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Measuring equality of opportunity in early childhood: A methodological proposal using demographic and health surveys

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Institute for Advanced Development Studies



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Measuring Equality of Opportunity in Early Childhood: A methodological proposal using Demographic and Health Surveys[#]

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Abstract:

There is conceptually a big difference between inequality of opportunity and inequality of outcomes, and the policies needed to address the two different kinds of inequality are also very different. However, it is difficult to measure inequality of opportunity. This paper proposes a new measure of equality of opportunity, based on the importance of family background variables for nutritional status in early childhood. We applied the proposed methodology to 166 Demographic and Health Surveys, from 60 different countries, carried out between 1991 and 2015. What stands out most strongly from these estimations is the low level of equality of opportunity in Latin America compared to the rest of the world. Family background is much more important for children's nutritional status in this region than in the rest of the world. In contrast, the countries of sub-Saharan Africa were found to have surprisingly high equality of opportunity, suggesting that in this region other factors than family background determine nutritional outcomes. The paper also explores relations between equality of opportunity and key development variables, as well as changes over time.

Keywords: Equality of opportunity, early childhood development, social mobility, nutritional mobility, Demographic and Health Surveys.

JEL classification codes: I14, I15.

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1. Introduction

The Lorentz curve and its corresponding Gini coefficient are often used to describe how unequal a country's income distribution is, and a high Gini coefficient is almost universally considered a sign of an unfair, and thus undesirable, outcome. However, the Lorentz curve is an incomplete measure of the fairness of the income distribution, because it says nothing about how each person has arrived at their present location in the distribution nor about how long they are likely to stay there (Andersen 2010).

In order to understand how unfair an income distribution is, it is necessary to understand the dynamics behind it. It is necessary to understand whether people have arrived at their current position in the distribution due to their own efforts -or lack thereof- or due to circumstances entirely beyond their own control (Roemer 1998). That is, we need to understand both the degree of equality of opportunity and the degree of equality of outcomes in order to judge the fairness and desirability of a particular set-up. The least desirable set-up is if inequality of opportunity translates into inequality of outcomes and high levels of poverty. Most desirable would be high equality of opportunity, moderate levels of inequality of outcome and low levels of poverty.

Many studies have found evidence of a general positive relationship between equality of opportunity and equality of outcomes, both across countries (e.g. Corak 2013; Neidhöfer 2016) and within countries over time or between provinces (e.g. Chetty et al. 2014 for the US; Fan 2015 for the case of China; and Güell et al. 2015 for the case of Italy). This positive relationship was termed “the Great Gatsby Curve” by Alan Krueger, Chairman of the Council of Economic Advisors, in his talk “The Rise and Consequences of Inequality” given at the Center for American Progress on January 12, 2012.

However, the relationship is not very strong (e.g. Brahim and McLeod 2016), and public policies can clearly have an effect on both equality of opportunity and equality of outcomes, thus disrupting the general relationship. Importantly, equality of opportunity and equality of outcomes may have opposite effects on growth, as shown for example by Marrero and Rodriguez (2013). In a recent comprehensive review of both laboratory experiments and cross-cultural evidence concerning inequality, Starmans et al. (2017) found that it is not inequality of outcomes that people object to, but rather unfairness. They conclude that it is important to disentangle concerns about inequality from concerns about unfairness and about poverty.

While there are well-established methods for quantifying equality of outcomes, measuring equality of opportunity has proven much more difficult. Andersen (2003) developed a useful method to estimate equality of opportunity during the educational phase of life, by assessing the importance of family background on educational outcomes. If household income and parents' education were important predictors of schooling gaps, then social mobility (or equality of opportunity) was considered low. In contrast, if all children received similar schooling irrespective of the wealth and education of their parents, this would indicate a high degree of equality of opportunity.

However, as primary and secondary education is becoming almost universal in most countries, both the variation in the outcome variable and the returns to education are decreasing. This means that, as an indicator for future outcomes, schooling gaps are becoming less and less useful.

In this paper, we propose an alternative, complementary method for quantifying the degree of equality of opportunity in a society. This method focuses on nutritional status in the first five years of life. Nutritional status can be reliably measured early in life, and it is also likely to have a significant influence on the future social and economic outcomes of the person (Currie 2009; Haas 2006). The basic idea is similar to that of Andersen (2003). If family background is important for the nutritional status of the child, equality of opportunity is considered low, whereas if the nutritional status is similar irrespective of the wealth, education and health of the parents, then equality of opportunity is considered high.

The remainder of the paper is organized as follows. Section 2 provides a review of the importance of early childhood nutrition on health, education and incomes later in life. Section 3 describes the data used and provides an overview on the improvements in childhood nutrition around the world since 1990. Section 4 presents a proposal on how to use standard Demographic and Health Surveys to estimate the importance of family background on childhood nutritional status. Section 5 shows how these results can be turned into a Nutritional Mobility Index and presents some preliminary results for all countries for which sufficient data is available and accessible. Section 6 analyzes the relationships between nutritional mobility and other variables of interest for the development community, such as GDP per capita, inequality of outcomes, and health care spending. In section 7 we look at changes over time in the Nutritional Mobility Index for the 17 countries for which at least four rounds of Demographic and Health Surveys are available. Section 8 discusses some limitations of the proposed methodology and section 9 concludes and provides directions for further research.

2. The importance of childhood nutrition – a literature review

Since one of the basic premises of this paper is that nutritional status in early childhood has important consequences throughout life, this section will review existing empirical evidence concerning the impacts of early childhood nutrition on outcomes later in life. According to the studies reviewed below, poor health in childhood can begin already *in utero*, and negatively affects cognitive development, limits future educational attainment, begets poor health later in life, diminishes lifetime earnings, and facilitates the intergenerational transmission of poverty.

2.1. Intrauterine growth restrictions have adverse health impacts later in life

The basis for *in utero* conditions affecting a child's health stems from the *foetal origins hypothesis* (Barker 1995), and the empirical evidence in support of this continues to grow. The hypothesis challenges prior held beliefs that the mother's womb provides a secure and unexposed environment for the foetus to grow in that is unaffected by environmental conditions or the mother's own health (Almond and Currie 2011). *In utero* health is typically measured by a child's weight at birth.

Victora et al. (2008), in their review of cohort studies from Brazil, Guatemala, India, Philippines and South Africa, provide support for the importance of intrauterine conditions for the child's health, not only finding a correlation between stunted mothers and children with low birthweight, but also finding that children born to stunted mothers are more likely to be stunted themselves. Dewey and Begum (2011) extensively review literature on the effects of poor *in utero* conditions. They report results from Özaltın et al. (2010), who use 109 DHS surveys from 1991-2008 in 54 countries to show that children (0-5) experience 40% increased risk of mortality when born to the shortest mothers.

These results are in large part attributed to intrauterine growth restriction (IUGR), which disproportionately affects the shortest/stunted mothers, as uterine blood flow and development of the uterus, placenta and foetus are all restricted causing increased risk of child mortality but also affecting immune functioning and increasing risk of chronic disease (Dewey and Begum 2011). Furthermore, the existence of long-term effects of low birth weight on educational and labour force outcomes, a result of *in utero* conditions, have been documented (Almond & Currie 2011; Currie and Goodman 2010; Delaney and Smith 2012; Dewey and Begum 2011; Victora et al. 2008). Oreopoulos et al. (2008), who use cohort studies of twins and siblings in Manitoba, Canada, show that children born with low birthweight were 8% less likely to be enrolled in 12th grade at 17 than their healthy counterparts, and that those born pre-term (under 38 weeks) are 2.5% less likely to be in 12th grade at 17 than a child born at 40 weeks. Black et al. (2008) also report that increases in birth weight are associated with increases in high school graduation, the IQs of men, earnings and adult height.

Likewise, two natural experiments have helped to prove the importance of intrauterine conditions to the long-term well-being of children in terms of health and socio-economic outcomes. Almond (2006) studied *in utero* exposure to the 1918 influenza pandemic in the United States. Tracking long-term outcomes using US Census data from 1960-1980, Almond showed that children exposed to the pandemic while *in utero*: experienced reduced educational attainment and were 15% less likely to graduate high school, reported increased rates of physical disability, earned lower incomes (for men, wages were 5-9% lower), and the likelihood of being poor increased 15%. Similarly, in a study on intrauterine exposure to the Dutch Famine in 1945, Lumey and Stein (1997) reported that exposure had latent health effects, as exposure nearly doubled obesity rates and increased the risk of heart disease. Hoddinott et al. (2013) expands upon the latent health effects of poor *in utero* conditions and suggests that the increase in the prevalence of chronic disease due to intrauterine shocks and low birthweight have direct costs not only for individuals but entire populations as well. Moreover, chronic diseases restrict human capital development as school days are missed affecting education, the number of days worked typically decreases thus affecting wages, and treating the disease is costly both in terms of time and money, negatively impacting wealth accumulation.

It is in all these ways that foetal conditions persist throughout the life course, the effects of which can remain dormant until late adulthood (Almond and Currie 2011). The finding that low

birthweight is predictive “of health or human capital outcomes in later life may indicate that low birthweight is a marker for poverty or other sources of deprivation...while *in utero*. If that deprivation persists through life, it is not clear whether it is these other factors (unobserved and persistent) or low birthweight that causes poorer outcomes in later life” (Strauss and Thomas 2007, p. 6). While the causal mechanism may be in doubt, there is little doubt health in early childhood and even *in utero* is important to combatting the persistence of poverty, as poor health from the earliest ages can alter the trajectory of the life course. The main mechanism through which this happens is likely to be the effect poor childhood health has on cognitive development.

2.2. Poor health in childhood negatively impacts cognitive development

Using 2004 data from UNICEF on the percent of children (0-5) living in poverty and data on the prevalence of chronic malnutrition (stunting) obtained from WHO for 156 countries, it is conservatively estimated that more than “200 million children under 5 years fail to reach their potential in cognitive development because of poverty, poor health and nutrition, and deficient care” (Grantham-McGregor et al. 2007, 60). Hoddinott et al. (2013) reviews evidence on the consequences of chronic undernutrition for future cognitive ability by citing the effects undernutrition has on the brain, altering chemical processes that deal with memory formation, motor skills, and the speed of brain functioning.

Using data from the United States, Behrman and Rosenzweig (2004) show that babies with low birthweight are limited in cognitive and neurological functioning, which limits their productivity as adults, and for women, increases the probability that their babies are also with low birthweight. Belli et al. (2005) cites early cost-benefit analyses from the 1980s-1990s underscoring that chronic malnutrition in the first two years of life permanently impairs cognitive ability, height and visual acuity, which damages future earnings and productivity. The effect of height on future earnings and productivity is particularly interesting, as a strong positive association exists between height and lifetime earnings and wages, in addition to a strong correlation between childhood height and adult height (Deaton 2007). It is argued “poor nutrition in childhood likely affects both future cognitive performance and adult height, leading to the observed correlation between height and earnings, even in countries where physical strength is no longer closely related to earnings potential” (Currie 2009, p. 108).

Case and Paxson (2008) affirm this argument when commenting on the positive association seen between height and labour market outcomes, noting it is not necessarily the case taller people make more money, but rather that height and cognitive ability are associated, and cognitive ability is rewarded in the labour market. It has been suggested this relationship exists due to the increased strength of taller individuals, but Case and Paxson also show that the positive correlation between

height and earnings stands in developed countries, where manual labour is far less prevalent, further pointing to height as a proxy for cognitive development.¹

Furthermore, both health, height and cognitive ability are products of inputs and investments in early childhood (Strauss and Thomas 2007). In two studies evaluating the effect of early childhood nutritional intervention and investment on adult outcomes in Guatemala, Hoddinott et al. (2008) and Maluccio et al. (2009) attribute long-term gains in schooling attainment, improved cognitive test scores, increases in adult height, and reductions in chronic malnourishment to the intake of nutritional supplements. Each study suggests further research is needed, but it seems increasing nutritional supplementation generates long-term benefits due to enhancement in cognitive ability, pointing to the importance of early childhood nutrition for cognitive development. In short, “poor health in childhood has been linked to diminished cognitive development and academic achievement (Boardman et al. 2002; Currie and Stabile 2006), and such insults are ultimately associated with lower levels of completed schooling (Case et al. 2005; Haas 2006; Haas and Fosse 2008) and impaired occupational attainment (Case et al. 2005; Haas 2006)” (Haas et al. 2011, p. 299).

