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Does women's empowerment affect the health of children?

The case of Mozambique

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Abstract: In developing countries, women's decisions concerning their children's health depend on 'empowerment' concerning decision-making, husband/partner's use of violence, woman's attitude towards this violence, available information, and resources. We derive an empowerment indicator using the 'fuzzy sets' and Alkire and Foster approaches to multidimensional poverty measurement. The health of children is a latent variable; their height and weight are observed health indicators. We apply the 'MIMIC' approach to the 2009 Mozambique Demographic and Health Survey. Children's health is better when the woman opposes her partner's violence, the higher her education and body mass index, among female children, and in urban areas.

Keywords: Alkire and Foster, Demographic and Health Survey, fuzzy approach to poverty measurement, health, Mozambique, women's empowerment

JEL classification: D13, J16, O55

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1 Introduction

> The poor suffer worse health and die younger. They have higher than average child and maternal mortality, higher levels of disease, and more limited access to health care and social protection. And gender inequality disadvantages further the health of poor women and girls. (OECD and WHO 2003)

The report quoted above, which considered health as an asset, stressed the fact that when poor people become sick, they have no income and cannot afford the cost of health care. They are 'trapped' in a situation which leaves them forever as poor, because bad health prevents them from investing in education and, as a consequence, from improving their labour productivity. As emphasized by Krishna (2010: 17), 'thousands of households in every region studied have succumbed to poverty on account of a combination of ill-health, lack of access to qualified medical attention, and high health care costs. Thousands of other people continue to live only one illness away from poverty.'

Other studies have taken a more macroeconomic approach, stressing the impact on health outcomes of the health system and of socioeconomic factors. The effect of government health expenditure on health outcomes does not seem to be very strong, among other reasons because of weak governance (Kamiya 2010; Wagstaff and Claeson 2004). Other studies have stressed the role of the composition of government health spending (McGuire 2006) and the density of human resources for health (Anand et al. 2008), in particular physicians' density per capita. Thomas and Frankenberg (2002) argue that there is in fact a positive link between various health indicators and different dimensions of economic prosperity, but causality could run in both directions (Deaton 2003).

As far as the determinants of health and health inequalities of children are concerned, Flegg (1982) emphasized the impact of income inequality, the level of education of women, and the number of physicians and nurses per capita. Smith and Haddad (2000), in a cross-country analysis covering the 1970–95 period, stressed four underlying determinants of child malnutrition: health environments, women's education, women's relative status, and per capita food availability. For Marmot (2005), 'within countries, not only is child mortality highest among the poorest households but also there is a social gradient: the higher the socioeconomic level of the household, the lower the mortality rate'.

The present paper takes a closer look at the determinants of the health of children, with a focus on the potential impact of women's empowerment. We follow to some extent a recent study by Zereyesus et al. (2017), who wondered whether women's empowerment in agriculture mattered for the health status of children. While their study used data covering northern Ghana, we examine the 2009 Demographic and Health Survey (DHS) to analyse the determinants of children's health in Mozambique.[1] Like Zereyesus et al. (2017), we implement the Multiple Indicators Multiple Causes (MIMIC) approach, which assumes that the health of children is a non-observed latent variable influenced by various determinants. Such a link defines a 'structural equation', while two 'measurement equations' relate observed health variables, the z-values of the height by age and weight by age of children up to the age of five, to the latent children's health variable. Section 2

[1] For more details of the data used, see USAID (2009).

reviews the various aspects of women's empowerment while Section 3 briefly describes the data sources and variables and Section 4 the MIMIC model. Section 5 presents the empirical results of our analysis. Section 6 concludes.

2 On women's empowerment

Emphasizing the concept of women's empowerment implies first that women have an important role to play in development.

2.1 On women and development

The term 'women in development' (WID) appeared in the development literature in the early 1970s when some development specialists rejected the idea of a 'trickle down', with respect to poor people as well as women. Some (Razavi and Miller 1995) even argued that development led to a deterioration in women's position, as stressed by Boserup (1970) in her book on the role of women in economic development. She emphasized the role of women in the agricultural economy (e.g. in Africa), suggesting that there was a positive correlation between this role and the status of women vis-à-vis men. The introduction of new technologies and cash crops, however, pushed women into the subsistence sector so that they lost their income, status, and, as a consequence, power relative to men. This is why the WID school of thought recommended bringing women back into the productive sphere.

In the late 1970s, however, there was a shift from the notion of WID to that of 'gender and development' (GAD), with a new focus on gender-based divisions in productive and reproductive work, and gender differences in access to and control over income and resources. For Razavi and Miller (1995), GAD 'aims to highlight the key differences between the incentives and constraints under which men and women work; the insights gained from this analysis are then used for tailoring planned interventions (credit, education, training, etc.) in such a way as to improve overall productivity'.

Jackson (1996), however, challenged this view. While GAD stressed the poverty of women as the main justification for designing development policies that would improve the status of women, she argued that anti-poverty policies cannot be expected to improve the position of women: there is a need for a gender analysis going beyond material definitions of deprivation. For her, the subordination of women is not a consequence of poverty because non-poor women may also experience subordination, whether via domestic violence, personal insecurity, mortality risk, or more generally limited opportunities. The next sections discuss the various aspects of women's empowerment or of its absence.

2.2 Women's empowerment and gender norms

There is a link between the concept of women's empowerment and the notion of gender norms, defined by Pearse and Connell (2016) as rules of conduct for women and men, including rules governing interactions between women and men. Some studies consider that norms persist because as children grow up, they internalize their society's consensual rules of conduct and in

turn socialize the next generation into the norms.[2] Others (Livingstone and Luxton 1989) consider that changes in gender norms are possible, for example via labour migration or technological change.

Kabeer (2011) believes that norms may be changed. She defined women's empowerment as a multidimensional process of change. It covers many aspects of women's lives:

> their sense of self-worth and social identity, their willingness and ability to question their subordinate status in society, their capacity to exercise strategic control over their own lives and to negotiate better terms in their relationships with others, and finally their ability to participate on equal terms with men in reshaping society.

For Kabeer (2012), women attribute their past failure to struggle for their rights to their fear of the consequences of doing so and to the inconceivability of such a battle. Empowerment implies the possibility of choosing between alternatives. There are first- and second-order choices. The former are strategic life choices determining the way individuals live the lives they want (the choice of livelihood, whether and whom to marry, whether to have children, etc.). The latter are less consequential choices, such as decisions concerning large or daily purchases. This emphasis on choices reminds us of Sen's (1985) concept of capabilities and of the notion of agency, which refers to the ability to define one's goals, to make decisions, to bargain and negotiate.

2.3 Women's empowerment and intra-household bargaining and resource allocation

tarting in the early 1990s, several studies examined the impact of intra-household resource allocation on the outcome of development policy (see Behrman 1997, Haddad et al. 1997, and Strauss and Thomas 1995 for reviews). This literature did not adopt Becker's (1981) unitary model where members of a household pool their resources. Unitary models are a special case of co-operative collective model assuming identical preferences and pooled resources. Individuals can choose between remaining single or forming a household. The latter option will be chosen if the (net) advantages associated with being in a household are greater than those obtained when remaining single. Such a model does not take into account the diversity of real households (Bergmann 1995) and ignores the existence of power relations and exploitation within a household (Katz 1997). Policies based on such a model are hence doomed to fail (Haddad et al 1997).

