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Child Monetary Poverty and Multidimensional Deprivations: Why They Differ

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Abstract

We analyze the causal effect of parental education on the potential mismatch between child monetary poverty and multidimensional deprivations. First, in a simple model of parental investment in child outcomes, we demonstrate that the misalignment between household monetary resources and parental education causes a mismatch. Indeed, a match between poverty and deprivation occurs whenever household consumption expenditure and parental education are correlated. Second, using micro-level data from Tanzania, we find that parental education has a negative effect on the probability that a monetarily non-poor child suffers some basic deprivations, and a positive effect on the likelihood that a monetarily poor child suffers no basic deprivations.

JEL Codes: I32, J13, O12.
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1 Introduction

The poverty measurement literature (e.g., Roelen et al. (2012); Roelen and Gassmann (2014); Alkire et al. (2015); Tran et al. (2015)) holds that there is a mismatch between poverty and multidimensional deprivation, particularly in reference to children (e.g., Roelen et al. (2012)); and that monetary poverty indicators are inadequate reflections of children's multidimensional well-being (White et al. (2003)). Yet the reasons for this mismatch are unclear. This paper examines this question both theoretically and empirically.[1]

Addressing this question is both timely and policy relevant. First, while it is often assumed that households that are not poor possess the purchasing power necessary to avoid basic child deprivations such as malnutrition and illiteracy (Thorbecke (2007)), recent evidence shows that this is not always the case (Menchini et al. (2012)). Second, the recently released UN's Sustainable Development Goals (SDGs) list the fight against both poverty and multidimensional deprivations as one of the priorities of international cooperation. The very first SDG aims to "eradicate extreme (monetary) poverty for all people" and to "reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions".[2] Yet around the globe, 836 million people still live in extreme poverty, among whom nearly half are children (Olinto et al. (2013)), while one in four children under the age of five suffers from stunted growth, and 57 million children remain out of school (Nations (2015)). These facts suggest that achieving SDG 1 may not be possible without a clear and practical understanding of the links between poverty and deprivation.

In this paper we advance the idea that turning household monetary resources into catalysts for improving children's well-being requires that parents be sufficiently endowed with complementary non-monetary resources such as education. We first articulate this idea in a simple model of parental investment in child well-being. We model a child's multidimensional well-being as

[1] In what follows, and for simplicity of exposition, we use the term "poverty" to refer to monetary poverty and the term "deprivations" to refer to non-monetary poverty dimensions.

[2] The term "poverty in all its dimensions" is equivalent to "multidimensional deprivation" in the terminology of this paper.

a composite of nutritional status and level of education. Our focus on child nutrition and level of education as constituents of child multidimensional well-being stems from the fact they comprise two of the three dimensions underlying the multidimensional poverty index (MPI), which was developed jointly by the United Nations Development Programme and the Oxford Poverty and Human Development Initiative in 2010. Moreover, of the three dimensions of the MPI, education and health (of which nutrition is an indicator) are the only ones that embody aspects of deprivation specifically relevant for children.

We link parental socioeconomic characteristics, in particular maternal education and household monetary resources, to a household's ability to adequately invest in the multidimensional well-being of its children. The link between household monetary resources and child outcomes is straightforward, as many of the constituents of a child's well-being, such as food and school fees, must be purchased. The link between parental education and child outcomes works through two important channels: *in utero* experiences and investment decisions for a growing child. Our theoretical model of child outcomes captures these two channels.

The model generates a number of testable predictions. In particular, we show that the misalignment between household monetary resources and parental education causes a mismatch between child poverty and deprivations.

We test these predictions using the 2012/2013 Tanzania National Panel Survey (NPS). Our empirical analysis focuses on the population of children aged 7-15. We find that parental education has a negative effect on the probability that a non-poor child suffers some educational deprivation, and a positive effect on the likelihood that a poor child suffers no educational deprivation.

The rest of the paper is organized as follows. In the next section, we situate this paper in the wider literature on child poverty and well-being. We then present a model of parental investment in children in Section 3. Section 4 presents our empirical analysis. Section 5 concludes the paper.

2 Literature Review

Our study bridges the literatures on child poverty measurement and on parental investments in children. Roelen et al. (2010), Roelen et al. (2012), Roelen and Notten (2013), and Roelen and Gassmann (2014) all propose case studies of the mismatch between child poverty and deprivation. Others have analyzed potential explanations of this mismatch (e.g., Perry (2002); Bradshaw and Finch (2003); Hulme and Shepherd (2003); Rendtel et al. (2004); Cancian and Meyer (2004); Alessio et al. (2011); Menchini et al. (2012); Roelen (2015)). Roelen (2015) highlights measurement error and lagged effects as two potential explanations. Bradshaw and Finch (2003) identify differences in the reliability and validity of the two types of measures to explain their mismatch. Some of these papers highlight the role of household characteristics, but only in relation to measurement issues. For example, the fact that income (or consumption) is almost always measured at the household level and so does not capture intra-household allocation of resources (Hulme and McKay (2008)). Furthermore, children are generally unable to influence this allocation or sustain their own livelihood (White et al. (2003)) to address their various deprivations. We contribute to this literature by highlighting parental education as a potential explanation in a context where altruistic parents invest in their children. Our modeling of child outcomes draws from the literature on parental investment in child outcomes (e.g., Thomas et al. (1991); Glewwe (1999); Currie and Moretti (2003); Currie and Moretti (2007); Chevalier et al. (2013); Currie et al. (2007)).

The link between income (and thus monetary poverty) and specific dimensions of child deprivation has also been widely studied. This includes Lawson and Appleton (2007), Singh and Sarkar (2015) and Alessio et al. (2011). All these studies find that variations in income only partially explain variations in deprivation and point to other factors as potential determinants of the mismatch between child poverty and deprivations. We contribute to this literature by investigating the potential role of parental education.

Further, an emerging body of the empirical literature finds that parental education, especially maternal education, influences several dimensions of child deprivation, including child's education and nutrition. This includes works by Lawson and Appleton (2007), Imai et al. (2014), Gunes (2015), and Cavatorta et al. (2015). We contribute to this literature by estimating the causal effect of parental education on the extent of the mismatch between child monetary poverty and educational deprivation.

3 A Model of Parental Investment in Child's Outcomes

In this section, we describe a simple model of parental investment in child's outcomes that generates predictions about the causes of a mismatch between child poverty and deprivation. Our model has two fundamental conceptual underpinnings. First, an individual experiencing poverty has insufficient monetary resources to lead a decent life. Second, an individual experiencing deprivation lacks the nutrition and education required to enjoy a minimum standard of living and to fully participate in society. Therefore, if monetary resources were all a family needs to ensure that their children enjoy an adequate standard of living, one would expect a match between the poverty and deprivations status of a child. Our model explores the causes of the observed mismatch between the two.

The basic idea underlying our analytical model is that, while a household's budget constraint determines the quantity of inputs it can purchase to produce child outcomes, the efficiency with which it produces these outcomes is determined by parental education. Let a household consists of an altruistic decision-making parent and a unique child. The parent has characteristics e (education) and y (household total consumption expenditures), all of which are exogenously given. Our model links these characteristics to the child's well-being.

A child's well-being is usually conceived of as a composite of different dimensions, including physical, emotional, psychological, social and economic. For the purpose of this study, we focus on two core aspects of child well-being: nutritional status (a constituent of her/his health status) and educational attainment. Nutrition directly contributes to the physical and emotional dimensions of child well-being, for example through its impacts on the child's weight, height, and susceptibility to morbidity. A child's level of education is seen as contributing to social, psychological, and economic dimensions of child well-being, for example by reducing the likelihood of a child's involvement in crimes (Lochner and Moretti (2004)). We model child well-being using a Cobb-Douglas aggregator function of her/his level of nutrition, n_c, and educational attainment, e_c:

$$b_c = (n_c)^{\beta} (e_c)^{1-\beta} \tag{1}$$

where $\beta \in (0, 1)$. Given some critical level of well-being, $\underline{b}$, a child is multidimensionally poor if and only if her/his level of well-being, as defined in (1), is less than $\underline{b}$.

A child's nutritional status is influenced by the level of household expenditures on her/his nutrition, x_n, as well as by his parent's level of education, e. There are two channels through which parental education can impact a child's nutritional status. The first channel is through *in utero* experiences, as the parent's education may influence the dietary and behavioral choices made prior to and during pregnancies, which in turn affect the child's birth weight (Chevalier and O'Sullivan (2007); Parlee and MacDougald (2014)). The second is a *post utero* channel, as a parent's education influences his knowledge of the basic nutrients required for the normal physical and emotional development of a child. Our modeling of child nutritional status n_c incorporates these two channels as follows:

$$n_c = A (x_n - \delta_n e)^{\alpha} (1 + e)^{\mu} \tag{2}$$

where A is a parameter capturing the effect of omitted factors (e.g., characteristics of the physical environment in which the child lives), $\delta_n > 0$, and $\alpha + \mu < 1$ to reflect omitted factors. The term $\delta_n e$ captures the parent's ability to assess her/his child's nutritional needs. It represents her/his perception of the minimum dietary requirement for child's nutrition, as influenced by her/his level of education, e. In other words, how much education a parent has affects her/his ability to choose the best nutrition inputs s/he can afford for her/his child.