Up to this point, we have seen evidence documenting the ‘long arm’ of childhood health – even beginning in utero – and have seen that poor health in childhood alters cognitive development trajectories and can cause development deficits. What those cognitive deficits lead to is where the large implications for nutritional mobility emerge.

2.3. Poor childhood health limits future educational attainment and diminishes adult earnings

Given poor childhood health limits cognitive development, which plays an important role for both schooling and occupational standing, it is no surprise the consequences of poor childhood health extend to educational attainment and future earnings. Studying Filipino children, Glewwe et al. (2001) found children in good health start school earlier and are more productive on a yearly basis as they have more time to learn. Currie and Goodman (2010) further document that poor childhood health impairs skill acquisition, increases school absences, and affects student’ abilities to learn. This relationship between health and education has been observed in a variety of settings.

Using National Child Development Study data from Great Britain, a positive and significant effect of childhood health on educational attainment, health, employment and earnings has been documented (Case et al. 2005). The findings suggest that unhealthy children, measured by height and birthweight, not only are in poorer health as adults, but also achieve less schooling and earn less on average as adults than their healthier counterparts. In Denmark, education and health have been shown to be two channels of earnings persistence across generations. Using a cohort analysis, Eriksson et al. (2005) take point of departure in the understanding that health capital affects labour market outcomes and can also explain earnings correlations across generations. In the article, health capital in childhood is affected by a number of factors including socio-economic Status

¹ For a more complete discussion on the relationship between cognitive ability and height, see Currie and Vogl (2013).

(SES), position in the income spectrum, *in utero* conditions, family health preferences and family background. Moreover, given the role of educational attainment in job market opportunities, and given the extent to which educational attainment is negatively impacted by poor health in early childhood, poor childhood health can be seen as a cause, functioning through its effect on education, that reduces earnings trajectories for less healthy populations. However, poor childhood health can simultaneously be seen as an outcome for those less healthy populations, as education and earnings both influence the health outcomes of future generations, further perpetuating the persistence of social inequalities and reflecting the interdependence of childhood health and SES (Haas et al. 2011).

In a less developed country context, improving childhood health is seen as a means to improve educational outcomes, which could in turn improve quality of life (Glewwe and Miguel 2007). As such, the correlation between increased educational attainment, and its subsequent income and wealth gains, have powerful implications for nutritional mobility, especially if disparities in educational attainment are due to poor health in childhood determined by family background (Olshansky et al. 2012). Likewise, Currie and Goodman (2010) conclude that given health's role in improving educational outcomes, if family background is a factor affecting childhood health, it is likely poor childhood health will affect future educational attainment and SES.

2.4. Poor childhood health can affect subsequent generations and contribute to the intergenerational transmission of poverty

As substantial associations between parental wealth, educational success and mobility have been documented (Black and Devereux 2010), it cannot be ruled out that health is not a factor in this relationship. Family wealth could act as a shield impeding health insults from reaching their children, thus enhancing cognitive ability of their children, while potentially increasing educational attainment, job opportunities, wages and wealth accumulation and in general leading to better health over the life course of their children (Pfeffer and Hällsten 2012). If this is so, health may act as a key facilitator in persistent outcomes within families and between generations. While intergenerational correlations of earnings and education have been extensively researched (see Black and Devereux 2010), the intergenerational correlation of health is increasingly studied to better understand health's role in the intergenerational persistence of poverty. Bhalotra and Rawlings (2013), using DHS data from 38 developing countries on 600,000 mothers and 2.24 million children from 1970-2000, provide the most convincing evidence of the intergenerational persistence of health. The authors investigate how maternal health impacts childhood health and status, finding that socio-economic status plays a mediating role in the intergenerational transmission of health as the negative effects of poor maternal health are greater for children born into poorer socio-economic conditions.

Additionally, the risks of having a short or stunted mother, which reflects cumulative health inputs and environmental circumstances over the entire life course of the mother (Case and Paxson 2008; Dewey and Begum 2011; Bhalotra and Rawlings 2013), are greater than that of having a taller mother alluding to a crucial role for health in determining life chances. These increased risks are

especially important given that stunted mothers are more likely to bear chronically malnourished children indicating the children born to stunted mothers are beginning life disadvantaged and are inherently more at risk (Dewey and Begum 2011). Behrman and Rosenzweig (2004) also discuss how hereditary factors play a role in the intergenerational correlation of health between mothers and their children, as nutritional preferences, habits and customs are passed down further perpetuating the health correlation across generations. Moreover, this correlation of health does not begin between mothers and their children, as a small correlation between grandmother's height and birthweight and their grandchildren's height and birthweight have also been found (Victora et al. 2008). As such, and in keeping with the interdependent relationship of health and socio-economic status proposed by Haas (2006) and Haas et al. (2011), poor health has the potential to generate poverty traps.

The literature suggests the intergenerational transmission of health is not solely genetic, as family background also plays a role in facilitating the persistence of health outcomes across generations. Considering the evidence presented on the long reach of childhood health, beginning with the health of the mother even prior to pregnancy and extending all the way to old age and wealth accumulation, it appears the 'long arm' of childhood health spans generations. As Case et al. (2005) aptly state: "children born into poorer families experienced poorer childhood health, lower investments in human capital and poorer health in early adulthood, all of which are associated with lower earnings in middle age – the years in which they themselves become parents." The effects of poor childhood health accumulate over time. The factors putting children at risk of poor health are very dependent on social circumstances and ultimately impact life chances and future opportunities. If these social circumstances are connected to family background characteristics, it could spell trouble for equality of opportunity.

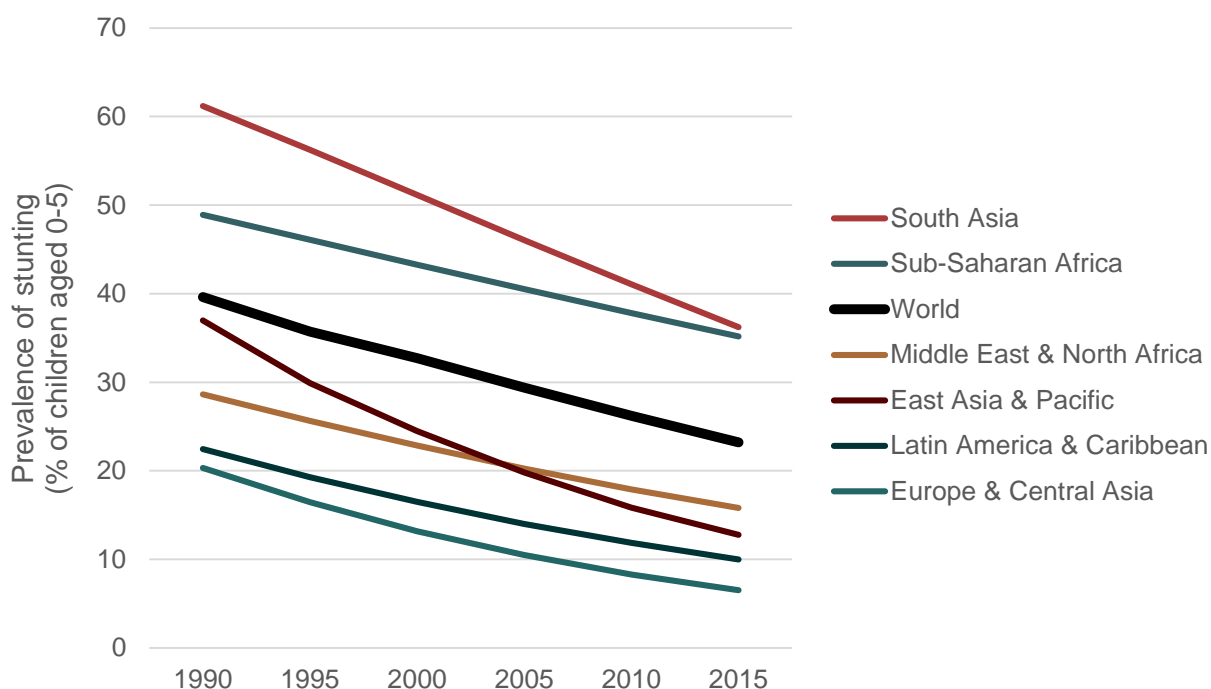
3. Data and basic tendencies in childhood nutrition

The data used in this paper is exclusively drawn from the Demographic and Health Survey (DHS) Program (<https://www.dhsprogram.com/>) which has been collecting data on health and socio-economic conditions in low- to middle-income countries since 1984. One feature of the DHS program is that it uses a core questionnaire for all of its surveys making cross-country comparisons possible. The DHS's target population is women in their reproductive age, defined as women aged 15-49, and their children who live in the household. The DHS survey design follows a two-stage cluster sampling procedure; the first stage consists of rural and urban clusters and the second stage of households in that cluster. The selection of the datasets for this paper was based on the availability of the required data for the analysis, such as height-for-age z-scores for children, the DHS wealth index and mother's height. The selection of data used comprises 60 countries from five regions of the world, encompassing 166 different survey rounds. The period covered is 1991-2015. In total, and for our purposes, 166 surveys have the data required for the analysis of 919,343 children. While some countries only have one suitable survey round available, other countries present up to nine rounds, resulting in an average of almost three rounds per country. The number of observations differs greatly between countries. For example, the smallest number of

observations is 565 for the estimation made in Kazakhstan, compared to the large size of the Indian DHS survey from 2005, which covers 41,071 children. The small numbers of observations in some surveys are largely caused by missing height-for-age data, which is not always available for all the children in the sample. However, the average number of observations is 5,538 (see Table A1 in the Appendix A for details).

During the period of analysis, the World has seen impressive improvements in child nutrition. Figure 1 shows that the share of stunted children (as measured by a height-for-age Z-score below -2) globally has fallen by 41% from 36% of all 0-5 year olds in 1990 to 23% in 2015. All regions have contributed to this fall, with South Asia and East Asia and the Pacific seeing the steepest drops, but Europe and Central Asia and Latin America and the Caribbean also seeing very large drops in percentage terms (68% and 56%, respectively). Sub-Saharan Africa is the region that has seen the least progress, with a drop of only 28% from 46% in 1990 to 35% in 2015. South Asia, despite dramatic improvements, still has the highest level of stunting, though.

Figure 1: Trends in early childhood stunting, 1990-2015, globally and by region



Source: Authors' elaboration based on data from the World Bank's World Development Indicators (<http://data.worldbank.org/indicator/SH.STA.STNT.ZS>).

While there is of course variation between countries within each region, few countries go completely against the trend. Benin is such a case, though, with childhood stunting increasing steadily from 25.1% in 1996 to 40.5% in 2011-12 (see Appendix A for country level details).

The large reductions in stunting worldwide imply that many fewer children get off to a bad start in life, and we might therefore expect to find increasing equality of opportunity. However, as we will see in the rest of this paper, this result is by no means automatic.

4. Measuring the importance of family background on childhood nutrition – a methodological proposal

In this paper we propose a new empirical method to estimate how important family background is for the nutritional status of young children, under the assumption that if family background is not important, this implies a high level of equality of opportunity (all children are equally nourished, irrespective of whether their parents are rich or poor, well-educated or not, short or tall). In contrast, if family background is important for the nutritional status of the child, equality of opportunity is low.

This section will explain in detail how we recommend estimating the importance of family background on the nutritional status of the child. First, we explain our preferred way of measuring childhood nutritional status, then we explain which family background variables we use, then the other control variables that need to be taken into account, and finally we explain our recommended procedure for determining the importance of family background.

4.1. Measuring childhood nutrition

Since we are using early childhood nutrition as a proxy for future life opportunities, we need the nutritional measure that is most closely related to future opportunities, which, according to the literature survey above, is height compared to what is normal for a healthy child. Low height (stunting) is an indicator of chronic malnutrition or frequent exposure to infections or parasites that prevent the child from absorbing the nutrients it is receiving. It is also an indicator that is persistent over time, in contrast to acute malnutrition, which can arise from temporary famine or illness, but can be reverted with timely treatment.

It is widely agreed the best indicator to use to analyze the chronic nutritional status of a group of children is the height-for-age z-score (HAZ), which indicates how many standard deviations a specific child is away from what is normal for a healthy child of the same gender and age. The reference growth curves currently in use were developed by the World Health Organization Multi Centre Growth Reference Study and reflect the growth of an ethnically diverse group of healthy, breast-fed children of non-smoking mothers from Brazil, Ghana, India, Norway, Oman and the USA (World Health Organization 2006).