To overcome this problem, 'collective models' (Chiappori 1988, 1992, 1997) have been proposed where household members have different preferences but the allocation of resources and time are still assumed to lead to Pareto-optimal outcomes. For Quisumbing (2003), 'in such a collective model nothing is assumed a priori about the nature of the decision process; that is, it does not directly address the question of how individual preferences lead to a collective choice'. There are two categories of collective model that emerge, one based on co-operative and the other on non-co-operative game theory.

[2] Such a view reminds us of Bourdieu's (2001) explanation of inequality, which focuses on the notion of habitus. For Bourdieu, an individual's level of education, his/her economic capital, the cultural capital he/she has, and the networks he/she may benefit from are at the origin of the 'habitus' of an individual. For Ashall (2004), the forms of capital mentioned by Bourdieu 'interact to structure not only people's life opportunities but also their modes of thought'. While many researchers use the expression 'gendered habitus', Ashall (2004) preferred to emphasize the notion of 'gender capital'.

In co-operative models, household decisions are the outcome of certain bargaining process. These models stress the role of outside options ('exit options') in the bargaining power of spouses and in intra-household welfare (see Manser and Brown 1980; McElroy and Horney 1981). By modifying the exit options of disadvantaged groups, policy can try to influence intra-household welfare. Collective models based on non-co-operative game theory (e.g. Lundberg and Pollak 1993) assume that an individual's actions depend on those of others and do not necessarily lead to Pareto-optimal allocations of resources. Udry (1996), for example, stressed the fact that within many African households, agricultural production occurs on many plots controlled by different members of the household. Pareto efficiency implies an efficient allocation of factors across these plots. Udry (1996) concluded, however, that plots controlled by women were cultivated much less intensively than similar plots within the household controlled by men. O'Laughlin (2007) criticized Udry's study as misrepresenting the relationship between gender and poverty in rural Africa. Udry's study focused on agricultural production whereas, according to O'Laughlin, it should have looked at the gendered division of labour across the whole range of activities in which household members participate. These relations may be hierarchical and conflictual but also co-operative (Sen 1990).

Research on the intra-household allocation of resources helped in the design of programmes aiming at modifying the behaviour of households, for example by recommending the transfer of income directly to women (e.g. PROGRESA, Mexico's National Program for Education, Health, and Nutrition). have been criticized because they do not focus enough on gender issues (Pearse and Connell 2016) or treat norms as exogenous to decisions in the home (Agarwal 1997; Sen 1990).

There is hence a need to devote more attention to intra-household outcomes and bargaining power, in particular in developing countries. For Doss (2013), measuring bargaining power is not a simple issue, as it is unobservable. Even measuring empowerment is not an easy task.[3] Assessing the magnitude of women's empowerment requires also collecting data on the extent of violence against women, an issue to which development specialists have devoted quite a lot of attention in recent years.

2.4 Women's empowerment and violence against women

Those who engage in violence against women are often intimate partners of those women. Such violence takes various forms: sexual harassment, prostitution trafficking, child marriages, dowry-related violence, 'honour' killings, etc. It leads to physical injuries, unwanted pregnancies, sexually transmitted infections, depression, homicide, and suicide (WHO 2009).

Using household surveys in Bangladesh, China, Cambodia, Indonesia, Sri Lanka, and Papua New Guinea, Fulu et al. (2013) estimated the prevalence and determinants of male perpetration of intimate partner violence and concluded that it was associated with experiences of childhood trauma, alcohol misuse and depression, low education, poverty, and involvement in gangs and fights with weapons. They recommended adapting policy interventions to the specific patterns of violence in each area. Jewkes et al. (2013) analysed the same data and stressed the need to address culturally rooted male gender socialization and power relations, abuse in childhood, and poverty.

[3] There is now quite a vast literature dealing with the definition and measurement of women's empowerment. See, for example, Alkire et al. (2013), Alsop (2007), Alsop et al. (2006), Ballon (2012), Ibrahim and Alkire (2007), Kabeer (2001), Mahotra et al. (2002), Narayan (2002), Vaz et al. (2016), and the World Bank Institute (2007).

One way to decrease gender-based violence is to give women access to assets and decent employment in order that they do not depend on their husband/partner. But to raise the degree of women's empowerment, it is also necessary to increase their mobility.

2.5 Women's empowerment and mobility

Uteng (2011) described the ways in which constrained (daily) mobility (the element of physical access to different facilities) affects women's empowerment. For Riverson et al. (2005), in most developing countries the distance to sources of water affects the consumption of water. Other studies have emphasized that given women's limited means to transport water, fuel, household goods, and food, they experience not only the physical burden of transportation through back-loading and head-loading but also the time burden because of the lack of transport. These obstacles to women's empowerment thus raise equity issues, but they also influence efficiency.

2.6 Women's empowerment and economic growth

Klasen (1999) explained how greater gender inequality in the use of human resources affects growth. If the distribution of talents is similar for both genders, not using women's ability to the same extent as that of men necessarily lowers the average productivity of human capital.

Gender equality affects growth, but economic growth may also have an impact on gender equality. For Kabeer and Natali (2013) and Quisumbing (2003) the first effect is stronger, as there is enough evidence that women's access to jobs, cash transfers, education, credit, land, and other assets has positive implications for poverty reduction, fertility decline, children's welfare, and agricultural productivity. For Duflo (2012):

> on the one hand, economic development alone is insufficient to ensure significant progress in important dimensions of women's empowerment, in particular, significant progress in decision-making ability in the face of pervasive stereotypes against women's ability. On the other hand, women's empowerment leads to improvement in some aspects of children's welfare (health and nutrition, in particular), but at the expense of some others (education).

2.7 Empirical studies of women's empowerment

Hanmer and Klugman (2016) systematically explored the DHS data of 58 countries, representing almost 80 per cent of the female population of developing countries. They concluded that women living in richer households were more likely to be able to exercise agency, but the impact of wealth was not as large as that of education. They also showed that the risk of suffering violence at home is associated with the husband's use of alcohol, as well as with the woman's own attitude to violence. Education has a protective effect against violence, but this impact is evident only at secondary and higher levels for women and at the higher level for men.[4] In fact, the data show that countries with higher levels of secondary school enrolment for girls tend to have lower levels of violence against women (see UNIFEM 2010).

[4] The policy implications of the previously mentioned studies are not clear-cut, because there is usually no direct information on what outcomes women would choose if they had more bargaining power (see, however, the study of Bertocchi et al. 2012).

Ballon (2012) proposed a structural model for measuring female empowerment, using a capability perspective. As in Kabeer (1999), empowerment is defined as the ability of a woman to make strategic decisions (those concerning the woman herself and those involving her children) and non-strategic life choices. Ballon (2012) used a MIMIC model (see Joereskog 1973; Joereskog and Goldberger 1975) and applied it to a study of Cambodian female empowerment in 2005.

