effect of women's bargaining power on child nutrition.

To obtain a consistent estimator, we assume the existence of an Instrumental Variable (IV) z_l that satisfies the assumption that $E(\varepsilon_{ijkl} | z_{ikl}) = 0$ and $E(\varphi_{jkl} | z_{ikl}) \neq 0$. Thus the instrument z needs to be strongly correlated with female bargaining power, but uncorrelated with other unobservable factors captured in the child health error term. Our construction of a plausible instrumental variable relates to the role of ethnicity of the mother of the child in terms of her bargaining power. More specifically, different ethnic groups may have different social norms that will influence threat points in intra-household bargaining (McElroy, 1990). For example, women from different ethnic groups of Burkina Faso are found to have different labour allocations and to receive different resources for health from their spouse depending on their bargaining power (Kevane & Wydick, 2001; Nikiéma, Haddad, & Potvin, 2008). In the Senegalese context we take advantage of the fact that generally Tukolor Fula women are less autonomous than Wolof women because of historical reasons. That is, Wolof women have always played an important political role since their society relies on a matrilineal political system, and this dates back to the pre-colonial period (Diouf, 1990). In contrast, Fula societies, which were Islamized before Wolof, have been characterized by a patrilineal political system in which women do not play any role (Sylla, 2001). As highlighted in the Ethnographic Atlas of Murdock (1967), in contrast to the Wolof, Tukolor Fula do not have any matrilineal kin group as they always belong to the father's lineage.

In this regard, however, when one regresses the variable ethnicity (Fula) coded 1 if the mother of the child is Fula and 0 if she is Wolof on women's bargaining power, as captured by our proxy variable, although the sign is negative as expected, it is not statistically significant – see the first column in Table 2.^{xi} However, as soon as we control for whether the woman lives in a community where her ethnicity is minority in the second column of Table 2, the ethnicity variable becomes significantly negative. This is due to the fact that it is not the ethnicity per se that matters for female empowerment, but the context in which this ethnicity is placed. More precisely, Fula households are more likely to live in a different ethnic community (10% among Fula live in a Wolof community while only 1% of Wolof live in a Fula community) and Fula women living in a Wolof community are found to have the strongest bargaining power among the women of the data set, as confirmed by simple t-tests. One could wonder about the reason why Fula women who live in Wolof communities have a greater bargaining power than their Wolof counterparts. Such finding is, for example, not explained by religious reasons since Wolof and Fula households belong to the same Muslim brotherhood (Tijaniyyah). Rather we think that, Fula living in a Wolof community are less exposed to social norms of the community and thus these Fula women are less likely to receive social penalties for failing to conform to the norms in the community than Wolof women.

To capture the effect of ethnicity on empowerment conditional on the ethnicity in the community of residence, we constructed a variable *Relative_ethnicity*,^{xii} which takes the value of 1 if the mother is Fula and lives in a Wolof village, which is the reference category (5.2% of children are in this category), of 2 if the mother is Wolof and lives in a Wolof village (60.4%), and of 3 if the mother is Fula and lives in a Fula village (34.4%). The 1% of Wolof who lives in a Fula neighbourhood is included in the last category since we make the assumption that the ethnicity of the community has more effect on woman's relative status than the ethnicity of the household. Note that because inter-ethnic marriage is not common and concerns only two households in the sample, the ethnicity of the woman is the same as household ethnicity. As can be seen from Table 2, this variable is a significant predictor of women's bargaining power and takes on the expected negative sign.

Insert Table 2

It is important to state the underlying identifying assumption of using *Relative_ethnicity* as instrument z_i . More specifically, the identifying assumption is that there are no other factors correlated with our variable that we will not control for but are correlated with child health. Given the nature of our variable, this would refer to other factors that are correlated with the decision to migrate as well as with the ethnicity of women, but for convenience sake we discuss these two factors separately.