The higher the parent's level of educational attainment, the better her/his assessment of a child's nutritional needs, which translates into a higher level of $\delta_n e$. Thus the term $x_n - \delta_n e$ captures the fact that the beneficial effects of parental education are only significant for child nutrition when household monetary resources are sufficiently high (REED et al. (1996)). The term $(1+e)^{\mu}$ captures the *in utero* channel for the impact of parent's education. Below, we establish conditions under which a child's nutritional status, n_c, rises with the parent's level of education, e.

Next, we follow the human capital literature (e.g., Chevalier et al. (2013)) in modeling a child's educational attainment as determined by parental education, e, and the level of monetary resources invested in child's schooling, x_e:

$$e_c = D\left[(x_e - \delta_e e)^{\alpha}(1+e)^{\mu}\right] \tag{3}$$

where $D > 0$ is an efficiency parameter measuring the quality of the schooling system and the effect of omitted factors, hence $\alpha+\mu < 1$. The term $\delta_s e$ captures the parent's perception of the minimum level of monetary resources required to create a cognitively stimulating environment for the child, as mediated by his level of education, e. This is consistent with (Kremer and Chen, 1999) who argue that better educated parents are more able to create a cognitively stimulating for their offspring. The term $x_e - \delta_e e$ thus captures the fact that the beneficial effect of parental education are only significant for child's education when household monetary resources are sufficiently high. The second term, $(1+e)^{\mu}$ captures the effect a parent's own education has on the child's innate learning ability, for example through *in utero* experiences. Below, we establish necessary and sufficient conditions for a child's schooling outcome to rise with parental education.

3.1 Household's Problem

The parent has preferences over own-consumption of a numeraire, c, and, altruistically, over her/his child's level of well-being, b_c. The utility function representing these preferences is given by

$$U_i = \ln(c - \underline{c}) + \gamma \ln b_c \tag{4}$$

where $\underline{c}$ denotes a subsistence requirement for the parent's own consumption, and $\gamma > 0$, the altruism parameter measuring the utility weight the parent assigns to the child's well-being.

All households are credit-constrained and thus finance all their expenditures out of household monetary resources, y. The budget constraint faced by a household with parental characteristics, (e, y), is given by

$$c + x_e + x_n \leq y. \tag{5}$$

Expression (5) implies that the levels of household expenditures on child nutrition and schooling are both measured in units of the numeraire. Given the properties of the utility function in (4), and using (1)-(5), we can express a typical household's problem as follows:

$$\max_{\langle n_c, s \rangle} U(x_e, x_n; e, y) \tag{6}$$

where

$$U(x_e, x_n; e, y) := \ln(y - x_e - x_n - \underline{c}) + \lambda_n \ln(x_n - \delta_n e) + \lambda_s \ln(x_e - \delta_e e) + R(e)$$

with

$$R(e) \quad : \quad = \gamma \ln (1+e)^{\mu} + \gamma\beta \ln A + (1-\beta)\gamma \ln D$$

$$\lambda_n \quad : \quad = \alpha\gamma\beta$$

$$\lambda_s \quad : \quad = \alpha\gamma(1-\beta).$$

The first order necessary and sufficient conditions for an interior solution to this problem lead to the following household's expenditure allocation choices:

$$c = \frac{1}{1+\lambda_e+\lambda_n}\left[y - (\delta_e+\delta_n)e + (\lambda_e+\lambda_n)\underline{c}\right] \equiv C(e,y) \tag{7}$$

$$x_e = \frac{1}{1+\lambda_e+\lambda_n}\left[\lambda_e(y-\underline{c}) + (\delta_e+\delta_e\lambda_n-\delta_n\lambda_e)e\right] \equiv X^e(e,y) \tag{8}$$

$$x_n = \frac{1}{1+\lambda_e+\lambda_n}\left[\lambda_n(y-\underline{c}) + (\delta_n+\delta_n\lambda_e-\delta_e\lambda_n)e\right] \equiv X^n(e,y) \tag{9}$$

Observe that the functions $C(.)$, $X^e(.)$, and $X^n(.)$ are all strictly increasing in y, suggesting that households with more monetary resources should exhibit better household and child outcomes. However, given any pair of parents with similar or identical monetary resources, differences in parental education can lead to differences in child outcomes. Indeed, one can see from (7) that the function C is strictly decreasing in e (i.e., $\partial C/\partial e < 0$), implying that education induces altruistic parents to sacrifice more for the well-being of their children. Indeed, if

$$\frac{\lambda_n}{1+\lambda_e} < \frac{\delta_n}{\delta_e} < \frac{1+\lambda_n}{\lambda_e}, \tag{10}$$

then it holds that better educated parents invest more in their child's nutrition (i.e., $\partial X^n/\partial e > 0$) and schooling (i.e., $\partial X^e/\partial e > 0$). These results are consistent with the literature on parental investments in children (e.g.,(Burchi, 2010); (Glewwe, 1999)). Condition (10) is purely technical, but can easily obtain, for example, by setting $\delta_e = \delta_n$.

For the rest of this study, and without loss of generality, let us set $\bar{c} = 0$, and assume for all (e, y), the condition

$$y > (\delta_e + \delta_n)\, e \tag{11}$$

holds. Condition (11) implies that how much a parent is willing to sacrifice for the well-being of her/his child does not violate her/his own subsistence requirement. This condition ensures that the positive effect of parental education on child outcomes is significant only when her/his monetary resources are sufficient. From (2), substituting in (9) yields:

$$n_c^* = \kappa \left[y - (\delta_e + \delta_n)\, e\right]^\alpha (1 + e)^\mu \equiv N(e, y) \tag{12}$$

where

$$\kappa = A \left(\frac{\lambda_n}{1 + \lambda_e + \lambda_n}\right)^\alpha .$$

Likewise, from (3), substituting in (8), rearranging terms yields:

$$e_c^* = \sigma \left[y - (\delta_e + \delta_n)\, e\right]^\alpha (1 + e)^\mu \equiv E(e, y) \tag{13}$$

where

$$\sigma = D \left(\frac{\lambda_e}{1 + \lambda_e + \lambda_n}\right)^\alpha .$$

Clearly, from (12) and (13), we have that a child's health status and level of educational attainment both increase with household monetary resources, y, suggesting that children whose parents have more monetary resources tend to suffer fewer basic deprivations like malnutrition and low educational attainments. What about children whose parents lack or have less education?

Proposition 3.1 *For all parents, if the pair* (e, y) *satisfies the inequality*

$$y > (\delta_e + \delta_n)\left[e + (1+e)\,\frac{\alpha}{\mu}\right], \tag{14}$$

then raising a parent's level of education, e*, raises her/his child's nutritional status* ($\partial N/\partial e > 0$)*, as well as her/his level of education (* $\partial E/\partial e > 0$*).*

Condition (14) has a similar interpretation to condition (11) above. Proposition 3.1 is consistent with empirical evidence stating that a parent's education is an important determinant of her/his child's educational attainment (e.g., Chevalier et al. 2013). Indeed, the following further crystallizes this idea:

Proposition 3.2 *Suppose that for all households, the pair* (e, y) *satisfies condition (11) hold. Then*

(i) the effect on a child's health status of raising household monetary resources is higher, the higher her/his parent's level of education (i.e., $\partial^2 h_c^*/\partial y \partial e$*);*

(ii) the effect on a child's level of education of raising household monetary resources is higher, the higher her/his parent's level of education (i.e., $\partial^2 e_c^*/\partial y \partial e$*).*

Proposition 3.2 implies that parental education and household monetary resources reinforce each other in enhancing child outcomes.

3.2 Parental Education and the Mismatch Puzzle

In this sub-section, we provide a theoretical explanation for the observed mismatch in the identification of child poverty and deprivations. We start with a characterization of a child's optimal level of multidimensional well-being—a measure of her/his multidimensional deprivation status—, as determined by household socioeconomic characteristics, including household monetary resources, y, and parental education, e.

From (1), substituting in (12) and (13), rearranging terms, yields a child's level of well-being as follows:

$$b_c^* = \phi \left[y - (\delta_s + \delta_n)\, e \right]^\alpha (1+e)^\mu \equiv B\,(e, y) \tag{15}$$

where

$$\phi := \kappa^\beta \sigma^{1-\beta}.$$

Observe then that if condition (11) is violated, $b_c^* = 0$, implying that parental education yields benefits in terms of child's outcomes only when household monetary resources are sufficiently high. Recall that we interpret an increase (respectively, a decrease) in the level of y as a decrease (respectively, an increase) in a child's level of poverty, and an increase (respectively, a decrease) in the level of b_c^* as a reduction (respectively, an increase) in a child's level of multidimensional deprivation.