2.8 Women's empowerment and child health

Malapit et al. (2015) analysed the 2012 Bangladesh Integrated Household Survey and provided empirical evidence on the relationship between empowerment gaps between men and women in the same household and children's wellbeing. They estimated relative empowerment using the Women's Empowerment in Agriculture Index (see Alkire et al. 2013). They concluded that increasing women's decision-making over credit and assets was associated with improvements in girls' nutritional status, while increasing women's life satisfaction and participation in groups was associated with improvements in boys' nutritional status.

In a study of the nutritional returns to parental education, Alderman and Headey (2014) concluded that maternal education yields larger returns than paternal education, although for both genders positive returns generally only appear with secondary education.

Malapit and Quisumbing (2014) checked what dimensions of women's empowerment in agriculture matter for nutrition-related practices and outcomes in Ghana. Using the Women's Empowerment in Agriculture Index, they concluded that women's empowerment is more strongly associated with infant and young child feeding practices and only weakly associated with child nutrition status.

Lépine and Strobl (2013) looked at the impact of women's bargaining power on child nutritional status using data from rural Senegal. They concluded that while standard ordinary least square (OLS) suggests that if a mother has more bargaining power, her children will have better nutritional status, their instrumental variables (IV) estimates indicate that the true impact is underestimated if the endogeneity of bargaining power is not taken into account.

In their study of women's empowerment and childhood malnutrition in Timor-Leste, Scantlan and Previdelli (2013) could not conclude that the association between women's empowerment and childhood malnutrition is causal. They found a positive relationship for two of the empowerment measures—attitudes towards violence and experiences of violence—but the strength of the association was quite small.

Ziaei et al. (2014) investigated the association between women's exposure to intimate partner violence and their children's nutritional status, using data from the 2007 Bangladesh DHS. They concluded that women were more likely to have a stunted child if they had lifetime experience of physical intimate partner violence.

Cunningham et al. (2015), using a survey of women's empowerment and child nutritional status in South Asia, made a distinction between three domains of empowerment: control of resources and autonomy, workload and time, and social support. These authors concluded that women's empowerment tends to be associated with child anthropometry.

Yimer and Tadesse (2015) believe that maternal and children's dietary diversity depends on the circumstances of the household but also on the status of women. Their argument is that the extent to which women have access to and control over resources largely determines the kind of care they provide for their children and for the rest of the household. Using Ethiopian household

survey data from 2013, they concluded that there is a positive correlation between women's empowerment indicators and better dietary diversity for both children and women.

3 The data sources and variables

We assume that evaluating the degree of empowerment of women requires taking a multidimensional approach to the measurement of these variables. We make a distinction between several domains of women's empowerment: decision-making, experienced violence, attitude of the woman towards this use of violence, available information, and material resources. Appendix 1 gives the detailed list of variables. To aggregate the variables included in each domain, we use first a weighting scheme adopted in the 'fuzzy approach' to poverty measurement, and second the Alkire and Foster (2011) methodology of poverty analysis.

We also assume that the health of children is a latent variable and that the only observed health variables are the height for age percentile, a variable referring to stunting, and the weight for age percentile, a variable referring to wasting. We implement the MIMIC model. We link the health of children to the following exogenous variables: one for each domain of women's empowerment, the educational level of the mother, her age and its square, her body mass index (BMI), the gender of the child, and the area of residence (region, and whether it is an urban or rural area). The MIMIC model allows for taking into account eventual measurement errors in the indicator variables.

4 The model

There is first a so-called *structural equation* written as

$$y^* = x\beta + u \qquad (1)$$

where y^* is a $(n \text{ by } 1)$ latent variable referring to children's health, n being the number of individuals in the sample, and x (an n by k matrix) refers to a set of exogenous variables assumed to affect a child's health. β is a $(k \text{ by } 1)$ vector of parameters and u an n by 1 vector reflecting the stochastic error.

Then there is a *measurement equation*, which takes into account the fact that the observed child health variables are imperfect indicators of a child's health. So we write that

$$y = y^*\Lambda + \varepsilon \qquad (2)$$

where y is an n by m matrix referring to a set of m independent indicators of a child's health, Λ denotes a 1 by m vector of factor loadings, and ε is an n by m matrix of measurement errors.

Combining (1) and (2), we obtain the following reduced form

$$y = x\beta\Lambda + u\Lambda + \varepsilon = x\pi + v \qquad (3)$$

where $\pi = \beta\Lambda$ is a k by m matrix of coefficients and $v = u\Lambda + \varepsilon$ is an n by m matrix of reduced form disturbances.

For more details on the estimation method, see Ballon (2012), Jöreskog (2002), and Jöreskog and Goldberger (1975).

5 Empirical results

Appendix 1 gives the list of variables introduced. We first made a distinction between various domains of living conditions: decision-making by the woman, actual use of violence by husband or partner, attitude of the woman towards the use of violence, material wealth, and level of information. Since for each domain the number of variables was quite high, there was a need to find a procedure to aggregate the variables available for these domains. We adopted, separately for each of the four domains mentioned previously, a weighting procedure proposed by Cerioli and Zani (1990) in their study of 'fuzzy poverty' (see Appendix 2 for an exact definition of these weights). The intuitive interpretation of these weights is as follows. If a high proportion of women gives a positive answer (the variable is then equal to 1) to a first question (e.g. do you own a radio?) while a much smaller proportion gives a positive answer to another question (e.g. do you own a refrigerator?), then one should give greater weight to the second question. In other words, if a household has a refrigerator, something which is rare, this should be a stronger indication of material wealth than if this household has a radio, something which is common.

Let us now look at Table 1a, which gives the means of the different variables, when this aggregation procedure is used. We see that 15 per cent of the women are the usual decision-maker (on health decisions, large household purchases, visits to relatives, managing the money the husband earns). As far as violence experienced by women (has the woman ever been humiliated, insulted, or made to feel bad, physically forced into unwanted sex, or forced into other unwanted sex acts by her husband or partner?) is concerned, 79 per cent of the women declared that they have not experienced such violence. We also observe that 89 per cent of the women believe that beating by their husband or partner (if the woman goes out without telling her husband, if she neglects her children, if she argues with her husband, if she refuses to have sex with her husband, or if she burns the food) is not justified. We used the weighting procedure previously described to derive an overall material wealth indicator that aggregates 14 dichotomous variables corresponding to the following questions. Is water available on the premises? Does the household have a radio, television, refrigerator, bicycle, motorcycle or scooter, car or truck, land-line telephone? Does the woman own, jointly or alone, a house or land? Is the floor material made of wood plank, parquet or polished wood, or tiles? Is the wall material made of bricks or cement blocks? Is the roof material made of calamine, cement fibre, ceramic tiles, or cement? The mean of this material wealth indicator turns out to be equal to 8 per cent.

The last domain for which this weighting procedure was used is information, which included three variables (does the woman read a newspaper or magazine, listen to radio, or watch television, more than once a week?). Here also the value of this aggregated indicator is quite small (15 per cent). Table 1a also indicates that 12 per cent of the women have a secondary or higher educational level and that 28 per cent live in urban areas. We also observe that on average the women are close to 29 years old, that their BMI is equal to 22.4, and that 50.1 per cent of the children are female. Finally, the z-values of the height by age and weight by age variables are respectively equal to 1.44 and 0.94.