The great advantage of the z-score measure is that it is independent of age and gender, since these two variables have already been taken into account when calculating the z-score. This greatly facilitates comparisons across age and gender and any other variable of interest. The HAZ variable is available in the DHS surveys only for 0-5 year-old children, so that is the age group that we will analyze.

Children are usually classified as chronically malnourished if their HAZ score is below -2, and as severely chronically malnourished if the HAZ score is below -3. In this study, however, we will use the original continuous HAZ score variable, rather than a dummy variable for chronic malnutrition, in order not to lose valuable information.

4.2. Measuring family background

According to the literature survey above, there are three important family background variables that can have a direct effect on children's health: 1) socio-economic status, 2) mother's education, and 3) mother's height.

To measure socio-economic status, we use the wealth quintiles calculated by DHS based on the assets and services present in the household. These wealth quintiles were specifically constructed to reflect relative socio-economic status based on asset variables readily available in all DHS surveys, such as: type of flooring, water supply, sanitation facilities, electricity, radio, refrigerator, telephone, vehicles, ownership of agricultural land, domestic servant, etc. (Rutstein and Johnson 2004). Fortunately, neither mother's education nor mother's height are used in the calculation of the wealth quintiles, so there is no overlap between our family background variables.

The wealth quintile variable was not calculated in the first rounds of DHS surveys, so the lack of this key variable prevents us from using some of the earliest DHS surveys (before 1991).

Both mother's education in years and mother's height in centimeters are core variables available in all DHS surveys.

4.3. Other important control variables that should be included

The age of the child (measured in months) is an important control variable since the likelihood of malnourishment varies substantially during the first five years of life. Young babies of breast feeding age usually grow quite close to the optimal growth curve, no matter whether they are from rich or poor households. However, discrepancies start emerging as soon as breast feeding stops and children depend on other sources of nourishment. A detailed analysis of the height data in the DHS surveys show that until about the age of 2.5 years, the gaps between rich and poor children's heights keep increasing, after which the gap tends to remain stable. Since the effect is non-linear, we include both age and age squared in the regression.

Although the age range from 0.5 years to 2.5 years is the most crucial for interventions to avoid permanent adverse effects of malnutrition, the effects of past malnourishment can be clearly observed in 2.5 to 5 years old children as well. We can therefore use the whole group of children for which anthropometric data is available, that is, all children up to 5 years old.

The gender of the child is also an important control variable. While some might suspect that young girls in developing countries are receiving lower priority by their parents than young boys, this control variable almost always show a slight advantage for girls, in terms of a higher HAZ score. According to the regression results presented in Appendix B, girls have a significantly higher HAZ

score than boys in 93 out of the 166 regressions carried out for this research, while boys only have a significantly higher HAZ score in five out of the 166 regressions (all in Bangladesh and Nepal). In the remaining 68 regressions, there were no statistical difference between boys and girls (see Appendix B for details).

Birth-order is another important control variable, since first-born and second-born children tend to be better nourished than their higher birth-order siblings (e.g. Rutstein and Winter 2014). As the number of children grow, scarce resources are shared between more persons in the family, so household size is another control variable that we include in the regressions.

Children of very young mothers have been shown to suffer disadvantages in terms of low birth weight and subsequent stunting (e.g. Fall et al. 2015), so we also include mother's age at the birth of the child as a control variable. Similarly, if the head of household is very young, the family tends to have fewer resources available to raise the children, so we also include the age of the head of household. The gender of the head of the household may also have an effect in some countries, and is also included as a control variable.

Finally, we include a rural dummy in the regressions, since rural and urban households by nature have very different access to sources of nutrition. One might think that, when controlling for wealth, education, family size and more, rural households would be better able to feed their children, since their main activity is to grow food. But we generally find the opposite result. Even when controlling for wealth, education, and all the other control variables mentioned above, urban households are generally better able to adequately feed their children. According to the regression results presented in Appendix B, rural children have a significantly lower HAZ score than urban children in 76 out of the 166 regressions carried out for this research, while rural children only have a significantly higher HAZ score in 10 out of the 166 regressions. In the remaining 80 regressions, there were no statistical difference between rural and urban regions, once controlling for other factors.

4.4. Using the Fields Decomposition to estimate the importance of family background

Following Andersen (2003), we recommend using the Fields' decomposition (Fields 1996, 2003, 2004) to assess the importance of family background on children's HAZ scores. The Fields' decomposition yields a Factor Inequality Weight (FIW) for each of the explanatory variables in a regression, indicating the percentage of the total variation in HAZ scores that is explained by each of the explanatory variables. The FIWs thus sum to the R^2 of the regression.

Appendix B shows the estimated FIWs for the three family background variables for all 166 DHS surveys analyzed.

A Stata ado-file for complementing an OLS regression with the Fields' decomposition is available from the corresponding author upon request.

5. A Nutritional Mobility Index to measure equality of opportunity in early childhood

In this section we show how the results from the regressions and decompositions in the previous section can be converted into a Nutritional Mobility Index (NMI). We want the NMI to vary between 0 and 1, with high values indicating high nutritional mobility (i.e. family background is not important for explaining children's nutritional status) and low values signaling low nutritional mobility (i.e. family background explains an important part of the variation in nutritional status between children).

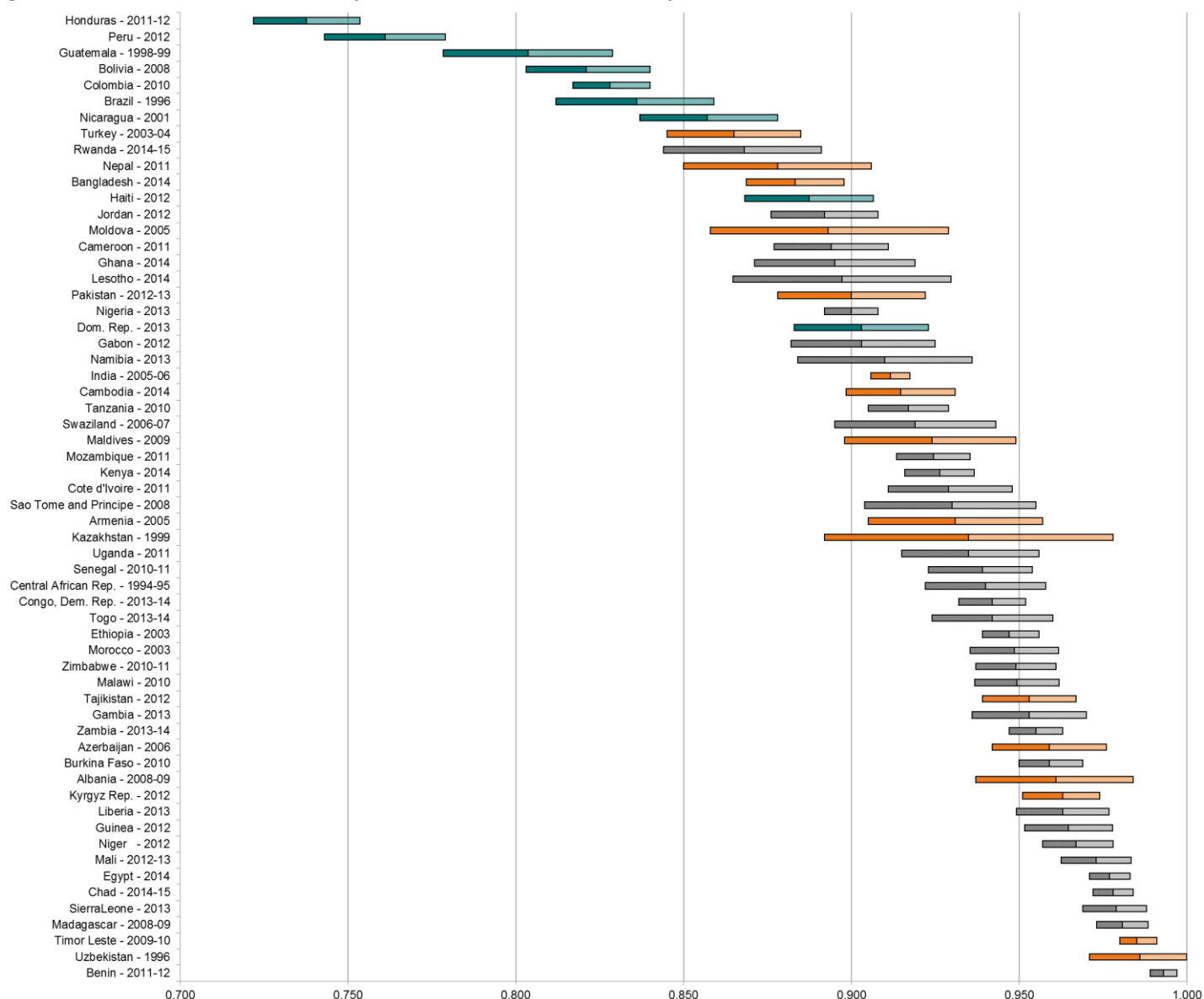
The Fields' decomposition allows us to create such an index, by simply subtracting the sum of the FIWs of the three family background variables from 1. Thus, the Nutritional Mobility Index for country i at time t becomes:

$$NMI_{i,t} = 1 - (FIW_{i,t}^{wealth} + FIW_{i,t}^{momedu} + FIW_{i,t}^{momheight})$$

Figure 2 shows the estimated NMI with 95% confidence intervals for the latest year available for all countries for which DHS surveys are available. The detailed data for these and previous years are available in Appendix C.

Countries are ordered from lowest nutritional mobility at the top to highest nutritional mobility at the bottom of the figure, and countries are colour coded by region (green = Americas; orange = Asia and Europe; grey = Africa and the Middle East). The graph includes the central NMI estimate, as well as a 95% confidence interval estimated by bootstrapping (1000 replications).

Figure 2: The Nutritional Mobility Index, all countries, latest year available



Source: Authors' estimation using the latest DHS survey available for each country.

It is clear from this graph that there are statistically significant differences between countries, with Latin American countries tending to have significantly lower nutritional mobility than countries in Africa, while Asian countries are somewhere in between. The NMI for Honduras, Peru, Guatemala, Bolivia, and Colombia, for example, are significantly lower than the NMI found in any country outside Latin America. The two Caribbean countries in the sample, Haiti and the Dominican Republic, are also in the low end, but more similar to Asian and European countries than to South American countries.

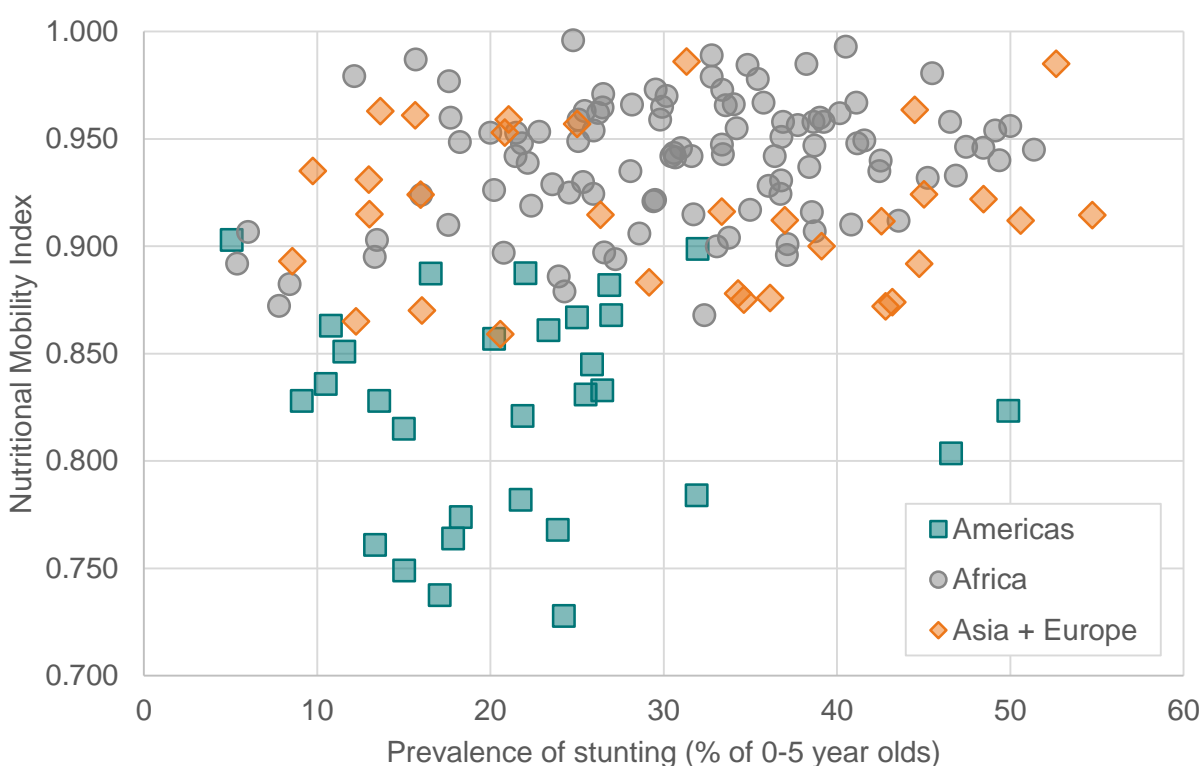
From these estimations it would seem that equality of opportunity in early childhood is much higher on the African continent, whereas there is much higher inequality of opportunity in the Latin American region. In the following sections we will explore why this might be the case.