Proposition 3.3 *If, for all households, the pair (e, y) satisfies the inequality*

$$y > (\delta_s + \delta_n) \left[\alpha + (1+\alpha)\, e \right], \tag{16}$$

then,

(i) reducing a child's level of poverty (an increase in y) reduces her/his level of multidimensional deprivation: $\partial b_c^* / \partial y > 0$;

(ii) increasing parents' level of education, e, reduces his child's level of multidimensional deprivation: $\partial b_c^* / \partial e > 0$;

(iii) the effect on a child's level of multidimensional deprivation of improving her/his poverty status is higher, the higher the parent's level of education (i.e., $\partial^2 b_c^* / \partial y \partial e$).

Condition (16) has a similar interpretation to that of conditions (14) and (11) above. Proposition 3.3-(i) suggests that monetary poverty and multidimensional deprivation are related phenomena. The question of interest however, is whether a child's poverty status uniquely determines her/his multidimensional deprivation status. Proposition 3.3 -(ii) and (iii) state that a child's poverty status is not the only determinant of her/his multidimensional deprivation status; parental education is another such determinant, and even influences the magnitude of the effect an exogenous change in a child's poverty status has on her/his multidimensional deprivation status. We argue in what follows that this strategic complementarity between household monetary resources (y) and parental education (e) is a key that unlocks the child poverty measurements' mismatch puzzle.

Since we established above that child poverty and deprivations are related phenomena, we base our theoretical exploration of the causes of the mismatch between these two measurements on the characterization of the elasticity of a child's multidimensional deprivation status with respect to her/his poverty status. The question of interest is: by how much will a child's multidimensional deprivation status improve following a 10% improvement in her/his poverty status?

To address this question, we first derive the elasticity of a child's multidimensional deprivation status with respect to her/his poverty status using (15). To do so, we interpret $B(e, y)$ as a measure of the multidimensional deprivation status of a child born in a household with socioeconomic characteristics (e, y). As mentioned above, we also interpret y as a measure of the child's poverty status. Then, since the function $B(e, .)$ is strictly increasing in y, we can define this elasticity as follows:

$$\varepsilon_{b/y} := \frac{y}{B(e, y)} \frac{\partial B}{\partial y}. \tag{17}$$

A necessary and sufficient condition for a child's multidimensional deprivation status to match her/his poverty status thus is that $\varepsilon_{b/y} = 1$, implying that a 10% improvement in her/his poverty status yields a 10% improvement in her/his multidimensional deprivation status. In other words, if household monetary resources were all that matters for a child well-being, then one would expect the elasticity of her/his multidimensional deprivation status with respect to her/his poverty status to equal unity, irrespective of other household socioeconomic characteristics. From (17), substituting in (15), and rearranging terms, yields a reformulation of this elasticity as follows:

$$\varepsilon_{b/y} = \frac{\alpha}{1 - f(e, y)}, \tag{18}$$

where

$$f(e, y) := \frac{(\delta_s + \delta_n) e}{y} \in (0, 1) \tag{19}$$

by virtue of *condition (11)*. Recall that, by assumption, $\alpha \in (0, 1)$. Then, observe from (18) and (19) that for a household where the mother has no education (i.e., $e = 0$),

$$\varepsilon_{b/y} = \alpha < 1.$$

More generally, a necessary and sufficient condition for $\varepsilon_{b/y} = 1$ is that $f(e, y) = 1 - \alpha$, which, from (19), implies that

$$e = \frac{(1 - \alpha)}{\delta_s + \delta_n} y.$$

We have just established the following results:

Proposition 3.4 *Let condition (11) holds.*

Then there is a match between child poverty and multidimensional deprivation if and only if household monetary resources and parental education are correlated.

Proposition 3.4 suggests that a mismatch is likely to occur whenever household monetary resources and parental education are misaligned or uncorrelated. We test this theoretical prediction against the data, adjusting our empirical model for potential confounders that may mask the causal effect of parental education on the mismatch.

3.3 Testable Predictions

In this sub-section, we summarize the testable predictions of our theoretical model. Our empirical model is devoted to the testing of these predictions:

P1. Household monetary resources and parental education each have a positive effect on child's nutritional status and level of educational attainment (Proposition 3.1)

P2. The effect of household consumption expenditures on a child's (i) nutritional status and (ii) level of education is higher, the higher her/his parent's level of education (Proposition 3.2)

P3. A child's deprivations status is influenced by both her/his poverty status and parental education (Proposition 3.3 -(ii) and (iii))

P4. The misalignment between household monetary resources and parental education is a predictor of the mismatch between child poverty and deprivations. Indeed, a match occurs whenever household monetary resources and parental education are correlated (Proposition 3.4).

Our first prediction (P1) comes from our intermediate results (12) and (13) and Proposition 3.1. These results show that parental education and household monetary resources have a significant influence on children's educational achievement and nutritional status.

Our second prediction (P2) comes from Proposition 3.2. This result states that parental education and household monetary resources reinforce each other in enhancing child outcomes. We test this prediction by allowing interaction between household consumption expenditures and parental education.

The third prediction (P3) comes from Proposition 3.3. The first empirical implication of this prediction is that household monetary resources has a significant effect on child deprivation. The second implication is that household monetary resources are not the only significant determinant of child deprivation. Therefore, we need to identify all other factors, including parental education, that influence child deprivations.

Our prediction (P4) suggests that, conditional on other factors, the occurrence or non-occurrence of a match between child's poverty and deprivation is governed by the extent of the association between household monetary resources and parental education. Our theoretical model is not explicit about the weight of other factors in the occurrence or non-occurrence of this match. This means that our empirical analysis must identify and include these remaining factors as potential confounders of the predictive effect of this association between parental socioeconomic characteristics. To test the fourth prediction, we proxy multidimensional deprivation with two of the three components of the MPI, namely, education and health deprivations.

4 Empirical Analysis

Our model provides testable predictions on the determinants of the probability that a child is both poor and deprived. In this section we test the predictions of our theory. However, before embarking on our empirical analysis, two facts are worth mentioning. First, our theory suggests that, conditional on other factors, the occurrence of a match between a child's poverty and deprivation status is governed by the nature of the association between household monetary resources and parental education. Second, although our model captures the weight of other factors in the occurrence or non-occurrence of this match, it does so only implicitly. This means that our empirical analysis must identify and include these remaining factors as potential confounders of the predictive effect of this association between parental socioeconomic characteristics.

4.1 Data Description

The data used in this study come from the 2012/2013 Tanzania National Panel Survey (NPS). The 2012/2013 Tanzania NPS is the third round in a series of nationally-representative household panel surveys that collect information on a wide range of topics, including consumption expenditures and a wealth of other socioeconomic characteristics. All three rounds of the NPS have been implemented by the Tanzania National Bureau of Statistics (NBS).

The 2012/2013 Tanzania NPS samples $5,010$ households including $25,412$ individuals and contains information at national and regional levels on education, health, household characteristics, living conditions and, anthropometric data on children of all ages. This allows us to examine education and nutritional deprivations simultaneously. Information is collected by through a household questionnaire. Our analysis focuses on the population of children aged $7-15$, which yields a sample of $4,346$ children.

Table 2 reports descriptive statistics of our sample of children. In our sample, 48% percent of children are male, implying a male/female sex ratio of 0.931, which is slightly lower when compared to the overall male/female sex ratio of 1.02 for Tanzanian children in the age group $0-14$.[3] The geographical distribution of the sample shows that approximately 75% of children aged $7-15$ live in rural areas, with the remainder living in urban areas.

4.1.1 Child Poverty and Deprivations Measurements

Household consumption expenditures are calculated using data from the Tanzania National Panel Survey. They comprise all sources of consumption, including food and non-food items, durable goods, and housing. In the survey, consumption expenditures are reported on an annual basis, which we convert to a monthly basis. These are converted to an adult equivalent basis to account for differences in size and age/sex composition of households. Thus, a child is identified as being poor if the monthly real consumption expenditures per adult equivalent of the household in which s/he lives are below a specified threshold consistent with the observed poverty rate.

Our focus is on two important dimensions of child deprivation –education and nutrition. We use two indicators to measure education deprivation, namely school enrollment and schooling-for-age (SAGE). A school-aged child is identified as education-deprived with respect to enrollment if s/he was not enrolled in school at the time of the survey. A child is identified as

[3] World Fact Book Tanzania, 2016, available online at https://www.cia.gov/library/publications/the-world-factbook/geos/tz.html

education-deprived with respect to $SAGE$, if her/his grade progression at school occurs at a rate below normal. In other words, this indicator measures school deprivation as an age-grade distortion (Psacharopoulos and Yang (1991)):

$$SAGE = \left(\frac{Years\ of\ schooling}{Age - E} \right) \times 100$$

where E represents the normal schooling entry age, which is 7 in Tanzania. A child is identified as below normal progression if $SAGE < 100$.

We measure children's nutritional status by their BMI-for-age z-score (thinness) and height-for-age z-score (stunting). A child is identified as thin (stunted) if his/her BMI-for-age z-score<-2SD (height-for-age z-score <-2SD).