Table 1a: Mean and standard deviation of the variables used when adopting the 'fuzzy aggregation procedure' (number of observations: 4399)

Variable	Mean	Standard deviation
z-value of height/age times 100	−143.878	149.810
z-value of weight/age times 100	−93.882	116.404
Decision-making	0.148	0.248
No experience of violence	0.788	0.313
Believes that beating is not justified	0.884	0.235
Material wealth	0.079	0.104
Information available	0.153	0.228
Education of mother	0.119	0.324
Residing in urban area	0.280	0.449
Age of mother	28.705	6.912
Square of age of mother	871.768	424.666
BMI of mother (centigrams per square metre)	2238.521	316.246
Female child	0.501	0.500

Source: Authors' calculations based on Mozambique DHS data.

Table 1b: Mean and standard deviation of the variables used when not implementing any aggregation procedure (number of observations: 4399)

Variable	Mean	Standard deviation
Person who usually decides on respondent's health care	0.219	0.414
Person who usually decides on large household purchases	0.123	0.328
Person who usually decides on visits to family or relatives	0.151	0.358
Person who usually decides what to do with money husband earns	0.101	0.302
Never been humiliated by husband	0.831	0.375
Never been insulted by husband	0.710	0.454
Never had forced unwanted sex	0.932	0.252

Never had forced other unwanted sexual acts	0.946	0.226
Does not think that beating justified if she goes out without the husband's/partner's permission	0.868	0.338
Does not think that beating justified if she neglects children	0.916	0.277
Does not think that beating justified if she argues with husband	0.844	0.363
Does not think that beating justified if she refuses having sex	0.930	0.254
Does not think that beating justified if burns food	0.924	0.265
Source of water on premises	0.140	0.347
Household has radio	0.556	0.497
Household has television	0.195	0.396
Household has refrigerator	0.103	0.304
Household has bicycle	0.460	0.498
Household has motorcycle/scooter	0.065	0.246
Household has car/truck	0.035	0.184
Main floor material	0.0229	0.167
Main wall material	0.214	0.410
Main roof material	0.028	0.166
Type of cooking fuel	0.027	0.163
Household has land-line telephone	0.004	0.064
Owns house alone or jointly	0.078	0.269
Owns land alone or jointly	0.079	0.269
Frequency reading newspaper/magazine	0.059	0.236
Frequency listening to radio	0.413	0.492
Frequency watching television	0.174	0.379

Source: Authors' calculations based on Mozambique DHS data.

Let us now look at the results of the estimation of the MIMIC model. They appear in Table 2, where we present results based first on the weighting scheme of the so-called 'fuzzy approach'

(without and with regional variables), and second on an assumption of equal weights to all the variables belonging to a given domain of empowerment. For the structural equation, we observe that when we ignore the regional variables, only two domains of empowerment have a significant (and positive) impact on the health of children: material wealth and the attitude towards beating (the woman believes that the latter is not justified). When we add regional dummy variables (describing in which region the woman lives and whether it is an urban or rural area), we note that only the domain of material wealth has a significant impact on children's health. However, when we use equal weights for all the variables of a given domain, the coefficient of the attitude towards beating remain significant, though not at the 5 per cent level. We also observe in all three regressions that the health of female children is higher and that the health of all children is higher, the higher the educational level of the mother and her BMI. The age of the mother does not have a significant impact on the health of the children. In many regions the health of the children is, ceteris paribus, lower than in the capital city of Maputo, except for the regions of Sofala, Inhambane, Gaza, and the province of Maputo. In most cases, we also observe that, ceteris paribus, the health level of the children is lower in rural areas. Finally, as expected, we observe a positive link between the variables describing the health of the children and the latent variable assumed to represent their health.[5]

Table 2: MIMIC with 'fuzzy approach' (number of observations: 4399)

	Different weights for aggregated variables	Different weights for aggregated variables	Different weights for aggregated variables	Different weights for aggregated variables	Equal weights for aggregated variables	Equal weights for aggregated variables
	Coefficient	$P > z$	Coefficient	$P > z$	Coefficient	$P > z$
Structural equation						
Decision-making	−0.774	0.896	−6.46	0.309	−7.82	0.210
Experienced violence	−1.41	0.759	2.42	0.627	2.35	0.725
Attitude towards beating	19.2	0.002	9.41	0.158	12.0	0.090
Information	5.38	0.482	8.29	0.307	9.53	0.159
Material wealth	74.8	0.000	60.2	0.002	50.2	0.001
Education of mother	19.5	0.000	14.8	0.008	15.3	0.005

[5] Note that one of the two coefficients is constrained to be equal to 1, as explained by Jöreskog and Goldberger (1975).

Age of mother	−1.81	0.243	−2.24	0.159	−2.29	0.151
Square of age of mother	0.024	0.341	0.034	0.191	0.034	0.181
BMI of mother	0.066	0.000	0.058	0.000	0.058	0.000
Female child	7.43	0.012	8.13	0.007	8.08	0.007
*Regions**						
Niassa urban			−26.2	0.036	−26.9	0.030
Niassa rural			−30.7	0.001	−31.9	0.001
Cabo Delgado urban			−22.5	0.076	−22.0	0.081
Cabo Delgado rural			−38.8	0.000	−37.2	0.000
Nampula urban			−32.3	0.006	−32.4	0.005
Nampula rural			−45.4	0.000	−45.6	0.000
Zambezia urban			−22.9	0.091	−23.5	0.082
Zambezia rural			−37.1	0.000	−36.7	0.000
Tete urban			−45.5	0.005	−46.8	0.004
Tete rural			−30.4	0.001	−31.1	0.001
Manica urban			−27.7	0.025	−27.5	0.025
Manica rural			−30.5	0.001	−30.2	0.001
Sofala urban			−14.8	0.139	−14.4	0.151
Sofala rural			-19.8	0.035	-20.0	0.031
Inhambane urban			16.8	0.278	16.8	0.275

Inhambane rural	4.06	0.679	4.90	0.617
Gaza urban	22.9	0.084	23.7	0.075
Gaza rural	17.5	0.081	18.6	0.065
Maputo province urban	2.08	0.831	2.42	0.803
Maputo province rural	14.4	0.255	14.7	0.244
Measurement equations				
height/age				
Latent variable	1 (constrained)		1 (constrained)	
Constant	−239	0.000	−244	0.000
weight/age				
Latent variable	1.13	0.000	1.13	0.000
Constant	−201	0.000	−206	0.000

Notes: * The basis of comparison is the city of Maputo.

Different weights (no regional variables): the likelihood ratio test of model versus saturated is

$\chi^2 = 58.37$ Prob $> \chi^2 = 0.000$

Different weights (with regional variables): the likelihood ratio test of model versus saturated is

$\chi^2 = 133.0$ Prob $> \chi^2 = 0.000$

Equal weights (with regional variables): the likelihood ratio test of model versus saturated is

$\chi^2 = 130.8$ Prob $> \chi^2 = 0.000$

Source: Authors' estimations.