6. Correlations between Nutritional Mobility and key variables of interest

In this section we will explore some simple correlations between our Nutritional Mobility Index and other variables of interest for the development community, such as stunting, GDP per capita, inequality of outcomes, and health care spending per capita.

First, as chronic malnutrition/stunting is falling around the world, one might expect that nutritional mobility would be increasing, as there would be less room for family background to determine differences in malnutrition. Figure 3 plots our Nutritional Mobility Index (all countries, all years) against the prevalence of stunting (in the same country in the same year).

Figure 3: Correlation between the prevalence of stunting and the Nutritional Mobility Index, all countries, all years available

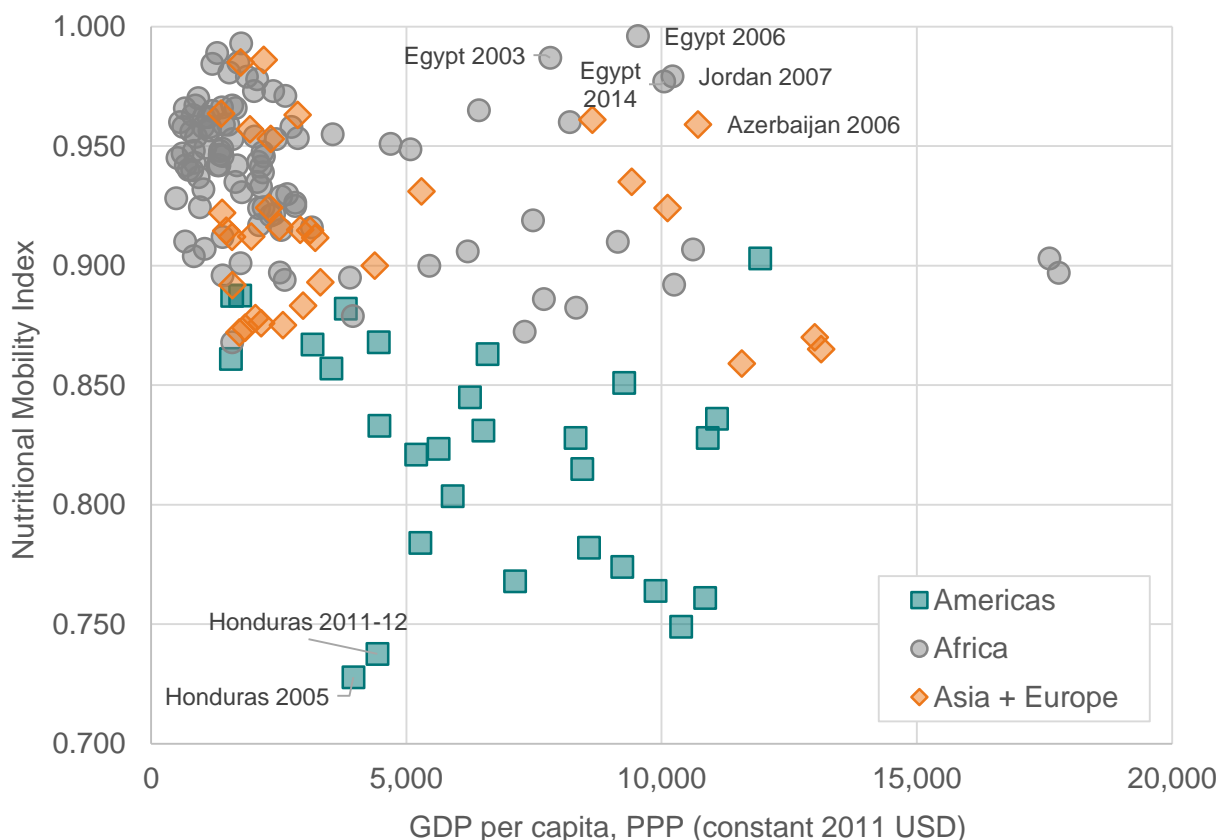


Source: Authors' estimation using all DHS surveys available.

The correlation is positive ($\rho = 0.31$), indicating that countries with high levels of stunting also have high levels of nutritional mobility, whereas countries with lower levels of stunting tend to have lower levels of nutritional mobility. This is the opposite than expected, and it means that focusing on reducing malnutrition is not automatically going to increase equality of opportunity. The positive correlation is mainly driven by the low levels of nutritional mobility in Latin America, though. If we only look at the observations in Africa and Asia, there is little evidence of a correlation, implying that the processes causing chronic malnutrition are relatively independent of the processes causing inequality of opportunity.

Second, we might expect countries to improve the Nutritional Mobility Index as they become richer and better able to fund basic public health services. However, this is not what we find. Figure 4 shows a negative correlation between GDP per capita and our Nutritional Mobility Index ($\rho = -0.43$), indicating that richer countries have less equality of opportunity than poorer countries. The result is to a large extent driven by the observations from Latin America, which tend to be relatively rich, but have low levels of equality of opportunity.

Figure 4: Correlation between the level of GDP per capita and the Nutritional Mobility Index, all countries, all years available



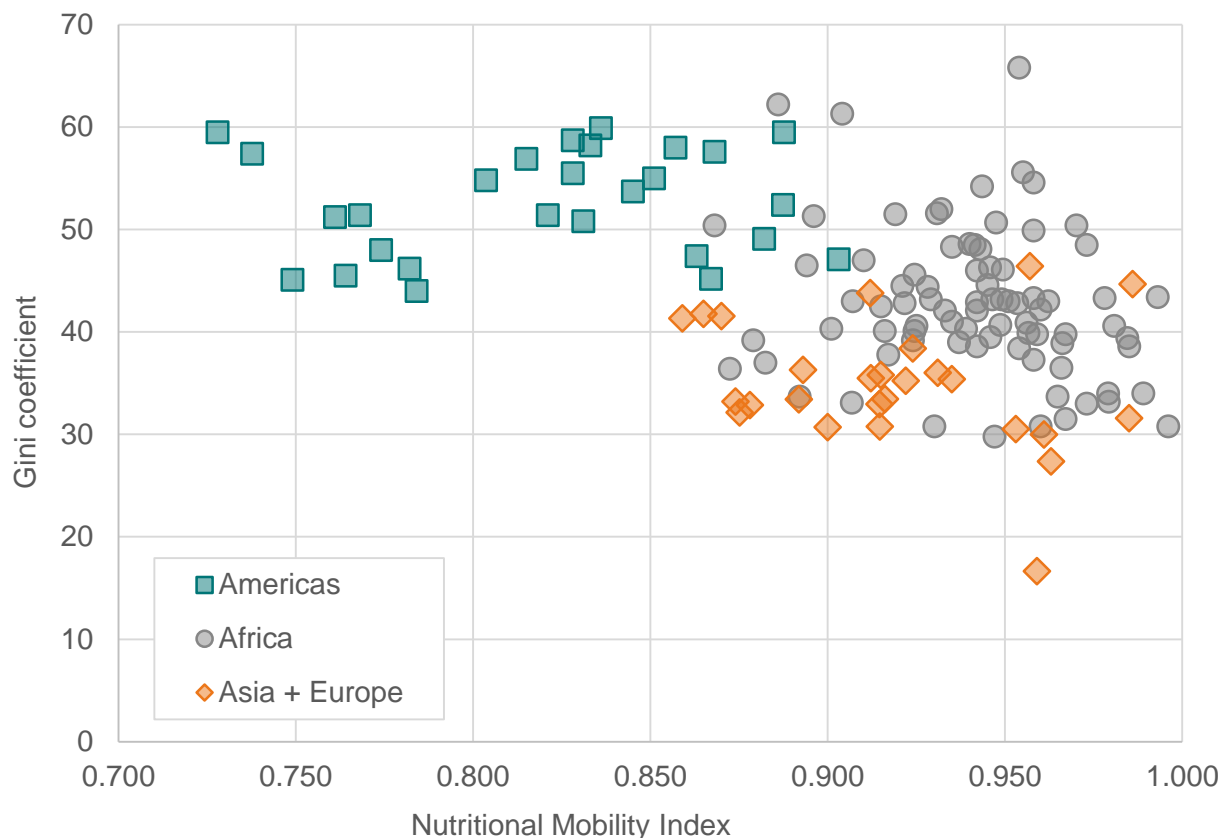
Source: Authors' estimation using all DHS surveys available and income data from the World Bank's World Development Indicators for the same countries and the same years.

It is important to note here that our sample does not include rich countries, so we could be observing only the downward sloping part of a U-shaped relationship between income and equality of opportunity.

In the figure we have pointed out a few countries that deviate from this general relationship. Egypt, especially, stands out with very high equality of opportunity while it also has relatively high levels of income. Jordan and Azerbaijan are also found in this relatively attractive location in the figure. In contrast, Honduras has relatively low levels of income and very low levels of equality of opportunity, which makes for an unattractive combination.

Third, we would expect more equality of opportunity to lead to more equality of outcomes as well. This is indeed what we observe. Figure 5 shows a negative correlation ($\rho = -0.44$) between our NMI and the Gini coefficient reflecting inequality of outcomes. Thus, higher equality of opportunity in early childhood is associated with lower inequality of incomes. Again, this correlation is mainly driven by the observations from Latin America, which show both low equality of opportunity and high inequality of outcomes.

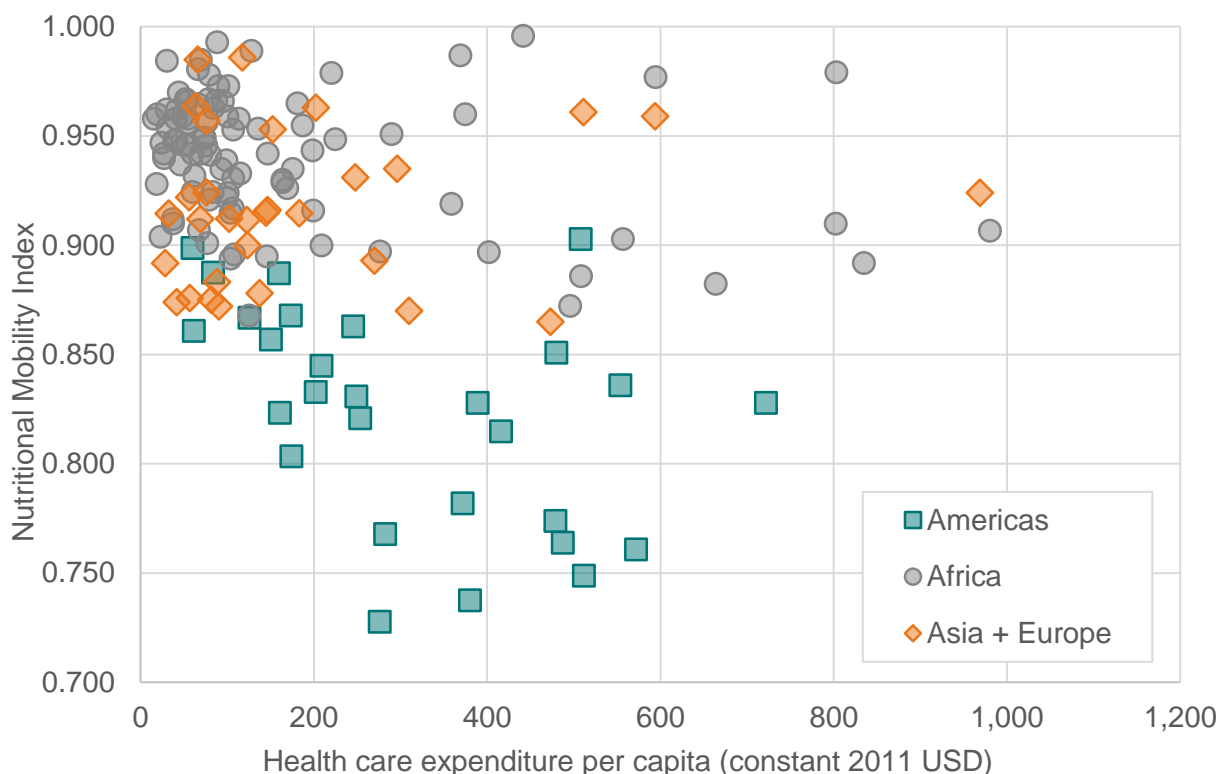
Figure 5: Correlation between equality of opportunity (NMI) and inequality of outcomes (Gini coefficient), all countries, all years available



Source: Authors' estimation using all DHS surveys available and inequality data from the World Bank's World Development Indicators for the same countries and the closest year available.