Dimension	Indicator	Definition. A child is identified as poor/deprived if:
Poverty	Real consumption	his/her household's monthly real consumption per adult equivalent is below the poverty line
Education	Enrollment	s/he is not enrolled in school
	Progression	his/her score SAGE <100
Nutrition	Thinness	his/her BMI-for-age z-score is <-2 SD
	Stunting	his/her height-for-age z-score is <-2 SD

Source: Tanzania national poverty line in 2012-13; and World Health Organization (WHO)

Table 1: Normative criteria for poverty and deprivation measurement

On the basis of the measurement criteria defined in Figure 4, we present in Table 3 rates of child poverty and deprivations by geography, gender and wealth quintile. Overall, 26.16% of children live in poor households. Corresponding figures for children suffering some form of basic deprivation are, respectively, 21.79% not enrolled in school, around 54% of enrolled children are below normal progression, 8.16% are thin and 33.14% are stunted. Figures broken down by regions show a large degree of heterogeneity. In particular, the rural area exhibits the highest rates of both poverty and school deprivation for children in our sample, whereas the Zanzibar region has the highest rate of thinness.

Figure 1 reports the total consumption expenditure quintile-group rates of deprivation. It shows the gradients for each of the four deprivations for Tanzania. Figure 1 shows that the poorest quintiles are generally more deprived than the richer quintiles. Therefore, we conclude that there is an obvious pro-rich gradient of deprivation in Tanzania. Figure 2 plots rates of child deprivations by parental educational level. Figure 2 shows that children having parents (father and mother) with no education are more deprived than those with educated parents.

4.1.2 Patterns of Mismatch between Child Poverty and Deprivation

In this sub-section we present a descriptive picture of the degree of mismatch between child poverty and deprivation in Tanzania. We first sort children in our sample into groups identified as (i) poor, (ii) education-deprived, and (iii) nutrition-deprived. Next, we measure the extent of the mismatch by characterizing the intersection between the group of children identified as poor and the group of those suffering some form of deprivation.

The Venn diagrams presented in Figure 3 give summary pictures of the observed patterns of mismatch in Tanzania. Figure 3.3*a* shows that roughly 32% of children in our sample are either poor or education-deprived (enrollment) $(A + B)$, but only 8.01% are identified as both poor and education-deprived (AB). Figure 3.3*b* shows the mismatch between poverty and deprivation in education using the grade progression indicator. It shows that 14.50% of children are identified as both poor and below normal progression at school, while 39.06% are identified as living in a non-poor household but below normal progression at school. Figure 3.3*c* shows the mismatch between poverty and deprivation in nutrition using thinness indicator. It shows that only 2.44% of children are identified as both poor and thin (see AB in Figure 1*c*), given that a total of 29.44% of children are either poor or thin $(A + B)$. Figure 3*d* shows the mismatch between poverty and deprivation in nutrition using the stunting indicator. It shows that 9.76% of children are identified as both poor and stunted, 9.76% of children are identified as only stunted while 16.41% of children are identified as only poor. Clearly, in all these figures, there is little matching, echoing findings in the literature (e.g., Roelen et al. (2012)).

We now turn to our empirical strategy for testing our theoretical predictions and identifying factors that explain the mismatch between in Tanzania.

4.2 Identification Strategies and Estimation Results

In this sub-section, we detail the steps of our empirical strategy and present results associated with each step.

4.2.1 The Effects of Household Monetary Resources and Parental Education on Child Education

We test the first prediction of our theoretical model (P1) that a child's level of education is positively affected by household monetary resources and parental education. We start by estimating the following linear probability model (LPM):

$$Education_{ih} = \beta_0 + \beta_1 I_h + \beta_2 X_{ih} + \beta_3 Z_h + \epsilon_{ih} \tag{20}$$

where $Education_{ih}$ equals to 1 if a child i living in household h suffers from education deprivation; I_h denotes household h's monetary resources measured by the natural log of real per adult equivalent consumption expenditure, X_{ih} is a vector of child i's own characteristics (age, gender, labor), as well as other household characteristics (numbers of children, household head characteristics and parental education), and Z_h, is a vector of characteristics of the community in which the child lives (rural versus urban, and access to basic public services such as hospitals, healthcare centers and primary schools). We use two indicators to measure a child's level of education deprivation. The first one is school enrollment, equal to 1 if child is not enrolled in school, and 0 otherwise. The second indicator measures schooling progress, and is denoted as $SAGE$; it is equal to 1 if $SAGE < 100$, and 0 otherwise. Standard errors are clustered at the household level in all of our regressions in order to deal with the fact that there may be multiple children in the household.

In order to address potential identification issues in isolating the causal effect of a mother's education on her children's outcomes due to the possibility of educational externalities within the household (Burchi (2012)), we control for father's level of education, as well as that of other members of the household, as these may impact children's outcomes and especially their educational attainment. We consider that not taking into account the level of education of other household members would potentially give rise to an omitted variable bias.

Table 4 reports the results of our first specification (Equation (20)). This table reports the coefficients from the regression of school enrollment and the coefficients from the regression of the *SAGE* dummy to capture grade repetition or below normal progression. We find that household monetary resources, other household characteristics (such as: number of children, household head characteristics and parental education), child characteristics, parents characteristics and place of residence all have significant effects on a children's educational outcomes. The results reported in Columns I and II of Table 4 rely on the assumption that all covariates are exogenous, especially the key variable of household monetary resources (total consumption expenditure). We recognize that household total consumption expenditure may be correlated with the error term, which may potentially bias the estimated coefficients. We discuss below the endogeneity of household total consumption expenditure and our strategy to identify its causal effect.

More specifically, we find that household consumption expenditures (monthly per adult equivalent expenditures) have negative and significant effects on the probability that a child suffers education deprivation. This result suggests that a 1% increases in household monetary resources decrease the probability that a child suffers education deprivation by 0.064 (or 6.4%), while it increases the probability that a child has a normal progression through school grades by 0.058 (5.8%). These results imply that the higher household monetary resources, the lower the probability that a child is education-deprived. This finding is similar to the result often found in most empirical studies that higher levels of monetary resources are associated with lower levels of child deprivation (Singh and Sarkar (2015)).

We also find that parental education has significant effects on the probability that a child suffers education deprivation. We observe that father's education has a more significant impact on the school enrollment decision than does mother's education. Similar evidence can be found in Tansel (1997). In contrast, for those enrolled in school, we observe that when it comes to a child's normal progression through school grades, the coefficients for mother's education are larger than those for father's education (not significant). The intuition behind these two results is that, in a context of African societies, most household decisions (including schooling enrollment for children) are made by the household head; but mothers matter more for a child's grade progression than fathers.

Finally, our results show that a child's own characteristics are significant determinants of her/his schooling outcomes. Indeed, we find that, compared to girls, boys are more at risk of dropping out of school or facing a slow rate of grade progression. Another important determinant of children's deprivation in education is child labor. We find that child labor increases the probability of dropping out of school by 0.063 (or 6.3%), but has no significant effect on a child's grade progression for those attending school.

As acknowledged previously, our baseline regressions have potential endogeneity issues. Some studies on the relation between household income and children's schooling have addressed the issues of endogeneity of household total consumption expenditure (e.g. Montgomery and Kouame (1993); Tansel (1997)). This endogeneity may arise from two sources. The first is reverse causality between household consumption expenditure and child labor decisions. As discussed in Benefo and Schultz (1994), and Behrman and Knowles (1999), if households make expenditure decisions simultaneously with schooling decisions there may be a bias. Behrman and Knowles (1999) argue that households may lower their consumption expenditures when they have school-age children in order to invest in child schooling. The second potential source of endogeneity arises from child labor. As discussed in Montgomery and Kouame (1993), if children work (chores in the home, in household enterprises or outside the household) and make a direct or indirect contribution to household income this could simultaneously affect household consumption and school enrollment. Therefore, the assumption of exogeneity of all covariates is not verified for household total consumption expenditure.

To resolve these potential endogeneity issues, we use the instrumental variables approach. This approach consists in estimating a two-stage model in which the second stage consists of estimating the equation (20) and the first stage consists of estimating the following model:

$$I_h = \alpha_0 + \alpha_1 V_h + \alpha_2 X_{ih} + \alpha_3 Z_h + \nu_h \tag{21}$$

In equation (21), V_h is the instrument, X_{ih} and Z_h are the vectors of control variables as in equation (20).

We instrument household consumption expenditures with a special index of household economic well-being. This index is constructed from survey respondents' answers to questions encompassing a wide range of household assets and services in our empirical setting. It is important to note that in constructing this index of household economic well-being, specific care is taken to exclude all assets and services that may have a direct effect on the child's education outcomes. This includes whether or not the household received cash transfer or remittances, whether or not it owns a television or a radio set. Specifically, we restrict the components of this special index of household economic well-being to include (i) the type fuel used for cooking (wood, charcoal, paraffin, gas or electricity stoves), (ii) the building material of the walls of the main dwelling occupied by the households, (iii) the type of toilet facilities household members have access to, and (iv) the type of access to drinking water. All these assets and services are unlikely to directly affect a child's education outcomes. Once we have identified all components of our index, we adopt an approach similar to that used to calculate the Demographic and Health Survey (DHS) Wealth Index[4] to generate our index of household economic well-being.