We also estimated the MIMIC model when adopting the Alkire and Foster approach to multidimensional poverty measurement. Appendix 2 indicates which cut-offs we selected for each domain of empowerment and what weights we chose for the different domains. Table A-1 in Appendix 2 presents the results. In the two first regressions, we keep the differentiation between the five domains of empowerment. In the second regression, we add the regional variables. In the third regression, we replace the five domains of empowerment with an overall empowerment variable by weighting the different domains. We observe in Table A-1 that two domains of empowerment have a significant impact on the health of children. One is experienced violence. However, the sign of the coefficient, curiously, is negative, implying that when women do not experience violence from their husband/partner, the health of children is lower. The other is material wealth, which has, as expected, a positive and significant sign (not at the 5 per cent level),

but only when regional variables are not included in the regression. The level of education of the mother, her BMI, and the gender of the child have, as in the case of Table 2, the expected significant impact. Note that in the third regression, where we aggregate the five domains of empowerment, the variable measuring the overall level of empowerment has no significant impact on the health of children.[6]

Finally, in Table A-2 we apply the MIMIC model without including any aggregated variable. In other words, variables summarizing the answers of the individual to all the questions related to empowerment are included in the regression. Table A-2 shows that when no regional variables are included, only a few empowerment variables have a significant coefficient: the variables expressing that the woman is the one who decides about health care and what to do with the money that the husband earns; and the presence of a television or a refrigerator. The educational level of the mother, her BMI, and the gender of the child are also significant and have the expected sign. When the regional variables are included in the regression, the following empowerment variables have a significant coefficient: the one expressing that the woman decides what to do with the money that the husband earns and the information variable stating that the woman listens to the radio. The coefficients of the education of the mother, her BMI, and the gender of the child are, as before, significant, with the expected sign. Most of the regional variables have a significant coefficient.

6 Concluding comments

Using the 2009 Demographic and Health Survey and implementing the so-called MIMIC approach to analyse the determinants of children's health in Mozambique, the empirical analysis presented in this paper, does not lead to clear-cut conclusions concerning the possible impact of women's empowerment on the health of children. Focusing our attention on the results of the 'fuzzy approach' and the regression including regional variables, we observed that the only empowerment domains that seem to have a significant positive influence on the health of children are material wealth and the fact that the woman does not justify beating by her husband/partner. Much less unambiguous is the positive impact on the health of children of the educational level of the mother and her BMI. Ceteris paribus, we also observed that the health of children is higher when the child is female and in urban areas. Finally, there are important differences between the various regions of Mozambique. This last effect is likely to be associated with differences in the extent and quality of health facilities, the impact of which seems to neutralize the role of most empowerment variables, whether aggregated or not.

[6] Such a result may raise some doubts as to the usefulness of applying the Alkire and Foster approach to this type of issue. We tried alternative weights but the coefficient of the overall empowerment variable was never significant.

References

Agarwal, B. (1997). '"Bargaining" and Gender Relations: Within and Beyond the Household'. *Feminist Economics*, 3(1): 1–51.

Alderman, H., and D.D. Headey (2014). 'The Nutritional Returns to Parental Education'. Discussion Paper 01379. Washington, DC: International Food Policy Research Institute (IFPRI).

Alkire, S., and J. Foster (2011). 'Counting and Multidimensional Poverty Measurement'. *Journal of Public Economics*, 95(7/8): 476-–87.

Alkire, S., R. Meinzen-Dick, A. Peterman, A.R. Quisumbing, G. Seymour, and A. Vaz (2013). 'The Women's Empowerment in Agriculture Index'. *World Development*, 52: 71–91.

Alsop, R. (2007). 'On the Concept and Measurement of Empowerment'. In N. Kakwani and J. Silber (eds), *The Many Dimensions of Poverty*. New York: Palgrave-Macmillan.

Alsop, R., M. Bertelsen, and J. Holland (2006). 'Empowerment in Practice: From Analysis to Implementation'. Washington, DC: World Bank, Poverty Reduction Group.

Anand, S., Y. Fan, J. Zhang, L. Zhang, Y. Ke, Z. Dong, and L.C. Chen (2008). 'China's Human Resources for Health: Quantity, Quality, and Distribution'. *Lancet*, 372: 1774–81.

Ashall, W. (2004). 'Masculine Domination: Investing in Gender?' *Studies in Social and Political Thought*, 9: 21–39.

Ballon, P. (2012). 'A Structural Model of Female Empowerment'. Oxford Oxford University, OPHI (Oxford Poverty and Human Development Initiative).

Becker, G.S. (1981). *A Treatise on the Family*. Cambridge, MA: Harvard University Press.

Behrman, J.R. (1997). 'Intrahousehold Distribution and the Family'. In M.R. Rosenzweig and O. Stark (eds), *Handbook of Population and Family Economics*. Amsterdam: North-Holland.

Bergmann, B. (1995). 'Becker's Theory of the Family: Preposterous Conclusions'. *Feminist Economics*, 1(1): 141–50.

Bertocchi, G., M. Brunetti, and C. Torricelli (2012). 'Is it Money or Brains? The Determinants of Intra-Family Decision Power'. Discussion Paper 6648. Bonn: Institute for the Study of Labor (IZA).

Boserup, E. (1970). *Women's Role in Economic Development*. New York: St Martin's Press.

Bourdieu, P. (2001). *Masculine Domination*. Translated by R. Nice. Stanford, CA: Stanford University Press.

Cerioli, A., and S. Zani (1990). 'A Fuzzy Approach to the Measurement of Poverty'. In C. Dagum and M. Zenga (eds), *Income and Wealth Distribution, Inequality and Poverty*. Berlin: Springer Verlag.

Chiappori, P.A. (1988). 'Rational Household Labor Supply'. *Econometrica,* 56(1): 63–89.

Chiappori, P.A. (1992). 'Collective Labor Supply and Welfare'. *Journal of Political Economy*, 100(3): 437–67.

Chiappori, P.A. (1997). 'Introducing Household Production in Collective Models of Labor Supply'. *Journal of Political Economy*, 105(1): 191–209.

Cunningham, K., M. Ruel, E. Ferguson, and R. Uauy (2015). 'Women's Empowerment and Child Nutritional Status in South Asia: A Synthesis of the Literature'. *Maternal and Child Nutrition*, 11(1): 1–19.

Deaton, A. (2003). 'Health, Inequality, and Economic Development'. *Journal of Economic Literature*, 41: 113–58.

Doss, C. (2013). 'Intra-household Bargaining and Resource Allocation in Developing Countries'. *World Bank Research Observer*, 28(1): 52–78.

Duflo, E. (2012). 'Women's Empowerment and Economic Development'. *Journal of Economic Literature*, 50(4): 1051–79.

Flegg, A.T. (1982). 'Inequality of Income, Illiteracy and Medical Care as Determinants of Infant Mortality in Underdeveloped Countries'. *Population Studies*, 36: 441–58.

Fulu, E., R. Jewkes, T. Roselli, and C. Garcia-Moreno, on behalf of the UN Multi-Country Cross-Sectional Study on Men and Violence research team (2013). 'Prevalence of and Factors associated with Male Perpetration of Intimate Partner Violence: Findings from the UN Multi-Country Cross-Sectional Study on Men and Violence in Asia and the Pacific'. *Lancet Global Health*, 1: e187–e207.

Haddad, L., J. Hoddinott, and H. Alderman (eds) (1997). *Intra-household Resource Allocation in Developing Countries: Models, Methods, and Policy*. Baltimore, MD: Johns Hopkins University Press for the International Food Policy Research Institute.