Fourth, increased public health care spending might theoretically help reduce inequality of opportunity. However, this is not what we find in our sample. Figure 6 shows a negative correlation ($\rho = -0.35$) between public health care expenditure per capita and our Nutritional Mobility Index, indicating that generally spending more on health is not enough to increase equality of opportunity in early childhood.

Figure 6: Correlation between public health care spending per capita and equality of opportunity (NMI), all countries, all years available



Source: Authors' estimation using all DHS surveys available and health spending data from the World Bank's World Development Indicators for the same countries and the same year.

Table 1 shows the results of regressing the above graphed variables on the Nutritional Mobility Index. Since there are missing observations for some of the explanatory variables, we present three different regressions. The first regression (column 1) only includes the prevalence of chronic malnutrition, which is available for the same countries and years as the NMI, so it includes all 166 observations. The estimated coefficient is positive and statistically significant with more than 99% confidence. This means that high levels of chronic malnutrition is associated with high levels of nutritional mobility, and low levels of chronic malnutrition is associated with low levels of nutritional mobility in a combined cross-section/time series context. This confirms what we found in Figure 3 above, but it is still the opposite of what we had expected. We had expected that as chronic malnutrition rates fall, there is less variation between children to explain, and thus we would expect that the family background variables would become less important, thus increasing the Nutritional Mobility Index. The fact that we observe the opposite is actually a methodological advantage, since it implies that changes in the NMI are not simply automatically driven by the drops in chronic malnutrition, but that the two are independent processes.

In the regression reported in the second column we include Health Expenditure per capita, and find a positive, but statistically insignificant effect. This means that general Health Expenditure is

not an effective way of creating equality of opportunity in early childhood. Interventions would have to be much more targeted to achieve this effect.

In the regression reported in the third column we include GDP per capita (PPP adjusted and in constant 2011 international dollars) and inequality (as measured by World Bank Gini approximations). These variables have several missing observations, so the number of observations in the regression is only 123. On the other hand, the R^2 has increased to 0.453, signalling the importance of these two variables.

Both coefficients are negative and highly significant, which means that high Nutritional Mobility is associated with low income and low inequality. The latter coefficient has the expected sign indicating that high equality of opportunity is associated with high equality of outcomes. The negative relation with incomes, however, is unexpected. It seems that in poor countries, which have high levels of chronic malnutrition, the malnutrition is dispersed relatively randomly across children, independently of the wealth, education, and health of the parents. It is possible that environmental factors (e.g. droughts, floods, and infectious diseases) are much more important in these areas.

Table 1: NMI regressed on chronic malnutrition, health expenditure, GDP and GINI

VARIABLES	(1) NMI	(2) NMI	(3) NMI
Prevalence of chronic malnutrition (%)	0.00150*** [0.000349]	0.00168*** [0.000371]	0.000417 [0.000434]
Health Expenditure per capita		0.00316 [0.00199]	0.00175 [0.00196]
GDP per capita (PPP constant 2011 \$)			-7.62e-06*** [1.93e-06]
GINI-Coefficient approx.			-0.00294*** [0.000551]
Constant	0.871*** [0.0122]	0.848*** [0.0184]	1.047*** [0.0318]
Observations	166	150	123
R-squared	0.096	0.114	0.453

Notes: Robust standard errors in brackets.

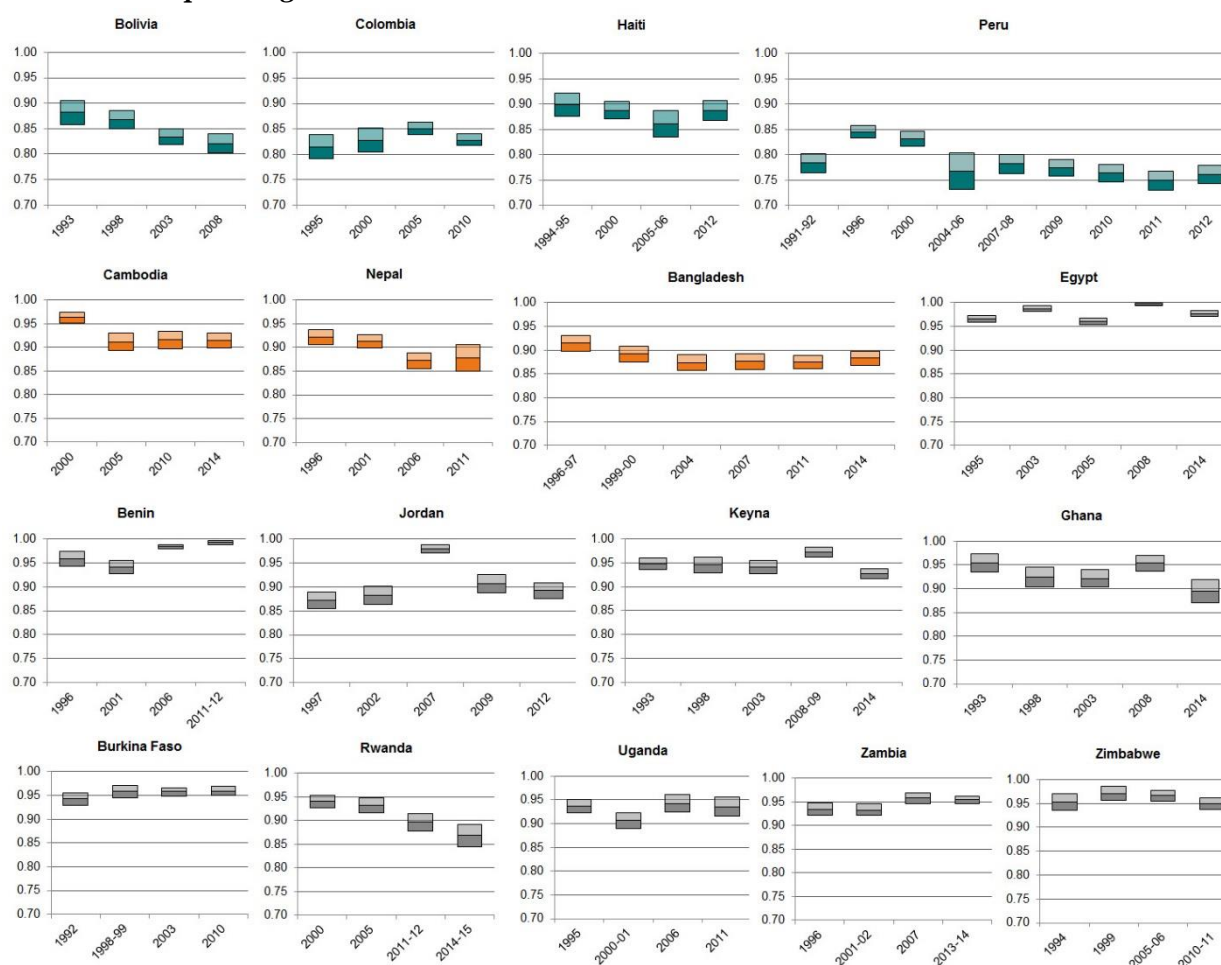
*** p<0.01, ** p<0.05, * p<0.1

It must be stressed that these regressions use unbalanced panel data due to the fact that the number of survey rounds per country and year in our data set is not constant. In addition to Africa being over-represented, high-income countries, which could have a large influence on the described correlations, are not included in the DHS database and are therefore absent from the regression.

7. Changes in Nutritional Mobility over time

Several countries have conducted Demographic and Health Surveys regularly since the 1990s, and for these countries it is possible to check whether Nutritional Mobility has changed over time. Figure 7 shows the NMI estimates (with 95% confidence intervals) for the 17 countries for which at least four DHS datasets spanning at least a decade are available.

Figure 7: Changes in the Nutritional Mobility Index over times for countries with at least four observations spanning more than a decade



Source: Authors' estimation for countries with at least four DHS survey rounds available.

Only one of the 17 countries, Benin, saw a significant increase in the Nutritional Mobility Index between 1996 and 2012. The increase was from an already high level, to practically perfect mobility. The latest two DHS surveys from Benin are very large, so the estimate of the NMI is very precise as well.

The biggest decline in Nutritional Mobility was observed for Rwanda, where the importance of all three family background variables increased substantially between 2000 and 2015, causing the NMI to decline by 0.072. The second biggest decline was observed in Bolivia between 1993 and

2008, where the NMI dropped by 0.061. In Ghana, all three family background variables at least doubled their importance between 1993 and 2014, causing a drop in the NMI of 0.059. Peru saw a small increase in the NMI in the early 1990s, but then a substantial decline between 1996 and 2012. This decline is mainly due to Mother's Height becoming more and more important, suggesting an intergenerational transmission of chronic malnutrition, which is not being effectively addressed by the Peruvian government.

8. Limitations of the proposed methodology

While the methodology for measuring equality of opportunity proposed in this paper has many advantages, it also has one potentially important drawback. If there are significant differences in the quality of data between countries, that could potentially explain differences in the Nutritional Mobility Index. Basically, as in all research, garbage-in implies garbage-out. But in this particular case, garbage-in means perfect-nutritional-mobility-out, because random family background variables obviously won't be significantly related to random childhood nutritional status, which implies low Factor Inequality Weights in the regressions and thus a high Nutritional Mobility Index.

While the proposed methodology relies on a highly standardized survey questionnaires and objective, easily measurable, and uncontroversial variables (such as height, age, weight, education, and the presence or absence of refrigerators and other household assets), some countries may have problems measuring even these objective variables correctly. For example, birth dates may not always be known by the respondents, in which case age is assessed roughly as, for example, two years or two and a half years.

Assaf, Kothari and Pullum (2015) uses 10 different indicators to assess the quality of the anthropometric data in 52 DHS country surveys conducted during the period 2005-2014. The first three indicators look for unusually high standard deviations in the z-scores, while indicators 4 and 5 check whether there is an unusually large difference in the standard deviations of z-scores for children under 2 years vs. children of 2 years and over (DHS surveys measure children under 2 years lying down, while children of 2 years and over are measured standing up). Indicators 6 to 8 check for unusual agglomerations of data points, through the calculation of Myers' indices, while the last two indicators analyze the frequency of missing data or unrealistic data points.

Table 2 and 3 from their report provide a good overview on general patterns in the quality of data for the 52 sample countries. Table 2 shows the worst ten countries for each of the ten indicators and all countries which appear five times or more are marked with a color. Benin and Albania are particularly problematic, showing up in the top ten for eight of the ten indicators. Similarly, Sierra Leone shows up seven times, indicating possible data quality problems.