One could argue that there might be a selection bias among the households who live in a different ethnic area, particularly if the household is a first-generation migrant. More specifically, it seems reasonable to think that households who migrate within rural areas may have different observable and unobservable characteristics that can also directly affect child nutritional status. In the literature, it appears that rural migrations are mostly explained by marital reasons and that “among farm households with equal endowments of wealth, those afflicted with more variable profits from cultivation are more likely to initiate arrangement conducive to income risk pooling that encompass greater distances, via both temporary migrants and longer-distance migration associated with marriage.” (Rosenzweig & Stark, 1989). For this reason, we further questioned Fula households who are currently living in Wolof rural communities about the time and the reason of their migration. The most important finding was that migration has not occurred recently. Indeed, Fula households surveyed had been in Wolof communities already for a long time, since their nomad descendants, coming from North Africa, decided to settle in Wolof areas in order to conduct agricultural work centuries ago. In this regard one may also want to note that our data set only covers farming households who own agricultural land and belong to a farmer organization. Although in theory, land use rights in Senegal are attributed by local land committees and thus cannot be sold or bequeathed (Caverivière, 1986), Lambert et al. (2011) have found that among a national representative sample of Senegalese, 48% of them reported that land was inherited and 71% among the sample whose father has died. Thus, one can be fairly confident that Fula households have inherited their lands many generations ago. It is then

unlikely that the Fula within our sample who live in Wolof communities have migrated any time recently and that we therefore need to worry about unobservable factors that affected their migration and current child nutritional status.

One may also want to note that ethnicity per se could of course be questioned as an identifying factor if, for instance, ethnic background affects anthropometric indicators through genetic predispositions. One should note that this question has been widely discussed in the literature, notably in order to know if the reference standards drawn from a sample of well nourished white children from developed countries could be applicable to children from developing countries. The famous paper of Habicht et al. (1974) brought evidence that the difference of growth of preschool children of different ethnicities were determined mostly by environmental rather than genetic factors.

We also ran a number of supplementary regressions to provide some evidence for the absence of a direct relationship between child malnutrition and the instrument. More specifically we analysed the effect of the instrument on the main nutrition status determinants according to the UNICEF i.e. on health environment, food security, and quality of caring.

Concerning the health environment, ethnicity could also directly affect child nutritional status through a cultural belief system regarding infant feeding. Indeed food taboos, maternal attitude, and the recognition of a special diet for children can vary depending on the ethnicity and have a direct effect on child nutritional status and some evidences of this is present in the anthropology of health literature. In Zaria in Nigeria, for example, Jinadu (1986) finds that 83% of the mothers never give meat or fish to their children since they believe that rich protein aliments cause intestinal worm and stomach pains, while 70% think that giving eggs to a child would make the child steal. In a poor area of Mali, Dettwyler (1986) found that when a child does not come to eat, the mother will never force him since she will consider he is not hungry. Mothers also believe that a child does not need to eat solid food before eight months. Opposite results were found in Togo where mothers use the practice of infant force-feeding, but this has a negative effect on

child health. Among Ibo and Ewe ethnicities, children will probably have a better nutritional status, *ceteris paribus*, since they have special food for infant that is known to be high-protein content (Cantrelle & Locoh, 1990). To the best of our knowledge there are no food taboos that could differ depending on the relative ethnicity, i.e., that may vary between ethnicities and rural communities. Murdock (1967) also highlighted that there was no anthropological differences concerning male genital mutilations between Wolof and Tukolor Fula. Male genital mutilation has a direct effect on infant health as circumcision is found to reduce urinary tract infections but is also found to be a source of infection (Singh-Grewal, Macdessi, & Craig, 2005). In order to further investigate the effect of the instrument on the health environment, we also looked at the effect of the instrument on the likelihood of being sick the month prior to the survey assuming that the health environment has an impact on the disease frequency. In the sample, 36% of the children had an illness the month prior to the survey, however once one controls for the district specific effects the *Relative_ethnicity* variable was not statistically significant. We also looked at the effect of the instrument on the access to drinking water, and after controlling for socio-economic characteristics and district fixed effects, the instrument was also not found to be a good predictor of the quality of water used for drinking.