[4]Available on: http://www.dhsprogram.com/topics/wealth-index/Wealth-Index-Construction.cfm

Table 5 reports the results of the instrumental variable regressions for child deprivations in education. We also report the results of the first-stage regression of the instrumental variable approach in Table 6. The results show that household monetary resources have a negative and significant effect on the probability that a child suffers education deprivation. We find that a 1% increases in household monetary resources decreases the probability that a child suffers education deprivations by 0.2% with respect to enrollment, and by 0.29% with respect to the indicator of normal progression.

To examine the validity of the household wealth index as an instrument of household consumption expenditure, we undertake some statistical tests. We first test the null hypothesis exogeneity of household consumption expenditure. The Hausman test indicates that we can consider this variable to be endogenous, and therefore we should deal with the identification issue. We also report the F-statistic of the test of global significance of our instrumental variable specification. Then, we test the significance of the endogenous regressors in the structural equation being estimated. The null hypothesis tested is that the coefficient of the endogenous regressor in the structural equation is equal to zero. The results show that the coefficients of the endogenous regressor in the structural equation is significantly non-null.

4.2.2 The Effects of Household Monetary Resources and Parental Education on Child Nutrition

We next test the first prediction of our theoretical model (P1) that a child nutrition is positively affected by household monetary resources and parental education. We start by estimating the following linear probability model (LPM):

$$Nutrition_{ih} = \beta_0 + \beta_1 I_h + \beta_2 X_{ih} + \beta_3 Z_h + \epsilon_{ih} \tag{22}$$

where $Nutrition_{ih}$ equals 1 if a child i living in household h suffers from nutritional deprivations (thinness or stunting), with all other covariates defined as before.

Note that we are not dealing with child health as measured by his/her disease or morbidity status. Instead, we consider nutrition as measured by BMI-for-age z-score and height-for-age z-score. It is well known that socioeconomic factors including household income determine a child's weight and height. However, the path of this influence is not direct. The pediatrics literature relates a child's thinness and stunting status to mother's physical environment during critical stages of fetal development (e.g., Martorell and Zongrone (2012); Prendergast and Humphrey (2014)). Indeed, paediatrics studies find that "environmental factors such as maternal nutritional status, feeding practices, hygiene and sanitation, frequency of infections and access to healthcare are the major determinants of growth in the first 2 years of life" (Martorell and Zongrone, 2012). In other words, the mother's environment is the main determinant of a child thinness and stunting status, through *in utero* experience. Many elements of the mother's physical environment (e.g., exposure to mosquito bites, distance to the closest water fountain; characteristics of the home environment such as, type of cooking fuels, etc.) are correlated with household income and/or consumption expenditures. More importantly, the mother (through *in utero* experience) is the only path of their effect on child thinness and stunting status. Therefore, it is quite reasonable in light of this literature, to believe that cluster-average household expenditures are exogenous to child's thinness and stunting status. Furthermore, even if a household through a positive shock such as reception of remittances or cash transfer were to have more monetary resources, this is unlikely to correct nutrition unless parents have adequate knowledge of the specific type of diet needed to bring about that corrective effect.

The estimates of equation (22) are presented in Table 7. Columns (I) and (II) report the estimates when we consider thinness as the indicator of deprivation in nutrition, while Columns (III) and (IV) report the estimates when we consider stunting. Columns (I) and (III) control for household characteristics and parental education. Household characteristics include consumption expenditures, the number of children in the household, the average level of education of other household members, the gender of the head of the household and a dummy variable indicating if an economic shock has affected the household over the past year. The results in Column (I) show that household monetary resources significantly decreases a child's probability of being thin. We also find, in Column (III), that household monetary resources and maternal education significantly decrease a child's probability of being stunted.

Column (IV), in addition to controlling for variables in Column (III), includes all the remaining controls. We find that the effects of household monetary resources and maternal education on a child's probability of being stunted remain statistically significant. However, we find that, when we include all controls, the effects of household monetary resources and maternal education on a child's probability of being thin are no longer statistically significant (Column (II)).

4.2.3 The Effects on Children' Outcomes of the Interaction between Household Monetary Resources and Parental Education

We test the second prediction of our theoretical model (P2) that the effect of household monetary resources on a child's (i) nutritional status and (ii) level of education is higher, the higher her/his parent's level of education. For this purpose, we modify our two specifications (20) and (22) to allow for the interaction between household consumption quintiles and parents' level of education.

The results are presented in Table 8. Since our results in the previous sub-section show that household consumption has no significant effect on a child's thinness status, we report only for stunting status as a measure of nutritional deprivation. For a child's enrollment status, we allow interactions between household's quintile of consumption expenditure and father's level of education because of our previous finding that father's education has a more significant impact on the school enrollment decision than does mother's education. However, when using $SAGE$ as a measure of a child school deprivation status, we consider the interactions between household's quintile of consumption expenditure and mother's level of education. We find that, for a given household consumption expenditure quintile, the probability that a child suffers education deprivation (based on school enrollment or grade progression rate) is lower the higher is her/his parents' level of education. However, for a child nutritional status, we find that, the probability that a child suffers nutritional deprivation (stunting) is lower the higher is her/his parents' level of education only from the second to the fifth quintiles. These results imply that household income and parental education reinforce each other in enhancing child outcomes in education and nutrition.

4.2.4 Assessing the Relative Contribution of Household Monetary Resources and Parental Education on Children's Outcomes

We next test the third prediction of our theoretical model (P3) that household monetary resources are not the only significant determinant of child deprivation. Therefore, we need to assess the relative contribution of each factor in our previous specifications. To do so, we perform a Shorrocks-Shapley decomposition of the R-squared of our previous specifications (20) and (22). The main objective of this decomposition is to evaluate the role played by household income (consumption expenditure) in securing children's needs in education and nutrition. Table 9 summarizes the Shapley decomposition results for different dimensions of deprivation considered in this study.

The results show that household monetary resources (measured by the natural log of real per adult equivalent consumption) explains approximately 7% of the variability of a child's enrollment status, and approximately 5% of her/his schooling progression status. We find that most of the variability in deprivation in education is explained by child characteristics (namely, gender, age, and child labor status), respectively 37% for schooling enrollment, and 52.3% for grade progression. Parental characteristics also have a substantial relative contribution. Indeed, mother's and father's characteristics account for respectively 14.4% and 15.2% of the variability of a child' enrollment status. When we measure child school deprivation using $SAGE$, we find that mother's and father's characteristics account for respectively 13.4% and

8.1% of the variability in child's deprivation.

The Shorrocks-Shapley decomposition results for nutrition show that household monetary resources plays an even less important role in explaining child nutritional deprivation. Household monetary resources explains only 0.2% of the variability in child thinness status and around 13.1% the variability in child stunting status. For child thinness status, we find that child characteristics accounts for 95.2% of the $R - squared$, while the contribution of her/his mother's (respectively father's) characteristics account for about 1.1% (respectively 0.6%). For a child stunting status, we find that child characteristics accounts for 47.5% of the $R - squared$, while the contribution of his/her mother's (respectively father) characteristics account for about 4.9% (respectively 9.6%). These results imply that child poverty and deprivations are different, but related, phenomena.

4.2.5 Explaining the Mismatch between Child Poverty and Deprivations

Finally, we test the fourth prediction of our theoretical model (P4), that parental education influences the mismatch between child poverty and deprivations. Our prediction P4 suggests that, conditional on other factors, the occurrence or non-occurrence of a mismatch between a child's poverty and deprivations is governed by the extent of the association between household monetary resources and parental education. Given the possible sample selection bias arising in a study of deprivation among monetary poor households, to test prediction P4 we use *Heckman selection models* to explain: (i) why a significant share of children living in monetarily non-poor households suffers from deprivation and, (ii) why a significant share of children living in monetarily poor households does not suffer from deprivations.

Figure 4 reports the proportion of deprived children by poverty status. As can be seen from Figure 4 the differences in the proportion of deprived children for the nutrition dimension between non-poor and poor households are not significant in our sample. For this reason, we decided to test the prediction that parental education influences the mismatch between child poverty and deprivations by focusing exclusively on the education dimension of child deprivations.

A *Heckman selection model* follows a two-stage approach. The first stage estimates a probability model of the poverty status of a household (i.e. the likelihood of being monetarily poor) with the application of a probit regression model as follows:

$$y_h^* = \beta_h X_h + \epsilon_h$$

where y_h^* is a latent variable denoting the probability that a household h is monetarily poor, and X_h is the vector of explanatory variables, and $\epsilon_h \sim N(0, \sigma^2)$

The dependent variable y_h is observed if the latent variable y_h^* is greater than zero:

$$y_h = \begin{cases} 1 & \text{if } y_h^* > 0 \\ \\ 0 & \text{if } y_h^* \leq 0 \end{cases}.$$

While estimating the first stage probit model, the inverse *Mill's ratio* is calculated for each household. To correct the selection bias, this *Mill's ratio* is incorporated as an explanatory variable in the second stage. However, the selection bias is not the only identification issue when using *Heckman* selection model. A *Heckman* model is identified when we identify at least one variable that affects selection (i.e, household poverty status) but not the outcome variable (i.e, child deprivations) (Sartori (2003)). Therefore, to correctly identify our *Heckman* selection model, we use our index of household economic well-being. As mentioned in the instrumental variable section, this variable is exogenous to child deprivations in education. Therefore, it constitutes a plausible identification variable.