Table 2. Countries with the highest values on the 10 measures of z-score standard deviations, height, weight and age, Myers' index, and flagged cases, ranked from highest to lowest values, DHS surveys 2005-2014

HAZ SD	WAZ SD	WHZ SD	HAZ SD < 2 years - HAZ SD ≥ 2 years	WHZ SD < 2 years - WHZ SD ≥ 2 years	Height Myers' index	Weight Myers' index	Age Myers' index	WHO flags	Height out of plausible limits
Benin	Benin	Benin	Timor-Leste	Mozambique	São Tomé and Príncipe	São Tomé and Príncipe	Niger	Benin	Namibia
Albania	Nigeria	Albania	São Tomé and Príncipe	Lesotho	Benin	Benin	Guinea	Albania	Malawi
Egypt	Sierra Leone	Egypt	Benin	São Tomé and Príncipe	Armenia	Armenia	Mali	Comoros	Swaziland
Nigeria	Comoros	São Tomé and Príncipe	Swaziland	Malawi	Namibia	Sierra Leone	Sierra Leone	Sierra Leone	Sierra Leone
Sierra Leone	Cameroon	Comoros	Zambia	Tanzania	Maldives	Egypt	Dominican Republic	Nigeria	Gambia
Comoros	Albania	Nigeria	Albania	Gambia	Malawi	Comoros	Albania	São Tomé and Príncipe	Benin
Mali	Mali	Timor-Leste	Lesotho	Timor-Leste	Niger	Azerbaijan	Comoros	Egypt	Peru
Congo Democratic Republic	Guinea	Azerbaijan	Kyrgyz Republic	Ghana	Burundi	Albania	Egypt	Pakistan	Nepal
Timor-Leste	Maldives	Sierra Leone	Tajikistan	Guinea	Tajikistan	Bolivia	Nepal	Azerbaijan	Guyana
Guinea	Congo Democratic Republic	Armenia	Comoros	Côte d'Ivoire	Zambia	Kyrgyz Republic	Ghana	Timor-Leste	Albania

Note: Countries that appear five or more times in the table are highlighted in different colors.

Source: Assaf, Kothari and Pullum (2015).

Table 3 is just the opposite of Table 2 and indicates the best countries in terms of the data quality indicators. DHS seems to do a particular fine job in Latin America with Columbia showing up in nine out of ten indicators' top ten list, Peru and Honduras eight out of ten times, and Bolivia appearing five times in the table. Curiously, Benin shows up once as well, underlining the importance of using various indicators for the assessment of data quality.

Table 3. Countries with the lowest values on the 10 measures of z-score standard deviations, height, weight and age, Myers' index, and flagged cases, ranked from lowest to highest values, DHS surveys 2005-2014

HAZ SD	WAZ SD	WHZ SD	HAZ SD < 2 years - HAZ SD ≥ 2 years	WHZ SD < 2 years - WHZ SD ≥ 2 years	Height Myers' index	Weight Myers' index	Age Myers' index	WHO flags	Height out of plausible limits
Peru	Colombia	Colombia	Armenia	Armenia	Guinea	Zimbabwe	Zambia	Peru	Azerbaijan
Colombia	Jordan	Peru	Peru	Benin	Peru	Honduras	Tajikistan	Colombia	Colombia
Jordan	Kyrgyz Republic	Honduras	Honduras	Maldives	Bangladesh	Dominican Republic	Senegal	Honduras	Congo Brazzaville
Honduras	Bolivia	Jordan	Azerbaijan	Colombia	Ethiopia	Cameroon	Burkina Faso	Jordan	Honduras
Dominican Republic	Cambodia	Bolivia	Niger	Honduras	Cameroon	Colombia	Burundi	Nepal	Kyrgyz Republic
Bolivia	Rwanda	Senegal	Senegal	Peru	Swaziland	Bangladesh	Mozambique	Rwanda	Bolivia
Senegal	Peru	Cambodia	Bangladesh	Nigeria	Colombia	Peru	Ethiopia	Haiti	Rwanda
Cambodia	Zimbabwe	Nepal	Haiti	Congo Brazzaville	Nepal	Tanzania	Gambia	Congo Brazzaville	Cambodia
Burundi	Azerbaijan	Rwanda	Colombia	Egypt	Honduras	Kenya	Namibia	Bolivia	Dominican Republic
Rwanda	Burundi	Zimbabwe	Pakistan	Azerbaijan	Zimbabwe	Guinea	Uganda	Burundi	Haiti

Note: Countries that appear five or more times in the table are highlighted in different colors.

Source: Assaf, Kothari and Pullum (2015).

Overall the report states that the anthropometric data of the selected 52 DHS surveys conducted between 2005 and 2014 is of good quality. However, Benin appears to be of somewhat lower quality than the rest. Thus, we should be cautious about concluding that Benin is the country with highest equality of opportunity. It could be that it is instead the worst at carrying out health surveys. Some other countries in the high end of the Nutritional Mobility graph (Figure 2), especially Sierra Leone and Timor-Leste, are also slightly suspicious.

In general, our proposed methodology is better at identifying countries with particularly low equality of opportunity than countries with very high equality of opportunity.

Another important limitation of the present study is the lack of data for rich countries. The correlations found in Figures 3 to 6 may look very different if rich countries were to be included.

9. Conclusions and directions for further research

There is conceptually a big difference between inequality of opportunity and inequality of outcomes, and the policies needed to address the two different kinds of inequality are also very different. This paper proposes a new measure of equality of opportunity, based on the importance of family background variables on the nutritional status in early childhood.

Equality of opportunity in early childhood is a condition for equality of opportunity in later phases of life, because disadvantages early in life have permanent effects which tend to subsequently get amplified in education systems, in labor markets, and in the capacity to save and invest. In that way, inequality of opportunity in early childhood can even be transmitted to future generations.

Equality of opportunity in early childhood can be thought of as the first crucial building block for a just society. Of course, even countries that perform well on this measure of equality of opportunity need to follow up with equal opportunities for education, and subsequently with equality of opportunity in the labor market. Countries that do not perform well on this measure, however, need to focus on this fundamental building block, as initiatives to address inequalities later in life probably will not be able to compensate for these initial inequalities.

We have applied the proposed methodology to 166 Demographic and Health Surveys, from 60 different countries, carried out between 1991 and 2015. What stands out most strongly from these estimations is the low level of equality of opportunity in early childhood in Latin America compared to the rest of the world. Family background is much more important for children's nutritional status in this region than in the rest of the world. In contrast, the countries of sub-Saharan Africa were found to have surprisingly high equality of opportunity.

The educational mobility literature has also found Latin America to be the least educationally mobile region (Hertz et al. 2007), but our findings suggest that these inequalities of opportunity among teenagers and young adults may stem from inequalities arising much earlier in life. In general, it is important for countries to understand in which phase of life the bottle necks to equality of opportunity appear.

Equality of opportunity is not enough by itself, though, if those opportunities are extremely limited. For example, a vicious pandemic might kill off all babies indiscriminately, which would imply high equality of opportunity, but nevertheless be unacceptable. In general, we find that the poorest countries in the world have the highest levels of equality of opportunity in early childhood. This implies a difficult trade-off as countries move out of poverty.

A few countries seem to have been able to avoid the drop in equality of opportunity that normally come with higher levels of income. Egypt, with very high equality of opportunity and relatively high incomes, would be a particularly interesting success case to study further.

At the other end of the spectrum we find some Latin American countries, like Honduras, Peru, Guatemala and Bolivia, with relatively low levels of income and very low levels of equality of opportunity. It would be interesting to compare and contrast these opposing cases in order to understand what specific policies and initiatives help promote equality of opportunity without compromising growth.

For most countries we do not have enough data to confidently assess changes over time. Even for the 17 countries for which we have at least four survey rounds spanning at least a decade, few show clear trends. Only one, Benin, shows significant increases in equality of opportunity over time. The ones with significant reductions in equality of opportunity include: Bolivia, Peru, Cambodia, Bangladesh and Rwanda.

Further research might narrow its scope and focus on country cases or regions to exploit the proposed methodology even more. Despite potential data quality problems, Benin is an interesting case to study in detail as it is the only country which has seen significant increases in nutritional mobility over time. Unfortunately, this improvement was also associated with substantial increases in chronic malnutrition over time. A country case study might shed light on the dynamics of the NMI with other important development indices such as prevalence of stunting, economic growth or poverty rates, as well as specific policy initiatives. Peru is well-suited for a detailed case study, not only because of the low and declining levels of equality of opportunity, but also because no other country in the world has carried out as many DHS surveys as Peru, so ample data is available.

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Appendix A: Summary statistics for all DHS surveys used

Table A1: DHS summary characteristics

Country	Survey Year(s)	Observations	% stunted	Country	Survey Year(s)	Observations	% stunted
Sub-Saharan Africa				Sub-Saharan Africa (cont.)			
Benin	1996	2,291	25.1	Malawi	1992	3,168	49.4
Benin	2001	3,833	30.4	Malawi	2000	9,117	49.2
Benin	2006	12,060	38.2	Malawi	2010	4,515	41.6
Benin	2011-12	7,579	40.5	Mali	1995-96	4,633	30.2
Burkina Faso	1992	3,945	33.4	Mali	2001	9,261	37.7
Burkina Faso	1998-99	3,653	36.9	Mali	2006	10,735	34.0
Burkina Faso	2003	8,102	38.6	Mali	2012-13	4,307	33.4
Burkina Faso	2010	6,503	29.8	Mozambique	1997	3,047	36.1
Cameroon	1998	1,736	29.4	Mozambique	2003	7,906	40.8
Cameroon	2004	3,123	31.7	Mozambique	2011	9,228	36.7
Cameroon	2011	5,030	27.2	Namibia	1992	2,455	28.6
Central African Rep.	1994-95	2,271	33.8	Namibia	2006-07	3,646	23.9
Chad	1996	5,470	40.1	Namibia	2013	1,754	17.6
Chad	2004	4,395	41.1	Niger	1998	3,847	41.2
Chad	2014-15	9,808	35.4	Niger	2006	3,685	50.0
Congo, Dem. Rep.	2007	3,187	39.0	Niger	2012	4,702	35.8
Congo, Dem. Rep.	2013-14	7,950	36.4	Nigeria	2003	4,263	38.5
Cote d'Ivoire	1994	3,338	24.5	Nigeria	2008	18,841	36.8
Cote d'Ivoire	2011	3,135	23.6	Nigeria	2013	24,418	33.1
Ethiopia	1992	8,569	50.7	Rwanda	2000	5,992	42.5
Ethiopia	1997	3,854	46.5	Rwanda	2005	3,625	45.2
Ethiopia	2003	9,572	38.7	Rwanda	2011-12	4,056	37.1
Gabon	2000	3,440	20.8	Rwanda	2014-15	3,514	32.3
Gabon	2012	3,314	13.4	Sao Tome and Principe	2008	1,435	25.3
Gambia	2013	3,028	20.0	Senegal	2005	2,779	16.0
Ghana	1993	1,811	25.9	Senegal	2010-11	3,485	22.1
Ghana	1998	2,611	25.9	Sierra Leone	2008	1,979	32.8
Ghana	2003	3,041	29.5	Sierra Leone	2013	4,043	32.8
Ghana	2008	2,359	22.8	Swaziland	2006-07	2,011	22.3
Ghana	2014	2,707	13.3	Tanzania	1996	5,164	43.5
Guinea	1999	2,899	26.2	Tanzania	2004-05	7,115	37.1
Guinea	2005	2,576	34.8	Tanzania	2010	6,755	35.0
Guinea	2012	3,079	26.5	Togo	1998	3,434	21.8
Kenya	1993	4,762	33.4	Togo	2013-14	3,167	21.4
Kenya	1998	2,878	31.0	Uganda	1995	4,458	38.4
Kenya	2003	4,591	30.7	Uganda	2000-01	5,073	38.7
Kenya	2008-09	5,061	29.5	Uganda	2006	2,360	31.6
Kenya	2014	8,946	20.2	Uganda	2011	2,058	28.1
Lesotho	2004	1,348	36.8	Zambia	1996	5,478	42.4
Lesotho	2009	1,600	30.6	Zambia	2001-02	5,393	46.9
Lesotho	2014	1,308	26.6	Zambia	2007	5,084	39.2
Liberia	2007	4,270	33.5	Zambia	2013-14	11,336	34.2
Liberia	2013	3,165	25.4	Zimbabwe	1994	2,078	21.5
Madagascar	1997	2,875	48.4	Zimbabwe	1999	2,593	26.5
Madagascar	2003-04	4,395	47.4	Zimbabwe	2005-06	3,873	28.2
Madagascar	2008-09	4,856	45.5	Zimbabwe	2010-11	4,276	25.1

Table A1: DHS summary characteristics (continued)