In order to test for a difference in diet and food security, several high and low protein food expenditures^{xiii} were regressed on a set of socio-economic determinants (household size, non-food expenditure amount and self-consumption expenditure amount), district dummies and on the instrument *Relative_ethnicity*. Results showed that the instrument was not significant in explaining most of food expenditures, which suggests that the Fula living in Wolof areas and Fula and Wolof living in their area do not spend different amounts of money on several food expenditures after accounting for household size. Thus, the quantity of food consumed may be similar among the households. We also analysed the effect of the instrument on the proportion of specific food expenditures in total food expenditures in order to test its effect on dietary quality. Following the food pyramid of the U.S. Department of Agriculture, we created the share of food recommended for frequent consumption (fresh fruits and vegetables), food not

recommended for frequent consumption (fats and oils, desserts, sugar) and other foods (grain, meat, dairy, fish). While controlling, for household size, income and location dummies the instrument was not found to be a predictor of these different categories of food.

Concerning the effect of the instrument on the quality of caring, we analysed the likelihood of seeking treatment from a qualified provider during the last illness by including the variables presented in Table 1 as well as variables measuring supply side aspect such as the accessibility of health facilities and prices and quality of medical services offered in the closest primary health care facility. Results indicated that the instrument was not a significant predictor of the likelihood of visiting a qualified health worker during the last illness. We also investigated the effect of the instrument on several health inputs that had a good variability in the sample. We found that the instrument was neither a significant predictor of the likelihood of being immunized against DCT nor of the likelihood of receiving assistance from a qualified health worker during delivery nor of the likelihood of delivering at home.

Finally, the nutritional status was regressed on the endogenous bargaining power measures and its instrument. Similarly, the relative ethnicity is not found to be a direct determinant of malnutrition, but affects malnutrition through bargaining power, since it is not significant in explaining child nutrition and as well as because the coefficient of the bargaining power variable is lower once the instrument is added as a control. Thus, there is little reason to believe that the distribution of well nourished under-5 children is directly affected by the relative ethnicity variable. Consequently, after controlling for environmental factors, there should not be any effect of the relative ethnicity on the anthropometric indicator.

4.2. Results

In terms of estimating the effect of women's bargaining power in child nutrition, one should note that mothers have several children on average, so that, since estimates are conducted at the child

level, the error term might not be independently and identically distributed. We thus calculate standard errors that are clustered by mother in order to obtain a cluster-robust covariance matrix estimator.

Insert Table 3

Column (1) of Table 3 first presents the determinants of malnutrition without controlling for the endogeneity of woman bargaining power using Ordinary Least Squared (OLS). As can be seen, a unit increase in our female empowerment proxy, *Multidim_wom*, increases child nutrition, as measured by the MUAC z-score, by 0.24 standard deviations. Note that in column (3), once we use the two-stage least squares (2SLS)^{xiv} to instrument for the potential endogeneity of this variable using our instrument *Relative_ethnicity*, the estimated impact more than triples, rising to 0.81 for each unit increase in bargaining power. This suggests that not controlling for endogeneity of female empowerment tends to under-estimate its effect on child nutrition. In other words, in rural Senegal women with a high bargaining power are more likely to live in a worse environment for child nutrition. The most plausible explanation for this is that less attention by husband is associated with more powerful mothers, but that these receive fewer resources from their partner. Our results on the effect of female bargaining power on child nutrition rest of course on the validity of the instrument. In this regard one may first note that the F-statistic in the first-stage is big enough to pass the weak instrument test ($F= 13.7$, $p\text{-value}=0.00$) and thus suggests that our instrument has considerable predictive power of the endogenous variable.

Although not the main focus of our study, the results of our estimation also highlight other characteristics that are important determinants of the nutritional status. More specifically, malnutrition increases with child age, where an additional year decreases the MUAC z-score by around 0.17 standard deviations. Girls have a greater MUAC z-score than boys by 0.2 standard deviations. Child's rank and the number of brothers have no effect on malnutrition, while the

number of sisters is positively correlated with the MUAC. One plausible explanation is that girls usually take care of their younger siblings. For instance, if older sisters allocate time to their younger brothers they will be more able to satisfy child's needs.^{xv} Income measured by total monthly expenditure is a strong determinant of a child nutritional status, where an increase of one point in the logarithm improves the MUAC z-score by 0.37 points. Since expenditure could be endogenous, the asset index was used as a proxy for permanent income. The weights used to construct the indicator are derived from the first dimension of MCA and includes the assets owned by the household (fridge, air conditioner, fan, radio, TV, vehicle). The use of the asset index did not alter the results as we find that an increase in one standard deviation in the asset index increases the MUAC z-score by 0.14 standard deviations (p-value<0.05) under IV and the effect of one standard deviation in the bargaining power index increases the MUAC z-score by 0.79 standard deviations.