First, we focus on deprived children in non-poor households. The results of the first-stage *Heckman model* are presented in Table 12. We find that the identifying variable –index of household economic well-being– has a significant positive effect on a household's probability of being monetarily non-poor. The results of the second stage of the *Heckman models* are presented in Table 10. With respect to deprivation in school enrollment, the results show that parental education (maternal, as well as, paternal) significantly decreases the probability of finding deprived children in non-poor households. We also find that the average level of education of other members significantly decreases this probability. We also find that the number of offspring and child labor increase a child's probability of being out of school even if the household is identified as non-poor. With respect to deprivation measured by grade progression (Table 10), we find that maternal education and the average level of education of other household members are the main determinants of the mismatch between household poverty and child deprivation in schooling progression. Importantly, we find that mother's secondary education decreases the probability that a child from non-poor households suffers education deprivation (with respect to deprivation in normal progression) by approximately 0.26.

Lastly, we focus on non-deprived children in poor households. The results of the first-stage *Heckman model* are presented in Table 13. We find that the identifying variable –index of household economic well-being– has a significant positive effect on a household's probability of being monetarily poor. The results of the second stage of the *Heckman models* are presented in Table 11. With respect to schooling participation for children in poor households, we find that paternal education (maternal and paternal) and average level of education of other household members significantly increase the likelihood that a poor child suffers no basic deprivation in education (with respect to school participation). In essence, if we observe children from poor households enrolled in school it is mainly because of parental education. With respect to normal progression in schooling for children in poor households, we find no significant effect of parental education on the likelihood that a poor child suffers deprivation in education progression.

5 Conclusion

At a time when the development community is entering a critical period in the fight to eradicate extreme poverty and to halve rates of multidimensional deprivation by 2030, empirical evidence documenting the mismatch between child poverty and multidimensional deprivation present a challenge for the targeting of policies to the appropriate populations. Investigating the determinants of this mismatch is therefore of paramount importance. This paper contributes to this objective in two ways.

First, we develop a theoretical model of parental investment in child outcomes to generate testable predictions about factors that influence the observed mismatch between child poverty and deprivation. We link child outcomes such as nutritional status and schooling achievements to parental and household characteristics including household income and parental education. Two important results emerge from this theoretical model: (a) we demonstrate that the effect, on a child's nutritional status and schooling achievements, of raising household monetary resources is higher, the higher is parental education (Proposition 2); (b) correlation between household monetary resources and parental education is necessary and sufficient for a match between child poverty and deprivations.

Second, we test our model's predictions using data from the third round of the National Panel Survey (NPS) conducted in Tanzania between 2012 and 2013, which focuses on children aged $7 - 15$. We do this in two steps. In the first step, we use linear probability models (LPM) to identify factors that influence the probability that a child is deprived in terms of education and nutrition, respectively. For both these LPM, the regression is adjusted for potential confounders, and appropriate identification strategies are applied. This allows us to empirically validate our first three theoretical predictions. In particular, application of the Shorrocks-Shapley Decomposition methodology shows that a child's poverty status explains only about 7% of the variability in her/his enrollment status, and approximately 5% in her/his schooling progression status. In contrast, mother's and father's characteristics account for respectively 14.4% and 15.2% of the variability in a child's enrollment status. These results imply that child poverty and deprivations are different, but related phenomena, which makes it highly important to explain the causes of their mismatch.

In the second step, we test our fourth theoretical prediction, stating that parental education influences the mismatch between child poverty and deprivation in the dimension of education. In particular, we find that parental education has a negative effect on the probability that a non-poor child suffers some basic deprivations and a positive effect on the likelihood that a poor child suffers no basic deprivation. These results suggest that misalignment between household monetary resources and parental education is an important predictor of the mismatch between child poverty and deprivation, and put parental education at the center of the fight against child poverty.

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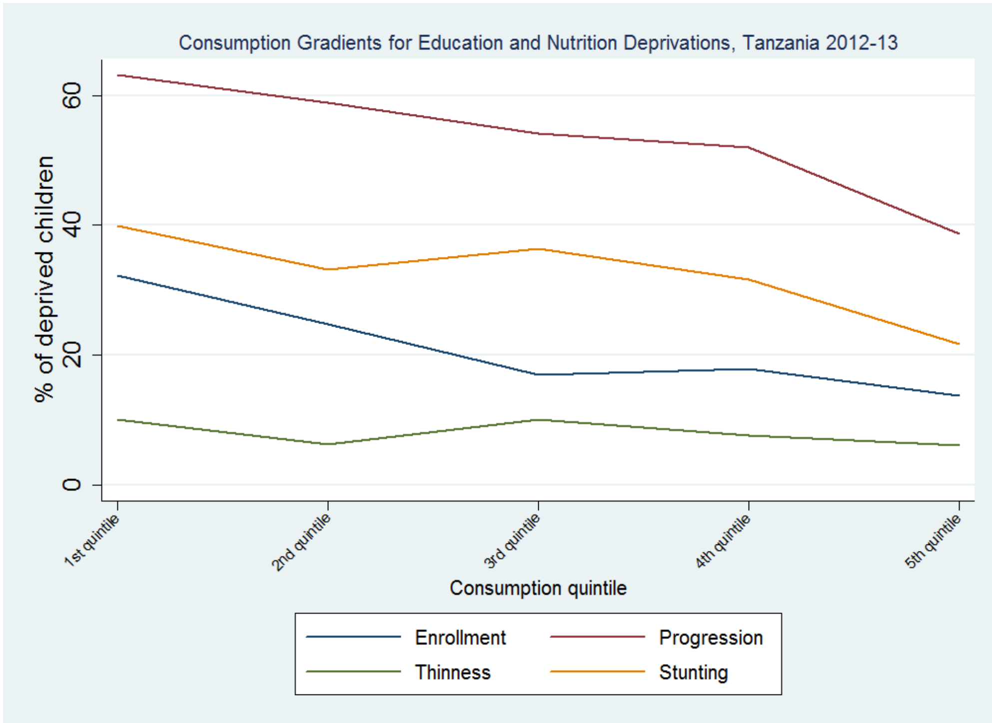