Country	Survey Year(s)	Observations	% stunted	Country	Survey Year(s)	Observations	% stunted
Latin America and the Caribbean				Asia			
Bolivia	1993	2,744	26.8	Bangladesh	1996-97	4,660	54.7
Bolivia	1998	6,121	27.0	Bangladesh	1999-00	5,289	44.7
Bolivia	2003	9,073	26.4	Bangladesh	2004	5,888	43.2
Bolivia	2008	7,663	21.9	Bangladesh	2007	5,245	36.1
Brazil	1996	3,990	10.5	Bangladesh	2011	7,601	34.6
Colombia	1995	4,466	14.9	Bangladesh	2014	6,940	29.2
Colombia	2000	4,153	13.6	Cambodia	2000	3,476	44.5
Colombia	2005	12,177	14.4	Cambodia	2005	3,572	37.0
Colombia	2010	15,359	9.1	Cambodia	2010	3,681	33.3
Dom. Rep.	1996	3,693	10.8	Cambodia	2014	4,297	26.4
Dom. Rep.	2013	3,169	5.1	India	1998-99	24,921	45.0
Guatemala	1995	8,440	49.9	India	2005-06	41,071	42.6
Guatemala	1998-99	3,833	46.6	Kyrgyz Rep.	1997	970	19.0
Haiti	1994-95	2,729	31.9	Kyrgyz Rep.	2012	4,002	13.7
Haiti	2000	5,470	22.0	Kazakhstan	1999	565	9.7
Haiti	2005-06	2,528	23.3	Maldives	2009	2,229	16.0
Haiti	2012	3,964	16.5	Nepal	1996	3,710	48.5
Honduras	2005	9,194	24.2	Nepal	2001	6,153	50.6
Honduras	2011-12	9,928	17.1	Nepal	2006	5,217	42.8
Nicaragua	1997-98	6,780	25.0	Nepal	2011	2,325	34.3
Nicaragua	2001	5,808	20.2	Pakistan	2012-13	3,064	39.1
Peru	1991-92	7,181	31.9	Tajikistan	2012	4,523	20.9
Peru	1996	14,705	25.9	Timor Leste	2009-10	7,501	52.6
Peru	2000	11,504	25.5	Uzbekistan	1996	952	31.3
Peru	2004-06	2,278	23.9				
Peru	2007-08	8,056	21.7	Eurasia			
Peru	2009	9,296	18.3	Albania	2008-09	1,295	15.7
Peru	2010	8,708	17.8	Armenia	2000	1,514	13.0
Peru	2011	8,693	15.0	Armenia	2005	1,226	13.0
Peru	2012	9,162	13.3	Azerbaijan	2006	1,921	21.1
Middle East and North Africa				Moldova	2005	1,297	8.6
Egypt	1995	10,247	14.9	Turkey	1993	3,134	20.6
Egypt	2003	6,045	15.7	Turkey	1998	2,770	16.1
Egypt	2005	12,286	17.7	Turkey	2003-04	4,020	12.2
Egypt	2008	9,459	24.8				
Egypt	2014	13,698	17.6				
Jordan	1997	5,559	7.8				
Jordan	2002	4,854	8.4				
Jordan	2007	4,399	12.1				
Jordan	2009	4,359	6.0				
Jordan	2012	6,243	4.4				
Morocco	1992	4,492	24.3				
Morocco	2003	5,342	18.2				

Appendix B: Basic regression and decomposition results for all DHS surveys used

Table B1: Basic regression and decomposition results

Country	Survey Year(s)	Rural dummy coefficient	Female dummy coefficient	FIW Wealth in %	FIW Mother's Education in %	FIW Mother's Height in %	Total FIWs	R-Squared
Sub-Saharan Africa								
Benin	1996	*-4.25	18.66	0.76	*0,3	3.08	4.14	20.93
Benin	2001	-11.09	*7.93	0.96	*0,42	4.39	5.77	22.03
Benin	2006	-14.34	25.25	0.69	0.48	0.34	1.51	8.73
Benin	2011-12	*6.64	23.33	0.40	*0,14	0.16	0.70	7.15
Burkina Faso	1992	-24.03	9.32	1.01	1.76	2.97	5.74	25.89
Burkina Faso	1998-99	-43.82	12.31	0.62	0.84	2.76	4.22	25.23
Burkina Faso	2003	-30.35	15.74	1.23	0.75	2.24	4.22	23.05
Burkina Faso	2010	-18.50	14.17	0.67	0.56	2.86	4.09	15.86
Cameroon	1998	*-1.80	18.70	1.29	2.76	3.88	7.93	24.72
Cameroon	2004	*-13.33	*3.41	2.62	1.45	4.41	8.48	18.67
Cameroon	2011	*7.96	13.78	4.59	2.77	3.25	10.61	20.28
Central African Rep.	1994-95	*-7.62	20.29	1.12	*0,41	4.46	5.99	28.97
Chad	1996	*-9.45	*4.99	0.46	1.01	2.31	3.78	23.27
Chad	2004	-19.66	*4.90	0.80	0.97	1.52	3.29	20.98
Chad	2014-15	-34.77	*8.33	0.04	0.67	1.59	2.30	16.93
Congo, Dem. Rep.	2007	-23.15	20.61	0.64	0.85	2.49	3.98	18.64
Congo, Dem. Rep.	2013-14	*-8.28	19.54	1.11	1.02	3.65	5.78	20.72
Cote d'Ivoire	1994	-12.72	10.34	1.62	0.68	5.21	7.51	24.03
Cote d'Ivoire	2011	-15.96	14.15	1.35	0.60	5.13	7.08	17.11
Ethiopia	1992	-35.27	*0.20	0.42	2.11	2.95	5.48	21.23
Ethiopia	1997	-40.86	13.18	*0,15	1.27	2.73	4.15	15.25
Ethiopia	2003	-29.24	*5.06	0.77	1.02	3.49	5.28	21.10
Gabon	2000	*-2.24	14.12	4.79	0.53	4.93	10.25	17.93
Gabon	2012	*-6.04	*6.96	2.40	1.66	5.61	9.67	15.32
Gambia	2013	-22.19	*0.78	1.07	*0,25	3.40	4.72	14.03
Ghana	1993	-25.85	*7.98	1.04	0.66	2.91	4.61	24.19
Ghana	1998	-15.85	15.30	2.77	1.05	3.74	7.56	23.30
Ghana	2003	*-9.07	20.05	3.10	1.39	3.35	7.84	20.90
Ghana	2008	*-1.55	*6.84	1.70	*0,22	2.74	4.66	17.99
Ghana	2014	*6.70	8.70	3.57	1.75	5.17	10.49	20.11
Guinea	1999	-23.94	*7.31	*0,39	0.81	2.58	3.78	14.94
Guinea	2005	-32.85	20.73	0.56	*0,12	0.87	1.55	19.61
Guinea	2012	-32.01	17.28	*0,59	0.67	2.27	3.53	16.70
Kenya	1993	-22.41	14.70	1.11	0.64	3.50	5.25	14.84
Kenya	1998	-22.63	14.95	1.92	1.27	2.24	5.43	18.52
Kenya	2003	-12.63	20.80	1.21	0.56	4.09	5.86	15.12
Kenya	2008-09	-17.12	18.22	0.85	*0,27	1.57	2.69	10.04
Kenya	2014	*-2.02	17.55	3.59	-0.56	4.34	7.37	12.82
Lesotho	2004	*-0.05	*7.39	1.75	*0,46	4.72	6.93	19.96
Lesotho	2009	*-1.49	14.24	1.27	1.22	3.16	5.65	16.39
Lesotho	2014	22.02	15.73	3.32	2.70	4.26	10.28	18.35
Liberia	2007	-17.69	17.88	0.92	0.33	2.16	3.41	16.52
Liberia	2013	*-1.39	15.18	0.70	0.34	2.65	3.69	16.06
Madagascar	1997	-12.93	22.97	*0,06	*0,12	5.24	5.42	25.56
Madagascar	2003-04	*0.53	17.57	0.47	0.61	4.29	5.37	12.13
Madagascar	2008-09	*-13.81	16.60	*-0,04	*-0,01	1.97	1.92	9.00
Malawi	1992	-29.10	16.61	1.65	1.11	3.24	6.00	25.59
Malawi	2000	-24.98	14.57	1.36	0.92	2.33	4.61	19.52
Malawi	2010	*-6.63	17.91	1.09	*0,19	3.78	5.06	12.36

* Coefficient is not significant at the 5% level.

Table B1: Basic regression and decomposition results (continued)

Country	Survey Year(s)	Rural dummy coefficient	Female dummy coefficient	FIW Wealth in %	FIW Mother's Education in %	FIW Mother's Height in %	Total FIWs	R-Squared
Sub-Saharan Africa (continued)								
Mali	1995-96	-13.62	*4.62	0.85	*0,18	1.96	2.99	27.38
Mali	2001	-41.45	10.84	1.40	1.06	1.88	4.34	19.10
Mali	2006	-31.48	10.26	1.03	0.48	1.87	3.38	14.84
Mali	2012-13	-40.24	*8.27	1.35	0.39	0.97	2.71	13.03
Mozambique	1997	-21.42	16.81	2.03	1.67	3.49	7.19	23.63
Mozambique	2003	-13.90	11.11	1.89	1.86	5.24	8.99	18.70
Mozambique	2011	*0.92	14.67	2.29	1.22	4.05	7.56	13.36
Namibia	1992	*-1.35	13.48	3.00	1.39	4.97	9.36	15.05
Namibia	2006-07	24.20	12.70	3.53	2.24	5.64	11.41	17.09
Namibia	2013	*4.85	*3.88	2.81	1.46	4.71	8.98	17.78
Niger	1998	-26.02	*7.62	*0,2	0.63	4.36	5.19	33.95
Niger	2006	-62.50	12.88	*-0,01	1.20	3.24	4.43	26.42
Niger	2012	-23.27	11.14	*0,03	0.57	2.66	3.26	12.65
Nigeria	2003	*-4.00	19.40	1.95	4.39	2.09	8.43	18.25
Nigeria	2008	-13.05	20.30	1.93	1.82	1.17	4.92	10.97
Nigeria	2013	*2.63	18.02	4.70	3.02	2.29	10.01	18.91
Rwanda	2000	-38.19	17.48	1.33	1.00	3.66	5.99	20.93
Rwanda	2005	-22.10	*7.69	1.98	0.49	4.36	6.83	19.72
Rwanda	2011-12	-31.94	16.25	2.85	2.08	5.45	10.38	22.49
Rwanda	2014-15	-17.78	19.57	4.11	2.46	6.65	13.22	22.76
Sao Tome and Principe	2008	28.34	*7.74	3.78	*-0,16	3.42	7.04	8.14
Senegal	2005	*-4.17	12.43	2.88	*0,46	4.30	7.64	13.30
Senegal	2010-11	*-11.61	17.39	1.98	0.81	3.36	6.15	12.33
Sierra Leone	2008	-39.90	20.46	*0,15	*0,23	0.70	1.08	8.35
Sierra Leone	2013	-41.68	*4.02	*0,01	*0,05	2.05	2.11	6.65
Swaziland	2006-07	*-2.10	13.00	1.49	1.53	5.06	8.08	18.17
Tanzania	1996	-25.37	11.71	1.43	0.26	7.06	8.75	20.63
Tanzania	2004-05	*-3.99	11.21	4.12	0.29	5.46	9.87	20.63
Tanzania	2010	-14.26	11.22	2.80	*0,23	5.24	8.27	18.20
Togo	1998	*-2.74	17.55	1.25	0.62	3.30	5.17	22.93
Togo	2013-14	-26.59	*7.39	1.42	0.74	3.66	5.82	16.78
Uganda	1995	-32.92	19.69	1.15	1.09	4.05	6.29	17.91
Uganda	2000-01	-19.04	9.86	2.00	1.31	6.00	9.31	18.07
Uganda	2006	-33.44	*10.22	1.09	1.20	3.49	5.78	13.54
Uganda	2011	-28.98	18.37	*0,51	1.25	4.70	6.46	18.02
Zambia	1996	*-8.67	9.88	1.72	0.51	4.28	6.51	19.97
Zambia	2001-02	*-10.85	10.21	1.52	0.45	4.69	6.66	19.84
Zambia	2007	-13.98	20.01	0.55	*0,08	3.55	4.18	12.57
Zambia	2013-14	7.72	16.10	1.30	0.27	2.94	4.51	10.59
Zimbabwe	1994	*-9.05	*7.90	*0,52	1.12	3.02	4.66	21.17
Zimbabwe	1999	*-0.22	22.97	*0,49	0.66	1.71	2.86	9.66
Zimbabwe	2005-06	*-12.51	9.34	*0,24	*0,05	3.08	3.37	10.28
Zimbabwe	2010-11	*-2.47	8.53	0.32	*0,14	4.68	5.14	17.58
Middle East and North Africa								
Egypt	1995	-14.97	11.71	1.32	*0,11	2.08	3.51	10.35
Egypt	2003	*-0.19	15.84	0.52	*0,07	0.81	1.40	2.25
Egypt	2005	*-6.35	17.89	1.27	*0,25	2.45	3.97	5.44
Egypt	2008	-15.73	15.77	*0,03	*0,01	0.42	0.46	4.24
Egypt	2014	*-0.20	16.80	0.16	0.16	1.99	2.31	3.16
Jordan	1997	-21.89	*3.80	2.02	1.50	9.24	12.76	17.05
Jordan	2002	-7.16	*-2.48	0.89	1.98	8.89	11.76	15.02
Jordan	2007	*-7.89	11.39	0.31	0.41	1.36	2.08	6.53
Jordan	2009	-8.85	9.20	1.09	1.45	6.79	9.33	12.43
Jordan	2012	-6.99	6.19	1.34	1.57	7.89	10.80	12.42
Morocco	1992	*-1.93	*1.29	6.27	2.00	3.84	12.11	21.74
Morocco	2003-04	*0.39	14.64	2.72	*0,15	2.27	5.14	8.07
Eurasia								
Albania	2008-09	46.05	*3.79	2.35	*0,49	1.10	3.94	5.12
Armenia	2000	*1.07	*11.78	1.35	0.69	6.47	8.51	3.94
Armenia	2005	*1.47	*-0.32	*0,64	*0,15	6.13	6.92	7.78
Azerbaijan	2006	*-2.86	*10.38	2.35	0.87	0.88	4.10	10.92
Moldova	2005	*-3.86	*4.24	2.99	*0,71	6.95	10.65	12.99
Turkey	1993	*5.05	*-1.36	6.28	3.58	4.20	14.06	26.44
Turkey	1998	*1.53	*-2.14	4.41	3.18	5.44	13.03	26.21
Turkey	2003-04	*-785	*-3.94	5.50	2.25	5.74	13.49	23.14