We also experimented with employing other measures of women's bargaining power with *Relative_ethnicity* as instrument. More specifically, we employed a categorical measure of women's bargaining power that gives information on who is the decision maker concerning child health, where this binary variable is coded 1 if the mother is involved in the decision process concerning child health, i.e., either because she decides alone or she decides with her husband, or zero otherwise. OLS results with this proxy indicated that when the mother is involved in the decision making, the MUAC Z-score increases by 0.41 standard deviations. However, unfortunately *Relative_ethnicity* was not sufficiently correlated to this binary variable (F-stat=0) to serve as a valid predictor of it in the first stage. We then analysed the effect on child nutrition of several other multidimensional measures of women's bargaining power. For example, one measure used was based on the women's decision-making power on expenditure *Multidim_exp*, while another captured the power to make decisions concerning child schooling and child health *Multidim_child* and a last measure *Multidim* included all the variables presented in Appendix 1. Again, although the coefficients based on OLS regression were similar to the one found with the proxy of women's bargaining power of choice, ($\beta_1=0.27$, P<0.01; $\beta_1=0.18$, P<0.01 and $\beta_1=0.23$, P<0.01

respectively), the instrument did not have enough predictive power with these measures (F-stat= 3.7 and F-stat= 0.7 and F-stat= 0.9 respectively).

To allow for non-linearity in the bargain power child ill health trade-off we also employed IV and non-IV quantile regression methods, where the estimated effect can be measured along the distribution of the MUAC values. We depict the estimated coefficients and their 5% confidence bands along the 18th until the 89th quantiles of the distribution of the MUAC in Figure 2 and Figure 3.^{xvi} Under OLS, the impact of bargaining power is stronger for children with a greater MUAC z-score. Under IV, the graphs indicate that the effect of bargaining power, when significant, is greater for all the children, no matter what their MUAC level. Perhaps more importantly, there appears to be a greater bargaining enhancing effect for the children with extreme MUAC z-scores. After correcting for endogeneity, the downward bias is found to be the greatest for the children with a low MUAC z-score.

Insert Figure 2 and Figure 3

4.3. Robustness Checks

Instead of using our ordered variable as instrumental variable, we alternatively tried decomposing it into a dummy for the ethnicity; a dummy if the ethnicity is minority in the community and their interaction and then utilizing them jointly as instrumental variables. Although the significance on these instrumental variables in the first stage was found to be somewhat weaker, they were still highly statistically significant (F-stat=6). Moreover, having several instruments allows us to run a test for overidentification (P-value=0.33), which provided further support for the validity of our instrumental variable approach. The resultant estimated coefficient on (instrumented) bargaining power proxy in the second stage was found to be very close (0.82) to the one where we used the ordered variable as instrument and similarly was statistically significant at the five per cent level.^{xvii}

Following Duflo and Udry (2004), we also used climatic shocks (rain and evapotranspiration shocks occurring the year before the survey in reference to the 10 years period average and their

interaction term) as instruments for bargaining power. In the sample the shocks had an effect on the likelihood for women of working in household fields and different effects on the productivity of women's and men's fields. Because of the low variability in evapotranspiration in the area, the district dummies were replaced by several variables capturing the characteristics of the community.^{xviii} We also controlled for the agricultural revenue of the household to take into account the fact that a climatic shocks could affect nutrition through food availability. By doing so, we found that an increase in one standard deviation in the woman's bargaining power increases the MUAC z-score by 0.5 and 0.86 standard deviations when bargaining power was measured by the variables *Multidim_wom* and the largest multidimensional indicator *Multidim* that includes all the variables presented in Appendix 1 in the MCA. The F-stats were 12 and 5 respectively and the overidentification test p-values were 0.14 and 0.31.