Figure 1: Consumption gradients for education and nutrition deprivations

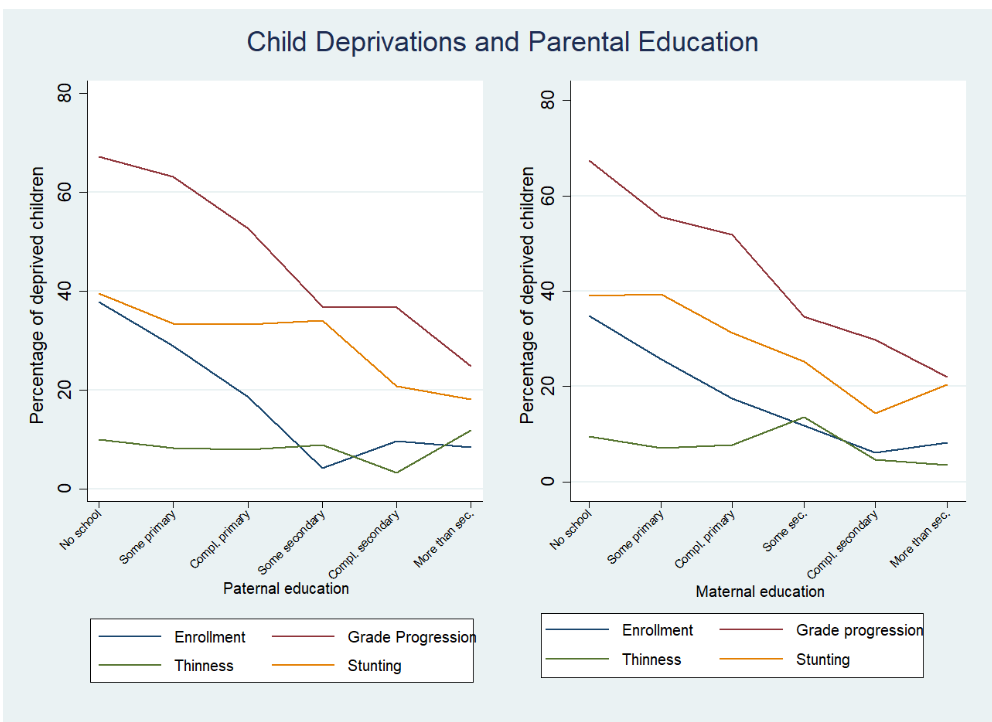

Figure 2: Child deprivations and parental education

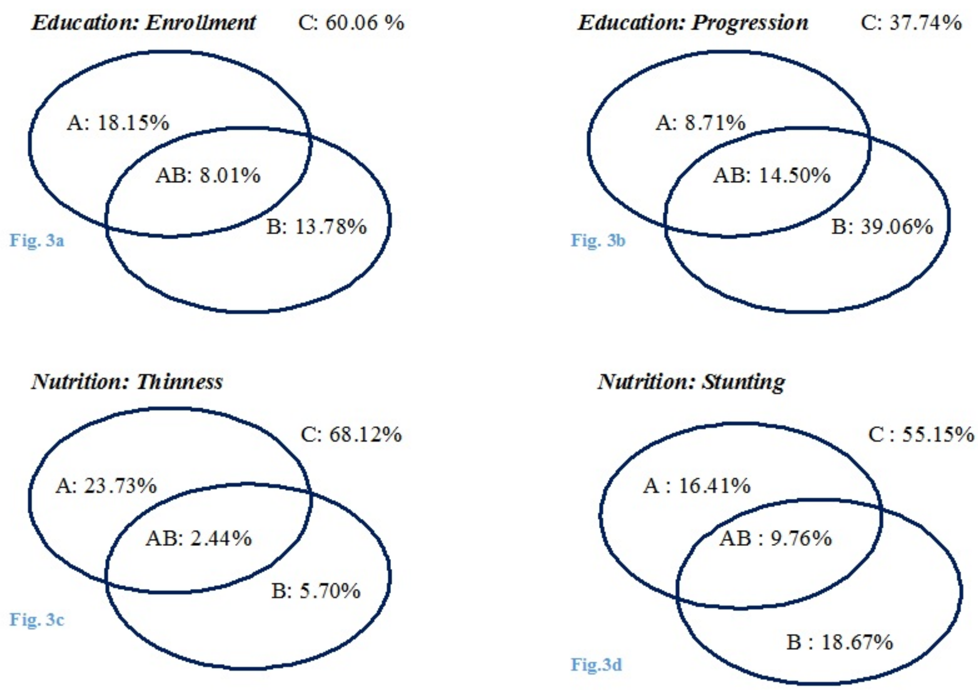

Figure 3: Patterns of mismatch between child poverty and deprivations

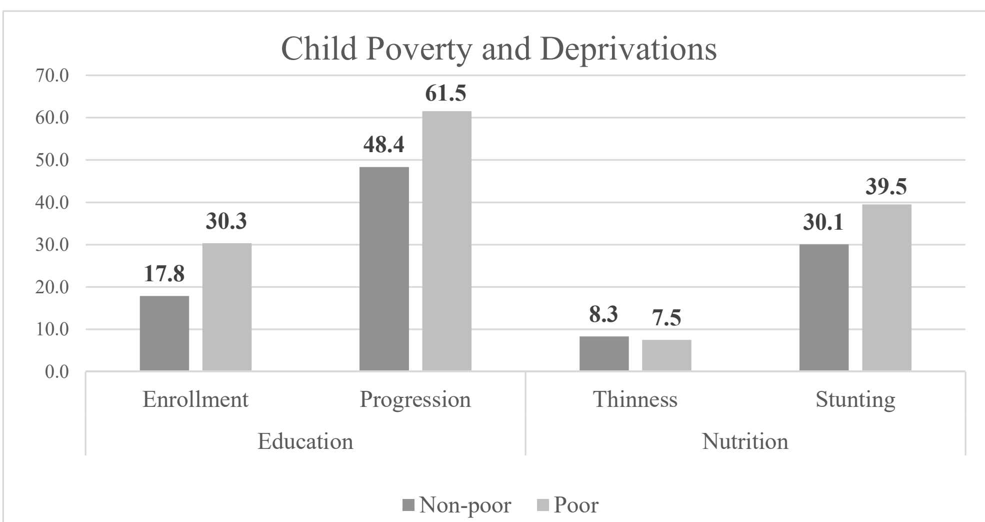

Figure 4: Child poverty and deprivations

Children aged 7-15		
Child characteristics	Number	Percent
Male	2,095	48.21
Female	2,251	51.79
Urban	1,101	25.33
Rural	3,245	74.67
Age 7	599	13.78
Age 8	540	12.43
Age 9	504	11.60
Age 10	508	11.69
Age 11	462	10.63
Age 12	495	11.39
Age 13	457	10.52
Age 14	409	9.41
Age 15	372	8.56

Source: Authors' own calculations from Tanzania's 2012/2013 NPS

Table 2: Sample Information

	Poverty	Education Deprivation		Nutrition Deprivation	
		Enrollment	Progression	Thinness	Stunting
Total	26.16	21.79	53.55	8.16	33.14
Region					
Dar es Salaam	0.90	12.65	30.08	6.30	26.15
Rest of urban	11.59	11.39	34.46	7.04	23.24
Rural	30.61	24.64	58.60	8.26	35.51
Zanzibar	16.72	8.25	65.78	14.01	26.87
Gender					
Male	25.16	23.97	58.34	8.68	37.24
Female	27.08	19.78	49.35	7.67	29.35
Wealth Quintile					
1st quintile	-	32.24	63.20	10.08	39.99
2nd quintile	-	24.75	58.91	6.34	33.23
3rd quintile	-	16.96	54.09	10.12	36.42
4th quintile	-	17.93	51.98	7.70	31.64
5th quintile	-	13.73	38.63	6.07	21.77

Source: Authors' own calculations from Tanzania's 2012/2013 NPS

Table 3: Child Poverty and Deprivation Rates

Table 4: Determinants of Child Education

	Enrollment		Progression	
Variables	Coef.		Coef.	
HH characteristics				
HH monthly consumption exp.	-0.064***	(0.020)	-0.058**	(0.024)
Number of kids	0.013***	(0.004)	0.003	(0.005)
Av. schooling others	-0.022***	(0.005)	-0.021***	(0.006)
HH head is female	-0.018	(0.058)	0.134	(0.102)
Negative shocks: yes	-0.018	(0.025)	0.080***	(0.030)
Month of survey fixed effect	Yes		Yes	
Child characteristics				
Child is female	-0.035**	(0.017)	-0.063***	(0.022)
BMI of child	0.037***	(0.010)	-0.060***	(0.012)
Age of child	-0.353***	(0.035)	0.315***	(0.037)
Age of child squared	0.017***	(0.002)	-0.011***	(0.002)
Child work	0.063***	(0.022)	-0.018	(0.027)
Mother characteristics				
Mother's age	-0.000	(0.002)	0.001	(0.002)
Mother living in HH	-0.061**	(0.028)	-0.057	(0.039)
Mother has primary	-0.098***	(0.027)	-0.137***	(0.031)
Mother has secondary	-0.121***	(0.043)	-0.235***	(0.055)
Self employed	-0.053	(0.053)	-0.148**	(0.063)
Unpaid family worker	-0.062	(0.056)	-0.100	(0.067)
Own farm	-0.076	(0.056)	-0.109	(0.067)
Father characteristics				
Father's age	0.003*	(0.001)	0.003**	(0.002)
Father living in HH	-0.014	(0.029)	-0.040	(0.037)
Father has primary	-0.114***	(0.037)	0.045	(0.042)
Father has secondary	-0.150***	(0.045)	-0.039	(0.056)
Self employed	0.018	(0.029)	-0.010	(0.045)
Unpaid family worker	0.076	(0.049)	-0.080	(0.065)
Own farm	0.008	(0.027)	-0.042	(0.042)
Other characteristics				
Gov. primary school	0.043	(0.031)	-0.002	(0.045)
HH is located in urban area	-0.055	(0.034)	0.014	(0.049)
HH is located in rural area	-0.017	(0.035)	0.112**	(0.050)
HH is located in Zanzibar	-0.137***	(0.052)	0.116	(0.075)
Intercept	2.861***	(0.307)	-0.976***	(0.371)
Number of obs.	1,992		1,546	
R-squared	0.210		0.302	

Robust standard errors in parentheses are clustered at the household level.
*p<.1; ** p<.05; *** p<.01.

Table 5: IV Estimation of the Effects of Household Monetary Resources on Child Education

Second-Stage Regressions		
Variables	Enrollment	Progression
HH monthly consumption exp.	-0.200***	-0.289***
	(0.048)	(0.063)
All Baseline Controls	Yes	Yes
Observations	1,989	1,989
Adjusted R-squared	0.184	0.255
Endogeneity test of endogenous regressors	10.196	15.985
p-value of endogeneity test	0.001	0.000
F-statistic	13.65	32.63
Anderson-Rubin chi-sq test of significance of endogenous regressors	16.83	21.49
p-value of Anderson-Rubin chi-sq test of endogenous regressors	0.000	0.000
F statistic for weak identification (Cragg-Donald or Kleibergen-Paap)	278.6	220.7
Hansen J statistic	0.000	0.000

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The instrument for household consumption is the generated wealth index of the household.

Table 6: IV First-Stage Regressions

First-Stage Regressions: Dependent Variable is HH monthly consumption exp.	
Variables	Coef.
HH wealth index	0.101***
	(0.008)
All Baseline Controls	Yes
Intercept	11.180***
	(0.221)
Observations	1,989
R-squared	0.445

Robust standard errors in parentheses are clustered at the household level.
*** p<0.01, ** p<0.05, * p<0.1.