Hanmer, L., and J. Klugman (2016). 'Exploring Women's Agency and Empowerment in Developing Countries: Where Do We Stand?' *Feminist Economics*, 22(1): 237–63.

Ibrahim, S., and S. Alkire (2007). 'Agency and Empowerment: A Proposal for Internationally Comparable Indicators'. *Oxford Development Studies*, 35(4): 379–403.

Jackson, C. (1996). 'Rescuing Gender From the Poverty Trap'. *World Development*, 24(3): 489–504.

Jewkes, R., E. Fulu, T. Roselli, and C. Garcia-Moreno, on behalf of the UN Multi-Country Cross-sectional Study on Men and Violence research team (2013). 'Prevalence of and Factors associated with Non-partner Rape Perpetration: Findings from the UN Multi-Country Cross-Sectional Study on Men and Violence in Asia and the Pacific'. *Lancet Global Health*, 1: e208–e218.

Jöreskog, K.G. (1973). 'A General Method for Estimating a Linear Structural Equation System'. In A. Goldberger and O. Duncan (eds), *Structural Equation Models in the Social Sciences*. New York: Seminar Press.

öreskog, K.G., and A.S. Goldberger (1975). 'Estimation of a Model with Multiple Indicators and Multiple Causes of a Single Latent Variable'. Journal of the American Statistical Association, 70(351): 631–39.

Kabeer, N. (1999). 'Resources, Agency, Achievements: Reflections on the Measurement of Women's Empowerment'. *Development and Change*, 30(3): 435–64.

Kabeer, N. (2001). 'Reflections on the Measurement of Women's Empowerment—Theory and Practice'. In A. Sisak (ed), *Discussing Women's Empowerment – Theory and Practice*. Stockholm: Novum Grafiska AB.

Kabeer, N. (2011). 'Between Affiliation and Autonomy: Navigating Pathways of Women's Empowerment and Gender Justice in Rural Bangladesh'. *Development and Change*, 42(2): 499–528.

Kabeer, N. (2012). 'Empowerment, Citizenship and Gender Justice: A Contribution to Locally Grounded Theories of Change in Women's Lives'. *Ethics and Social Welfare*, 6(3): 216–32.

Kabeer, N., and L. Natali (2013). 'Gender Equality and Economic Growth: Is there a Win–Win?' Working Paper 417. Brighton, UK: Institute of Development Studies (IDS).

Kamiya, Y. (2010). 'Determinants of Health in Developing Countries: Cross-Country Evidence'. Discussion Paper DP-2010-E-009. Osaka, Japan: Osaka School of International Public Policy (OSIPP).

Katz, E. (1997). 'The Intra-household Economics of Voice and Exit'. *Feminist Economics*, 3(3): 25–46.

Klasen, S. (1999). 'Does Gender Inequality Reduce Growth and Development? Evidence from Cross-Country Regressions'. Washington, DC: World Bank.

Krishna, A. (2010). *One Illness Away. Why People Become Poor and How They Escape Poverty*. Oxford: Oxford University Press.

Lépine, A., and E. Strobl (2013). 'The Effect of Women's Empowerment on Child Nutrition in Rural Senegal'. *World Development*, 45: 17–30.

Livingstone, D.W., and M. Luxton (1989). 'Gender Consciousness at Work: Modification of the Male Breadwinner Norm among Steelworkers and Their Spouses'. *Canadian Review of Sociology/Revue canadienne de sociologie*, 26(2): 240–75.

Lundberg, S., and R.A. Pollak (1993). 'Separate Spheres Bargaining and the Marriage Market'. *Journal of Political Economy*, 101(61): 988–1010.

ahotra, A., S.R. Schuler, and C. Boender (2002). 'Measuring Women's Empowerment as a Variable in International Development'. Background paper prepared for the World Bank Workshop on Poverty and Gender: New Perspectives. Washington, DC: World Bank.

Malapit, H.J.L., and A.R. Quisumbing (2014). 'What Dimensions of Women's Empowerment in Agriculture Matter for Nutrition-Related Practices and Outcomes in Ghana?' Discussion Paper 01367. Washington, DC: International Food Policy Research Institute (IFPRI).

Malapit, H.J.L., E. Sraboni, A.R. Quisumbing, and A. Ahmed (2015). 'Gender Empowerment Gaps in Agriculture and Children's Well-Being in Bangladesh'. Discussion Paper 01470. Washington, DC: International Food Policy Research Institute (IFPRI).

Manser, M., and M. Brown (1980). 'Marriage and Household Decision-Making: A Bargaining Analysis'. *International Economic Review*, 21(1): 31–44.

Marmot, M. (2005). 'Social Determinants of Health Inequalities'. *Lancet*, 365: 1099–104.

McElroy, M.B., and M.J. Horney (1981). 'Nash-Bargained Household Decisions: Toward a Generalization of the Theory of Demand'. *International Economic Review*, 22(2): 333–49.

McGuire, J.W. (2006). 'Basic Health Care Provision and Under-5 Mortality: A Cross-National Study of Developing Countries'. *World Development*, 34: 405–25.

Narayan, F. (2002). *Empowerment and Poverty Reduction*. Washington, DC: World Bank.

OECD (Organization of Economic Cooperation and Development) and WHO (World Health Organization) (2003). *Poverty and Health*. Geneva: World Health Organization.

O'Laughlin, B. (2007). 'A Bigger Piece of a Very Small Pie: Intra-household Resource Allocation and Poverty Reduction in Africa'. *Development and Change*, 38(1): 21–44.

Pearse, R., and R. Connell (2016). 'Gender Norms and the Economy: Insights from Social Research'. *Feminist Economics*, 22(1): 30–53.

Quisumbing, A.R. (2003). 'Household Decisions, Gender and Development: A Synthesis of Recent Research'. Washington, DC: International Food Policy Research Institute (IFPRI).

Razavi, S., and C. Miller (1995). 'From WID to GAD: Conceptual Shifts in the Women and Development Discourse'. Occasional Paper 1. Geneva: United Nations Research Institute for Social Development (UNRISD).

Riverson, J., M. Kunieda, P. Roberts, N. Lewi, and W.M. Walker (2005). 'An Overview of Women's Transport Issues in Developing Countries. The Challenges in Addressing Gender Dimensions of Transport in Developing Countries. Lessons from the World Bank's Projects'. Washington DC: The World Bank.

Scantlan, J., and A. Previdelli (2013). 'Women's Empowerment and Childhood Malnutrition in Timor-Leste: A Mixed-Methods Study'. Portland, OR: Mercy Corps.

Sen, A. (1985). *Commodities and Capabilities*. Amsterdam: North-Holland.

Sen, A. (1990). 'Gender and Cooperative Conflicts'. In I. Tinker (ed), *Persistent Inequalities: Women and World Development*. Oxford: Oxford University Press.

Smith, L.C., and L. Haddad (2000). 'Explaining Child Malnutrition in Developing Countries. A Cross- Country Analysis'. Washington, DC: International Food Policy Research Institute (IFPRI.

Strauss, J.A., and D. Thomas (1995). 'Human Resources: Empirical Modeling of Household and Family Decisions'. In T.N. Srinivasan and J. Behrman (eds), *Handbook of Development Economics*. Amsterdam: North Holland.