The analysis was also conducted for only the sub-sample of women whose husband was absent during the interview. On average, it was found that the presence of the husband increases the average women's power. In the sample, the average of women's power was -0.05 but it was only -0.14 in the sample of women whose husband did not attend the interview. The coefficient of woman's bargaining power was stronger when the analysis only focused on the 439 women whose husband was absent during the interview, as an increase in one standard deviation in the woman's power index was shown to increase the MUAC z-score by 0.96 standard deviations (F-stat=25). However, it should be noted that there might be a selection bias in that the presence of the husband at the woman's interview may not have been random.

5. CONCLUDING REMARKS

We investigated whether mother's bargaining power prevents children from being malnourished using data on a rural Senegalese region. To estimate this, we employ an instrumental variable strategy, which corrects for the potential endogeneity of mother's bargaining power. Although, in the literature it is generally assumed that unobservable characteristics of the mother will tend to over-estimate the coefficient of mother's bargaining power, our results indicate that the coefficient is downward biased under standard OLS, especially for children with a low MUAC z-

score. A possible reason for the downward bias is that in Senegal a high mother's bargaining power may be because the father does not invest a lot in his wife and her children, resulting in an unfavourable context for child health. This finding relies on the assumption that spouses' parenting ability is not observed by the researcher and is negatively correlated with mother's bargaining power and positively correlated with child MUAC z-score.

The findings presented in this paper corroborate those of previous studies where women's bargaining power is discovered to be a strong determinant of child nutrition. However, the finding that more women's power is associated with a worse environment for child nutrition is counterintuitive and probably due to social norms in Senegal. Indeed, this result may not be relevant to different settings, especially where a high woman's decision power is widely accepted by society. The estimated impact presented here may also vary in other settings and may depend on the measure of women's empowerment.

Although our results are robust to the use of different measures of bargaining power and instruments, our paper suffers from several limitations. A main limitation is that our data set only included information on the MUAC so it was not possible to test if women's bargaining power also has an effect on stunting and other measures of wasting. The paper also did not address how a change in woman's bargaining power over time affects child malnutrition. Indeed, an explicit investigation of the main determinants of a change in bargaining power in a society as well as their effect on child outcomes would be of a particular interest.

Future studies could undertake similar analysis in different settings in order to see if the downward bias is confirmed in low-income countries. It would also be very useful to test the coherence of the results under different measures of bargaining power using an identical instrumental variable strategy or any other appropriate method to correct for the endogeneity of women's bargaining power. Finally, as stated before, the effect of women's bargaining power on several nutrition and health outcomes could be explored in future works.

Our results have several implications. Firstly, results indicate that women's bargaining power is an important determinant of child nutrition and policies that aim to increase women's power

such as microfinance projects could appear to be very effective as they will not only increase the well-being of women but will also generate positive externalities towards children, especially towards the most vulnerable ones. However, the finding that high women's power is currently associated with a negative context of child health supports the idea that high woman's power is currently looked down upon in Senegalese society. Thus, policies aiming to increase women's bargaining power should point at a change in social norms. Finally, since women's power is assumed to affect child health through health inputs, arguably efforts should still be deployed on policies aiming to prevent and cure severe nutrition, so the increase in women's power as a strategy to fight child malnutrition should not take the place of nutrition policies but rather should be seen as complementary.

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Table 1: Descriptive statistics on sample of children with non-missing information on malnutrition and matched to their mother

Variables	Obs.	Mean and proportion	Standard deviation	Min	Max
MUAC z-score	578	0.090135	1.272959	-5.66075	4.047722
Women's bargaining power	578	-0.12701	0.979	-1.499	1.687
Child's age (in years)	578	2.535569	1.386086	0.25	5.193703
Child's sex (reference: boys)	578	0.480969	0.500071	0	1
Son of head of household (HH)	578	0.648789	0.477762	0	1
Relative rank of the child among siblings	578	1.340325	0.323801	0.4	1.8
Number of brothers	578	1.951557	1.454476	0	7
Number of sisters	578	1.816609	1.315526	0	6
Health insurance status	575	0.064348	0.245585	0	1
Number of other individuals	578	7.204152	4.098846	2	17
Sex of HH (reference: male)	578	0.069204	0.254021	0	1
Mother rank=-1 (Reference: Monogamy)	578	0.095156	0.293684	0	1
Mother rank=1 (First wife)	578	0.086505	0.281352	0	1
Mother rank =2 (Last wife)	578	0.124568	0.330514	0	1
Mother's age (in years)	578	32.02595	7.286964	16	51
Mother's literacy	578	0.249135	0.432887	0	1
Father's age (in years)	578	49.61543	12.63798	24	87
Father's literacy	577	0.246101	0.431112	0	1
Share health in expenditure	576	0.065042	0.085617	0	0.75
Log of total expenditure	578	4.301578	0.435574	3.063406	5.823236
Housing quality	578	0.087848	0.961121	-5.32172	2.936613