Table 7: Determinants of Child Nutrition

	Thinness		Stunting	
Variables	I	II	III	IV
HH characteristics				
HH monthly consumption exp.	-0.020**	0.006	-0.093***	-0.100***
	(0.009)	(0.010)	(0.018)	(0.025)
Number of kids	-0.002	-0.002	-0.011***	-0.008*
	(0.002)	(0.002)	(0.003)	(0.004)
Av. schooling others	0.002	-0.000	-0.014***	-0.016**
	(0.002)	(0.003)	(0.004)	(0.006)
HH head is female	-0.047**	-0.020	0.008	0.051
	(0.022)	(0.033)	(0.059)	(0.090)
Negative shocks: yes	-0.016	-0.011	0.002	0.000
	(0.014)	(0.013)	(0.024)	(0.030)
Parental education				
Mother has primary	-0.018	-0.011	-0.019	-0.006
	(0.014)	(0.013)	(0.025)	(0.032)
Mother has secondary	0.017	0.033	-0.072*	-0.040
	(0.022)	(0.024)	(0.037)	(0.057)
Father has primary	-0.001	-0.011	0.000	-0.082*
	(0.015)	(0.017)	(0.030)	(0.043)
Father has secondary	-0.004	-0.016	-0.014	-0.060
	(0.021)	(0.023)	(0.041)	(0.056)
Month of survey fixed effect	No	Yes	No	Yes
Child characteristics	No	Yes	No	Yes
Mother characteristics	No	Yes	No	Yes
Father characteristics	No	Yes	No	Yes
Other characteristics	No	Yes	No	Yes
Intercept	0.320***	0.104	1.441***	1.328***
	(0.096)	(0.142)	(0.194)	(0.364)
Number of obs.	3,158	1,992	3,158	1,992
R-squared	0.005	0.340	0.030	0.106

Robust standard errors in parentheses are clustered at the household level.
*** p<0.01, ** p<0.05, * p<0.1.

Table 8: Interaction Effects between Household Monetary Resources Quintile and Parental Education

	Education				Nutrition			
	Enrollment		Progression		Thinness		Stunting	
Variables	Coef.		Coef.		Coef.		Coef.	
Interaction Effects								
1st quintile*Primary	-0.096*	(0.055)	-0.187***	(0.059)	-0.052**	(0.024)	-0.038	(0.058)
1st quintile*Secondary	-0.478***	(0.081)	-0.051	(0.085)	-0.083**	(0.036)	0.416***	(0.087)
2nd quintile*Noschooling	-0.049	(0.064)	-0.034	(0.072)	-0.045*	(0.026)	-0.059	(0.068)
2nd quintile*Primary	-0.099*	(0.059)	-0.140**	(0.060)	-0.035	(0.024)	-0.074	(0.060)
2nd quintile*Secondary	-0.401***	(0.077)	-0.423**	(0.175)	0.049	(0.045)	-0.140	(0.168)
3rd quintile*Noschooling	-0.111*	(0.066)	-0.037	(0.065)	-0.025	(0.030)	-0.118*	(0.071)
3rd quintile*Primary	-0.183***	(0.054)	-0.165***	(0.060)	-0.039	(0.026)	-0.123**	(0.058)
3rd quintile*Secondary	-0.197**	(0.093)	-0.386***	(0.150)	-0.044	(0.060)	0.148	(0.150)
4th quintile*Noschooling	-0.005	(0.073)	-0.175**	(0.085)	-0.020	(0.033)	-0.137*	(0.073)
4th quintile*Primary	-0.191***	(0.055)	-0.225***	(0.061)	-0.017	(0.025)	-0.078	(0.058)
4th quintile*Secondary	-0.184**	(0.085)	-0.275**	(0.116)	0.001	(0.054)	-0.306***	(0.097)
5th quintile*Noschooling	-0.079	(0.075)	-0.065	(0.091)	-0.079**	(0.033)	-0.159*	(0.089)
5th quintile*Primary	-0.198***	(0.056)	-0.262***	(0.064)	-0.033	(0.026)	-0.188***	(0.063)
5th quintile*Secondary	-0.216***	(0.065)	-0.338***	(0.078)	0.030	(0.035)	-0.242***	(0.073)
Child characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of obs.	1,992		1,546		1,992		1,992	
R-squared	0.215		0.306		0.344		0.109	

Robust standard errors in parentheses are clustered at the household level. *** p<0.01, ** p<0.05, * p<0.1.

Table 9: Shorrocks-Shapley Decomposition

	Education				Nutrition			
	Enrollment		Progression		Thinness		Stunting	
Regressor	Shapley v.	%	Shapley v.	%	Shapley v.	%	Shapley v.	%
HH consumption exp.	0.015	6.9	0.015	4.9	0.001	0.2	0.014	13.1
Other HH charact.	0.042	20.1	0.050	16.6	0.008	2.4	0.019	18.4
Child charact.	0.079	37.5	0.158	52.3	0.324	95.2	0.050	47.5
Mother charact.	0.030	14.4	0.041	13.4	0.004	1.1	0.005	4.9
Father charact.	0.032	15.2	0.025	8.2	0.002	0.6	0.010	9.6
Locational charact.	0.012	5.7	0.014	4.6	0.002	0.5	0.007	6.5
R-squared	0.210	100.0	0.302	100.0	0.340	100.0	0.106	100

Table 10: Estimates of the Heckman Model for Deprived Children in Education in Non-poor Household

Heckman (the outcome models): Deprived children in non-poor HH				
	Enrollment		Progression	
Variables	Coef.		Coef.	
HH characteristics				
Number of kids	0.013***	(0.004)	0.002	(0.006)
Av. schooling others	-0.017***	(0.005)	-0.025***	(0.007)
HH head is female	-0.080	(0.075)	0.166*	(0.097)
Child characteristics				
Child is female	-0.015	(0.019)	-0.054**	(0.025)
Age of child	0.010**	(0.004)	0.069***	(0.006)
Child work	0.061***	(0.022)	0.001	(0.029)
Mother characteristics				
Mother has primary	-0.092***	(0.027)	-0.126***	(0.037)
Mother has secondary	-0.108**	(0.048)	-0.258***	(0.062)
Mother other charact.	Yes		Yes	
Father characteristics				
Father has primary	-0.149***	(0.033)	0.065	(0.049)
Father has secondary	-0.169***	(0.045)	-0.037	(0.063)
Father other charact.	Yes		Yes	
Other characteristics	Yes		Yes	
lnsig_1	-0.987***	(0.024)	-0.795***	(0.024)
atanhrho_12	0.402***	(0.151)	0 .513***	(0.113)
Number of obs.	2,737		2,737	

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

Table 11: Estimates of the Heckman Model for Non-deprived Children in Education in Poor Household

Heckman (the outcome models): Non-deprived children in poor HH				
	Enrollment		Progression	
Variables	Coef.		Coef.	
HH characteristics				
Number of kids	0.003	(0.008)	0.023**	(0.012)
Av. schooling others	0.036***	(0.014)	0.005	(0.019)
HH head is female	0.065	(0.157)	0.471**	(0.228)
Child characteristics				
Child is female	0.095**	(0.041)	0.127***	(0.046)
Age of child	0.000	(0.009)	-0.097***	(0.010)
Child work	-0.075	(0.046)	0.137***	(0.051)
Mother characteristics				
Mother has primary	0.098**	(0.046)	0.085	(0.060)
Mother has secondary	0.524	(0.450)	-0.448	(0.448)
Mother other charact.	Yes		Yes	
Father characteristics				
Father has primary	0.094*	(0.055)	-0.054	(0.071)
Father has secondary	0.132	(0.155)	-0.188	(0.166)
Father other charact.	Yes		Yes	
Other characteristics	Yes		Yes	
lnsig_1	-0.756***	(0.055)	-0.757***	(0.145)
atanhrho_12	-0.473***	(0.155)	0.731*	(0.380)
Number of obs.	2,734		1,543	

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

Table 12: Heckman First-Stage Regressions: Non-Poor

Heckman (First-Stage): Dependent Variable is HH Monetary Poverty Status (1 if non-poor)		
Variables	Coef.	Std. Err.
Index of household economic well-being	0.245***	(0.026)
HH characteristics		
Number of kids	-0.022*	(0.012)
Av. schooling others	-0.002	(0.019)
HH head is female	-0.455**	(0.228)
Other characteristics		
Negative shocks: yes	-0.233***	(0.082)
Cash transfer	-0.087	(0.090)
Other income	0.000**	(0.000)
Land/field ownership	0.225*	(0.124)
Other controls	Yes	Yes
Number of obs.	2,737	2,737
Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.		

Table 13: Heckman First-Stage Regressions: Poor

Heckman (First-Stage): Dependent Variable is HH Monetary Poverty Status (1 if poor)		
Variables	Coef.	Std. Err.
Index of household economic well-being	-0.252***	(0.026)
HH characteristics		
Number of kids	0.023**	(0.012)
Av. schooling others	0.005	(0.019)
HH head is female	0.471**	(0.228)
Other characteristics		
Negative shocks: yes	0.237***	(0.082)
Cash transfer	0.071	(0.091)
Other income	-0.000**	(0.000)
Land/field ownership	-0.206	(0.126)
Other controls	Yes	Yes
Number of obs.	2,734	2,734
Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.		