Thomas, D., and E. Frankenberg (2002). 'The Measurement and Interpretation of Health in Social Surveys'. In C. Murray, J. Salomon, C. Mathers, and A. Lopez (eds), *Measurement of the Global Burden of Disease*. Geneva: World Health Organization.

Udry, C. (1996). 'Gender, Agricultural Production, and the Theory of the Household'. *Journal of Political Economy*, 104(5): 1010–46.

UNIFEM (United Nations Development Fund for Women) (2010). *Investing in Gender Equality: Ending Violence against Women and Girls*. New York: United Nations.

USAID (2009). 'DHS Program. Survey Summary. Mozambique: Standard AIS, 2009'. USAID. Available at: https://dhsprogram.com/what-we-do/survey/survey-display-322.cfm (accessed 24 September 2017).

Uteng, T.P. (2011). 'Gender and Mobility in the Developing World'. Background paper prepared for the World Development Report 2012 on Gender Equality and Development. Washington, DC: World Bank.

Vaz, A., P. Pratley, and S. Alkire (2016). 'Women's Autonomy in Chad Using the Relative Autonomy Index'. *Feminist Economics*, 22(1): 264–94.

Wagstaff, A., and M. Claeson (2004). 'Rising to the Challenge: The Millennium Development Goals for Health'. Washington, DC: World Bank.

WHO (World Health Organization) (2009). *Violence Prevention: The Evidence. Promoting Gender Equality to Prevent Violence against Women*. Geneva: World Health Organization.

World Bank Institute (2007). 'Empowerment in Practice: Analysis and Implementation. A World Bank Learning Module'. Washington, DC: World Bank.

Yimer, F., and F. Tadesse (2015). 'Women's Empowerment in Agriculture and Dietary Diversity in Ethiopia'. Working Paper 80. Washington DC: Ethiopia Strategy Support Program, Ethiopian Development Research Institute (EDRI) and International Food Policy Research Institute (IFPRI).

Zereyesus, J.A., V. Amanor-Boadu, K. Ross, and A. Shanoyan (2017). 'Does Women's Empowerment in Agriculture Matter for Children's Health Status? Insights from Northern Ghana'. *Social Indicators Research*, 132(3): 1265–80.

Ziaei, S., R.,T. Naved, and E.-C. Ekström (2014). 'Women's Exposure to Intimate Partner Violence and Child Malnutrition: findings from Demographic and Health Surveys in Bangladesh'. Maternal & Child Nutrition, 10(3): 347–59.

Appendix 1: List of variables used

Women's empowerment

Decision-making

'Person who usually decides on respondent's health care': equal to 1 if wife is the one deciding

'Person who usually decides on large household purchases': equal to 1 if wife is the one deciding

'Person who usually decides on visits to family or relatives': equal to 1 if wife is the one deciding

'Person who usually decides what to do with money husband earns': equal to 1 if wife is the one deciding

Actual use of violence by husband

'Ever been humiliated by husband/partner': equal to 1 if wife has not been humiliated

'Ever been insulted or made to feel bad by husband/partner': equal to 1 if wife has not been insulted

'Ever been forced into other unwanted sex by husband/partner': equal to 1 if wife has not been forced

'Ever been forced into other unwanted sexual acts by husband/partner': equal to 1 if wife has not been forced

Attitude towards use of violence

'The wife thinks that beating is justified if she goes out without telling husband': equal to 1 if wife does not think so

'The wife thinks that beating is justified if she neglects the children': equal to 1 if wife does not think so

'The wife thinks that beating is justified if she argues with husband': equal to 1 if wife does not think so

'The wife thinks that beating is justified if she refuses to have sex with husband': equal to 1 if wife does not think so

'The wife thinks that beating is justified if she burns the food': equal to 1 if wife does not think so

Resources of household

'Time to get to water source': equal to 1 if on premises

'Household has: radio': equal to 1 if there is a radio

'Household has: television': equal to 1 if there is a television

'Household has: refrigerator': equal to 1 if there is a refrigerator

'Household has: bicycle': equal to 1 if there is a bicycle

'Household has: motorcycle/scooter': equal to 1 if there is a motorcycle/scooter

'Household has: car/truck': equal to 1 if there is a car/truck

'Main floor material': equal to 1 when wood plank, parquet or polished wood, tiles

'Main wall material': equal to 1 when bricks or cement blocks

'Main roof material': equal to 1 when made of calamine, cement fibre, ceramic tiles, or cement

'Type of cooking fuel': equal to 1 when electricity or natural gas

'Household has: telephone (land-line)': equal to 1 if there is a land-line telephone

'Owns a house alone or jointly': equal to 1 if the wife owns a house alone or jointly

'Owns land alone or jointly': equal to 1 if the wife owns land alone or jointly

Information

'Frequency of reading newspaper or magazine': equal to 1 if at least once a week

'Frequency of listening to radio': equal to 1 if at least once a week

'Frequency of watching television': equal to 1 if at least once a week

Other characteristics of household

'Highest educational level of the wife': equal to 1 if she has a secondary or higher educational level

'Age': current age of the mother

'Square of Age': square of current age of the mother

'bmi': body mass index of the mother

'female': equal to 1 if the child is female

Regional variables

The following areas have been distinguished: Niassa Urban; Niassa Rural; Cabo Delgado Urban; Cabo Delgado Rural; Nampula Urban; Nampula Rural; Zambezia Urban; Zambezia Rural; Tete Urban; Tete Rural; Manica Urban; Manica Rural; Sofala Urban; Sofala Rural; Inhambane Urban; Inhambane Rural; Gaza Urban; Gaza Rural; Maputo province Urban; Maputo province Rural. The basis of comparison was the capital city of Maputo.

Health variables of children

'Height/age': z-value of height/age of the child (number of standard deviations from the mean this variable is)

Weight/age': z-value of weight/age of the child ((number of standard deviations from the mean this variable is)

Appendix 2: Methodological notes

Weighting procedure when using the so-called 'fuzzy approach'

When, for some domains, we did not aggregate variables via correspondence analysis, we proceeded as follows. Since all the variables were dichotomous and assuming f_j is the proportion of respondents who answered 1 to question *j*, the weight w_j of question *j* was defined as

$$w_j = \frac{ln(1/f_j)}{\sum_{j \in domain} ln(1/f_j)} \quad \text{(A-1)}$$

Cerioli and Zani (1990) suggested these weights in their paper on fuzzy poverty measurement.

The Alkire and Foster approach in the case of dichotomous variables

The Alkire and Foster (2011) way of measuring multidimensional poverty has become extremely popular in recent years. This approach may also be relevant for other domains where a multidimensional analysis is desirable, such as measuring women's empowerment (see Alkire et al. 2013). In our study, which includes only dichotomous variables, implementing the Alkire and Foster technique requires selecting for each domain of women's empowerment a cut-off, *k*, which we defined as being equal to half the number of variables in the domain plus 1 (or 0.5 if the number of variables is odd). Appendix 1 gives the list of variables in each domain. Within each domain, each variable thus had an equal weight. In a first stage, each domain of empowerment was included separately in the regressions. In a second stage, we aggregated all the empowerment domains into an overall empowerment variable, using the following weights for the domains. We gave a weight of 0.16 to decision-making, experienced violence, and attitude towards beating, a weight of 0.47 to material wealth (the domain with the highest number of variables), and a weight of 0.5 to information.