Table 2: Association between women's bargaining power and the instrument controlling for other determinants (n=446)

VARIABLES	(1)	(2)	(3)
Ethnicity (Fula=1, Wolof=0)	0.068 (0.255)	-0.419* (0.228)	
Ethnicity is minority in the community		0.788*** (0.257)	
Fula_minority			-0.406* (0.1226)
R-squared	0.237	0.252	0.249

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

Table 3: Determinants of child nutrition

VARIABLES	OLS		OLS		2SLS		2SLS	
	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
Multidim_wom	0.237***	0.065	0.216***	0.064	0.806**	0.341		
Child's age (in years)	-0.161***	0.043	-0.153***	0.044	-0.167***	0.047	0.023	0.033
Child's sex (ref: boys)	0.220**	0.112	0.229**	0.114	0.204*	0.123	0.042	0.081
Child of head	0.243	0.242	0.243	0.243	0.065	0.309	0.302	0.218
Health insurance	0.068	0.232	-0.009	0.237	0.355	0.313	-0.618**	0.281
Relative rank of the child among siblings	0.070	0.217	0.109	0.219	0.033	0.233	0.129	0.170
Number of brothers	0.056	0.053	0.055	0.053	0.051	0.057	0.006	0.049
Number of sisters	0.095*	0.056	0.094*	0.057	0.113*	0.064	-0.031	0.052
Number of other individuals	0.021	0.020	0.024	0.020	0.018	0.022	0.009	0.019
Gender of HH (ref: male)	-0.262	0.414	-0.288	0.414	-0.277	0.510	-0.019	0.317
Rank wife=-1 (ref: monogamy)	0.546	0.363	0.589	0.362	0.378	0.414	0.358	0.253
First wife (ref: monogamy)	-0.029	0.239	-0.095	0.231	0.060	0.260	-0.263	0.188
Last wife (ref: monogamy)	-0.385*	0.217	-0.417*	0.213	-0.253	0.243	-0.278	0.178
Age of mother (in years)	-0.012	0.012	-0.010	0.012	-0.014	0.012	0.006	0.009
Mother literacy (ref: illiterate)	0.172	0.148	0.158	0.148	0.112	0.161	0.078	0.112
Age of father (in years)	0.012*	0.006	0.013**	0.006	0.008	0.007	0.008	0.005
Father literacy (ref: illiterate)	-0.119	0.150	-0.108	0.150	-0.045	0.164	-0.107	0.123
Log of expenditure	0.409***	0.129	0.415***	0.136	0.369**	0.155	0.078	0.142
Share health in expenditure	1.748**	0.779	1.749**	0.797	1.068	0.922	1.156**	0.487
Housing quality	0.052	0.076	0.064	0.078	0.015	0.077	0.083	0.072
Relative_ethnicity (ref: Fula mother in Wolof community)			-0.350	0.214			-0.594***	0.164
Observations	572		565		565		565	
R ²	0.18		0.18		0.04		0.28	
F-test of instrument in first stage								13.15***

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

Figure 1: Decision-power within the household (n=837 married women)

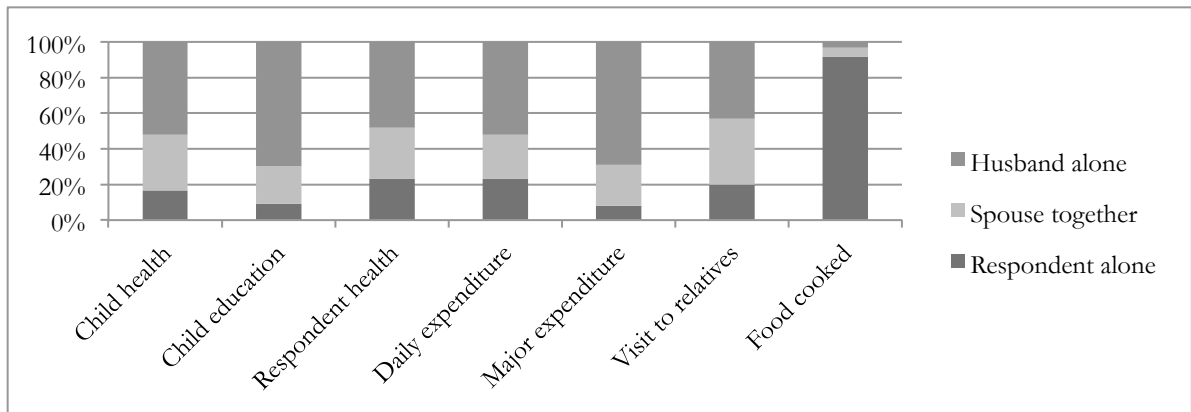


Figure 2: Non-IV Quantile regression estimates

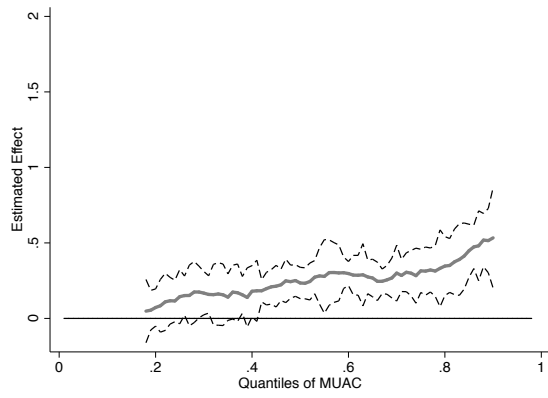
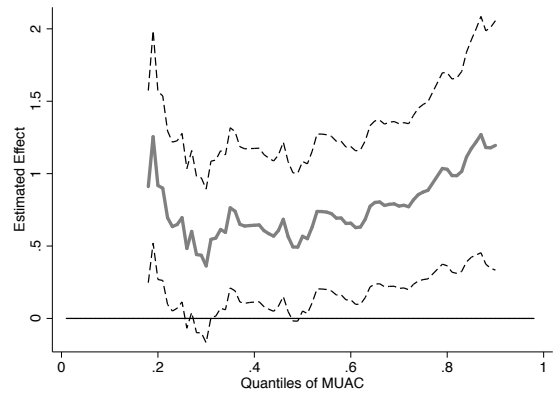


Figure 2: IV Quantile regression estimates



Appendix 1: Woman's power section in the survey questionnaire

The section includes 11 questions that were asked to the female married respondents and one question that was filled by the interviewer.

	Dimension	Question	Code
Respondent	Economic	Q1. Have you worked during the last 12 months?	1:Yes, 0:No
		Q2. How much does your income make up in total household income?	1:Nothing, 2:Less than half, 3:Half, 4:more than half
		Q3. What is the share of total household expenditures that you control?	1:Nothing, 2:Less than half, 3:Half, 4:more than half
	Decision-power	Q4. Who takes decisions concerning your health?	1:The respondent, 2:both spouses, 3: husband, 4:another person
		Q5. Who takes decisions concerning the health of children?	1:The respondent, 2:both spouses, 3: husband, 4:another person
		Q6. Who takes decisions concerning the schooling of children?	1:The respondent, 2:both spouses, 3: husband, 4:another person
		Q7. Who takes decisions concerning the daily expenditures?	1:The respondent, 2:both spouses, 3: husband, 4:another person
		Q8. Who takes decisions concerning the large expenditures of the household?	1:The respondent, 2:both spouses, 3: husband, 4:another person
		Q9. Who takes decisions concerning the food cooked every day?	1:The respondent, 2:both spouses, 3: husband, 4:another person
		Q10. Who takes the decisions concerning the visit to your relative?	1:The respondent, 2:both spouses, 3: husband, 4:another person
	Mobility	Q11. Can you go out without the permission of your husband?	1: Yes, 2: depends where I go, 3:No
Interviewer	Q12. How did the husband react during the interview?	1: husband was absent, 2: husband said nothing, 3: husband said something quietly, 4: husband said something violently, 5: husband answered for his wife	