Appendix 3: Additional empirical results

Table A-1: MIMIC model with the Alkire and Foster approach (number of observations: 4399)

	Separate aggregation for each domain	Separate aggregation for each domain	Separate aggregation for each domain	Separate aggregation for each domain	Overall aggregation: one variable 'Empowerment'	Overall aggregation: one variable 'Empowerment'
	Coefficient	$P > z$	Coefficient	$P > z$	Coefficient	Standard error
Structural equation						
Empowerment					14.7	0.325
Decision-making	−5.50	0.340	−8.39	0.144		
Experienced violence	−12.1	0.003	−6.49	0.093		
Attitude towards beating	−7.42	0.220	−1.90	0.731		
Information	1.15	0.795	2.95	0.517		
Material wealth	23.7	0.074	19.4	0.121		
Education of mother	19.9	0.000	15.1	0.003	20.6	0.000
Age of mother	−0.116	0.939	−2.75	0.071	−2.00	0.194
Square of age of mother	−0.026	0.301	0.038	0.128	0.030	0.223
BMI of mother	0.029	0.000	0.035	0.000	0.060	0.000
Female child	−10.2	0.002	4.76	0.087	7.71	0.008

*Regions**				
Niassa urban	−50.1	0.000	−29.5	0.013
Niassa rural	−57.7	0.000	−35.0	0.000
Cabo Delgado urban	−51.2	0.000	−30.6	0.011
Cabo Delgado rural	−69.0	0.000	−47.5	0.000
Nampula urban	−57.8	0.000	−37.0	0.001
Nampula rural	−72.9	0.000	−51.0	0.000
Zambezia urban	−53.4	0.000	−29.3	0.023
Zambezia rural	−66.8	0.000	−44.0	0.000
Tete urban	−67.6	0.000	−46.4	0.003
Tete rural	−56.9	0.000	−34.7	0.000
Manica urban	−53.0	0.000	−31.0	0.009
Manica rural	−59.3	0.000	−35.8	0.000
Sofala urban	−42.2	0.000	−19.1	0.046
Sofala rural	−53.4	0.000	−27.3	0.002
Inhambane urban	−9.43	0.508	10.8	0.463
Inhambane rural	−23.5	0.014	−4.78	0.599
Gaza urban	−5.35	0.663	16.8	0.184

Gaza rural	−12.0	0.196	9.59	0.303
Maputo province urban	−16.9	0.067	−0.041	0.996
Maputo province rural	−13.0	0.269	7.75	0.521
Measurement equations				
height/age				
Latent variable	1 (constrained)		1 (constrained)	
Constant	−123	0.000	−231	0.000
weight/age				
Latent variable	1.22	0.000	1.17	0.000
Constant	−68.8	0.000	197	0.000

Notes: *The basis of comparison is the city of Maputo. For one aggregation per domain: the likelihood ratio test of model versus saturated is $\chi^2 = 171.8$ Prob $> \chi^2 = 0.000$.

For an overall empowerment variable: the likelihood ratio test of model versus saturated is $\chi^2 = 119.81$ Prob $> \chi^2 = 0.000$.

Source: Authors' estimations based on Mozambique DHS data (USAID 2009).

Table A-2: MIMIC approach when none of the explanatory variables is aggregated (number of observations: 4399)

Structural equation				
Variable	Coefficient	$P > z$	Coefficient	$P > z$
Decides on health care	−13.3	0.002	−12.6	0.004
Decides on large household purchases	−1.18	0.812	−3.47	0.526
Decides on visits to relatives	0.619	0.889	−0.373	0.938
Decides on what to do with money husband earns	15.4	0.007	16.2	0.005
Not humiliated by husband	−3.36	0.420	−0.891	0.845
Not insulted by husband	−0.822	0.814	2.72	0.483
Not forced into unwanted sex	−6.48	0.420	3.27	0.704
Not forced into other unwanted sexual acts	−8.80	0.328	3.45	0.714
Beating not justified if goes out without permission	5.95	0.228	5.69	0.281
Beating not justified if neglects children	1.82	0.782	7.50	0.284
Beating not justified if argues with husband	−4.15	0.366	−6.07	0.231
Beating not justified if refuses having sex	−4.27	0.523	0.454	0.949
Beating not justified if burns food	2.67	0.678	7.02	0.314
Source of water on premises	6.92	0.173	3.85	0.479
Household has radio	1.93	0.530	2.90	0.381
Household has television	15.0	0.013	8.48	0.174
Household has refrigerator	13.6	0.063	10.7	0.160
Household has bicycle	−9.18	0.003	−0.564	0.865
Household has motorcycle/scooter	0.280	0.961	8.69	0.170
Household has car/truck	13.0	0.173	9.58	0.333
Main floor material	−0.851	0.925	6.03	0.538
Main wall material	6.07	0.168	3.04	0.544
Main roof material	−6.61	0.487	−3.48	0.742

Type of cooking fuel	7.37	0.485	3.55	0.759
Household has land-line telephone	−2.20	0.921	−9.23	0.699
Owns house alone or jointly	−17.3	0.033	−12.2	0.156
Owns land alone or jointly	8.62	0.272	10.9	0.196
Highest educational level	14.5	0.007	15.3	0.008
Frequency reading newspaper/magazine	−3.99	0.539	0.185	0.979
Frequency listening to radio	2.83	0.356	7.60	0.025
Frequency watching television	−5.69	0.258	−7.37	0.189
Current age of mother	−1.59	0.298	−2.36	0.143
Square of current age of mother	0.017	0.503	0.035	0.178
Mother’s BMI	0.049	0.000	0.058	0.000
Gender of child is female	4.91	0.088	8.29	0.007
Regions				
Niassa urban			−25.6	0.054
Niassa rural			−30.7	0.005
Cabo Delgado urban			−19.1	0.157
Cabo Delgado rural			−33.5	0.002
Nampula urban			−33.8	0.008
Nampula rural			−44.6	0.000
Zambezia urban			−24.7	0.088
Zambezia rural			−37.1	0.000
Tete urban			−42.5	0.010
Tete rural			−29.7	0.004
Manica urban			−24.7	0.061
Manica rural			−26.2	0.013
Sofala urban			−12.0	0.271

Sofala rural			−19.3	0.071
Inhambane urban			14.8	0.355
Inhambane rural			4.66	0.662
Gaza urban			25.4	0.069
Gaza rural			18.3	0.094
Maputo province urban			1.49	0.881
Maputo province rural			14.5	0.271
Measurement equations				
z-value of height per age	1 (constrained)		1 (constrained)	
Constant	−208	0.000	−245	0.000
z-value of weight per age	1.22	0.000	1.11	0.000
Constant	−175	0.000	−206	0.000

Note: Likelihood ratio of model versus saturated (without regions): $\chi^2 = 123.1$ Prob $> \chi^2 = 0.000$.

Likelihood ratio of model versus saturated (with regions): $\chi^2 = 160.5$ Prob $> \chi^2 = 0.000$.

Source: Authors' estimations based on Mozambique DHS data (USAID 2009).