Appendix 2: Construction of women's bargaining power: Multiple correspondence analysis (n=758)

Categories	Weight	Contribution to index
<u>Have you worked during the last 12 months?</u>		
No	-0.621	0.03
Yes	0.281	0.014
<u>Who takes decision on woman's health?</u>		
Respondent alone	1.514	0.129
Respondent and husband	0.61	0.028
Husband alone	-1.108	0.145
<u>Who takes decision concerning the visit of respondents' relatives?</u>		
Respondent alone	1.455	0.105
Respondent and husband	0.762	0.054
Husband alone	-1.132	0.188
<u>Does the respondent can go out without any permission?</u>		
Yes	1.456	0.052
It depends where she goes	0.979	0.099
No	-1.129	0.155
Percentage explained by dimension		72.71

Endnotes

ⁱ As a matter of fact, for many Senegalese women financial responsibility of the husband is a matter of honor, where financially independent women are often associated with sex-workers (Guerin, 2008; Pilon, Seidou Mama, and Tichit, 1997).

ⁱⁱ As households differ in size and demographic composition, equivalence scales are used to make comparable consumption indicators.

ⁱⁱⁱ The sample-size requirement was calculated in the framework of the impact study of the agro-sylvo-pastoral insurance scheme by following the methodology described in Duflo et al. (2007) to determine the Minimum Detectable size Effect (MDE).

^{iv} World Health Organization and National Centre for Health Statistics

$$v \quad zscore = \frac{((\frac{X}{M})^L - 1)}{SL}$$

where X is the MUAC of the child, M is the median of the distribution, L is skewness and S is the coefficient of variation.

vi We regressed monthly total expenditure over the number of adults and the number of kids and by dividing the two coefficients obtained we found that an adult costs about 3 times more than a child. Concerning the presence of economies of scale, we assumed very low economies of scale since households consume more private goods but not the absence of economies of scale since there might be some economies of scale in food preparation if larger households are more likely to have a more efficient cook or if they are more efficient at eliminating waste since they are more likely to own a fridge.

vii Among those children 60% have a mother who is the head of the household and is not married. For the rest of the children whose the head of the household is a male, they are not the children of the head, they are usually the children of a woman who live in the household but who is not the wife of the head, usually she is the sister of the head.

viii This variable is only weakly correlated with the presence of the father in the household (coefficient correlation=-0.36) or to the variable capturing the gender of the head (coefficient correlation =-0.34).

ix This could not be tested empirically.

x References curves of WHO are computed for children aged between 91 and 1856 days.

xi Estimates are conducted for women who have at least one child under-5. Standard errors clustered at the household level are presented in parentheses. Control variables include wife characteristics (age, literacy, health status, share of earned income, work status, farming worker), husband characteristics (age, literacy, health status, farming worker) household characteristics (land area, number of kids, polygamy) and 16 district dummies.

xii Note that 7 Moorish children are excluded from the total sample to simplify the construction and interpretation of the instrumental variable.

xiii Several estimates were run for rice, poultry, meat, fish cereal, dairy products, vegetable, fruit, sugar, oil expenditures.

xiv In the first stage, women's bargaining power is regressed over all exogenous variables and the instrument and predicted values are saved. In the second stage, the women's bargaining power variable is replaced by its predicted value of the first stage.

xv Estimates were also conducted by including the presence of younger and older brothers and sisters, but due to a lack of observations, the standard errors associated with the variable capturing the number of older sisters increases substantially, resulting in non-significance of the variable although the coefficient remains constant at 0.1 (coefficients of the variable number of younger sisters is lower at 0.07) which suggests that this explanation might be plausible.

xvi Unfortunately for quantiles lower than the 18th and greater than the 89th the maximum likelihood estimation for the IV model did not converge due to the small number of observations within these ranges.

xvii Detailed results are available from the authors.

xviii Variables include the distance to paved road, presence of electricity, quality of care in the closest primary health care facility, distance to the closest low-level and high-level provider.