* Coefficient is not significant at the 5% level.

Table B1: Basic regression and decomposition results (continued)

Country	Survey Year(s)	Rural dummy coefficient	Female dummy coefficient	FIW Wealth in %	FIW Mother's Education in %	FIW Mother's Height in %	Total FIWs	R-Squared
Latin America and the Caribbean								
Bolivia	1993	*5.16	*3.77	5.21	*0,92	5.67	11.80	23.61
Bolivia	1998	*-3.08	7.43	4.82	1.74	6.69	13.25	20.03
Bolivia	2003	*3.61	*2.70	5.55	2.06	9.06	16.67	25.99
Bolivia	2008	*1.70	*3.96	7.51	1.86	8.48	17.85	26.42
Brazil	1996	*-4.25	12.74	5.03	*0,67	10.74	16.44	23.01
Colombia	1995	17.57	13.55	4.34	1.41	12.75	18.50	23.01
Colombia	2000	*2.74	6.24	3.11	*0,46	13.58	17.15	23.60
Colombia	2005	*-3.76	6.41	3.24	1.42	10.27	14.93	22.38
Colombia	2010	*-0.93	4.84	1.70	1.43	14.04	17.17	21.66
Dom. Rep.	1996	*-6.29	13.90	5.70	3.14	4.87	13.71	20.12
Dom. Rep.	2013	11.50	13.15	2.99	*0,63	6.08	9.70	12.59
Guatemala	1995	-10.29	6.56	4.13	2.81	10.72	17.66	33.33
Guatemala	1998-99	*1.28	8.53	4.36	4.64	10.64	19.64	29.16
Haiti	1994-95	*7.92	*8.02	5.19	1.52	3.41	10.12	21.08
Haiti	2000	*-3.31	16.05	3.08	2.56	5.60	11.24	18.39
Haiti	2005-06	*-0.86	9.90	3.95	2.55	7.40	13.90	19.44
Haiti	2012	*7.47	10.65	2.93	2.77	5.56	11.26	18.02
Honduras	2005	*-0.16	6.30	9.32	3.92	13.98	27.22	34.89
Honduras	2011-12	*1.08	6.29	7.86	2.71	15.66	26.23	33.54
Nicaragua	1997-98	18.79	12.82	5.06	1.73	6.48	13.27	20.06
Nicaragua	2001	*-5.76	*3.99	3.97	2.90	7.39	14.26	22.50
Peru	1991-92	-10.06	6.22	8.52	3.25	6.98	18.75	32.57
Peru	1996	-13.91	8.45	5.30	3.02	7.20	15.52	25.35
Peru	2000	-15.94	*0.53	6.82	2.93	7.13	16.88	28.11
Peru	2004-06	-18.38	8.19	11.39	3.11	8.75	23.25	36.56
Peru	2007-08	-17.55	*1.99	7.18	5.03	9.61	21.82	30.05
Peru	2009	-15.19	4.59	8.93	1.98	11.65	22.56	29.60
Peru	2010	-12.91	*3.71	8.95	3.13	11.51	23.59	30.57
Peru	2011	-17.42	*0.74	9.59	3.50	12.05	25.14	32.11
Peru	2012	-12.62	*2.25	9.35	2.17	12.38	23.90	29.67
Asia								
Bangladesh	1996-97	-12.98	*-2.36	1.56	3.06	3.92	8.54	21.94
Bangladesh	1999-00	-14.30	*-5.61	3.12	3.00	4.70	10.82	20.71
Bangladesh	2004	*-0.32	-6.88	4.14	2.46	6.01	12.61	21.69
Bangladesh	2007	-8.38	-8.36	2.74	2.58	7.09	12.41	22.59
Bangladesh	2011	*2.52	-5.65	4.40	2.15	5.94	12.49	19.01
Bangladesh	2014	*-2.63	*-5.00	3.13	3.29	5.25	11.67	19.35
Cambodia	2000	*5.99	*-1.70	0.58	0.95	2.11	3.64	16.62
Cambodia	2005	*0.20	*6.25	3.01	1.09	4.69	8.79	23.59
Cambodia	2010	*-4.89	*-5.81	3.27	0.64	4.49	8.40	18.24
Cambodia	2014	*0.09	*1.43	3.50	*0,37	4.66	8.53	17.03
India	1998-99	*-4.79	*-1.08	2.01	2.83	2.74	7.58	23.38
India	2005-06	*0.52	*0.47	2.86	2.31	3.67	8.84	16.88
Kazakhstan	1999	*-19.14	*3.47	*0,58	*0,06	5.89	6.53	11.80
Kyrgyz Rep.	1997	-23.65	*15.00	*0,14	*-0,15	4.34	4.33	17.33
Kyrgyz Rep.	2012	*6.59	11.39	*0,01	0.14	3.57	3.72	11.20
Maldives	2009	*5.18	*6.38	0.94	*0,18	6.52	7.64	8.38
Nepal	1996	-19.52	*-1.72	1.78	1.60	4.46	7.84	27.66
Nepal	2001	-12.75	-7.50	2.42	1.55	4.81	8.78	22.97
Nepal	2006	*-5.56	-7.34	3.40	3.78	5.67	12.85	27.38
Nepal	2011	-21.47	*0.01	4.90	2.32	4.97	12.19	25.54
Pakistan	2012-13	15.88	13.66	5.61	1.31	3.09	10.01	18.85
Tajikistan	2012	-11.41	*-3.39	1.01	0.26	3.44	4.71	10.66
Timor Leste	2009-10	*-3.77	15.61	0.30	*0,11	1.05	1.46	10.20
Uzbekistan	1996	32.80	37.78	*0,3	0.56	0.55	1.41	8.24

* Coefficient is not significant at the 5% level.

Appendix C: Nutritional Mobility Index estimates

Table C1: The Nutritional Mobility Index (with 95% confidence intervals) for all countries all years

Country	Survey Year(s)	NMI lower bound	NMI Central Estimate	NMI upper bound	Observations	Country	Survey Year(s)	NMI lower bound	NMI Central Estimate	NMI upper bound	Observations
Latin America and the Caribbean						Sub-Saharan Africa					
Bolivia	1993	0.858	0.882	0.906	2,744	Benin	1996	0.943	0.959	0.974	2,291
Bolivia	1998	0.849	0.868	0.886	6,121	Benin	2001	0.928	0.942	0.956	3,833
Bolivia	2003	0.818	0.833	0.849	9,073	Benin	2006	0.980	0.985	0.989	12,060
Bolivia	2008	0.803	0.821	0.840	7,663	Benin	2011-12	0.989	0.993	0.997	7,579
Bolivia	2012					Burkina Faso	1992	0.929	0.943	0.956	3,945
Brazil	1996	0.812	0.836	0.859	3,990	Burkina Faso	1998-99	0.944	0.958	0.971	3,653
Colombia	1995	0.792	0.815	0.838	4,466	Burkina Faso	2003	0.949	0.958	0.966	8,102
Colombia	2000	0.805	0.828	0.852	4,153	Burkina Faso	2010	0.950	0.959	0.969	6,503
Colombia	2005	0.838	0.851	0.863	12,177	Cameroon	1998	0.897	0.921	0.944	1,736
Colombia	2010	0.817	0.828	0.840	15,359	Cameroon	2004	0.897	0.915	0.934	3,123
Dom. Rep.	1996	0.841	0.863	0.885	3,693	Cameroon	2011	0.877	0.894	0.911	5,030
Dom. Rep.	2013	0.883	0.903	0.923	3,169	Central African Rep.	1994-95	0.922	0.940	0.958	2,271
Guatemala	1995	0.809	0.823	0.838	8,440	Chad	1996	0.953	0.962	0.972	5,470
Guatemala	1998-99	0.778	0.804	0.829	3,833	Chad	2004	0.957	0.967	0.977	4,395
Haiti	1994-95	0.876	0.899	0.922	2,729	Chad	2014-15	0.972	0.978	0.984	9,808
Haiti	2000	0.871	0.888	0.905	5,470	Congo, Dem. Rep.	2007	0.947	0.960	0.974	3,187
Haiti	2005-06	0.835	0.861	0.887	2,528	Congo, Dem. Rep.	2013-14	0.932	0.942	0.952	7,950
Haiti	2012	0.868	0.887	0.907	3,964	Cote d'Ivoire	1994	0.908	0.925	0.942	3,338
Honduras	2005	0.710	0.728	0.746	9,194	Cote d'Ivoire	2011	0.911	0.929	0.948	3,135
Honduras	2011-12	0.722	0.738	0.754	9,928	Ethiopia	1992	0.936	0.945	0.955	8,569
Nicaragua	1997-98	0.850	0.867	0.885	6,780	Ethiopia	1997	0.946	0.958	0.971	3,854
Nicaragua	2001	0.837	0.857	0.878	5,808	Ethiopia	2003	0.939	0.947	0.956	9,572
Peru	1991-92	0.765	0.784	0.802	7,181	Gabon	2000	0.876	0.897	0.919	3,440
Peru	1996	0.833	0.845	0.857	14,705	Gabon	2012	0.882	0.903	0.925	3,314
Peru	2000	0.816	0.831	0.846	11,504	Gambia	2013	0.936	0.953	0.970	3,028
Peru	2004-06	0.732	0.768	0.803	2,278	Ghana	1993	0.935	0.954	0.972	1,811
Peru	2007-08	0.763	0.782	0.801	8,056	Ghana	1998	0.904	0.924	0.945	2,611
Peru	2009	0.758	0.774	0.791	9,296	Ghana	2003	0.903	0.922	0.940	3,041
Peru	2010	0.747	0.764	0.781	8,708	Ghana	2008	0.936	0.953	0.971	2,359
Peru	2011	0.730	0.749	0.767	8,693	Ghana	2014	0.871	0.895	0.919	2,707
Peru	2012	0.743	0.761	0.779	9,162	Guinea	1999	0.946	0.962	0.978	2,899
						Guinea	2005	0.974	0.984	0.995	2,576
Middle East and North Africa						Guinea	2012	0.952	0.965	0.978	3,079
Egypt	1995	0.958	0.965	0.972	10,247	Kenya	1993	0.935	0.947	0.960	4,762
Egypt	2003	0.982	0.987	0.993	6,045	Kenya	1998	0.930	0.946	0.962	2,878
Egypt	2005	0.953	0.960	0.968	12,286	Kenya	2003	0.928	0.941	0.955	4,591
Egypt	2008	0.993	0.996	0.999	9,459	Kenya	2008-09	0.963	0.973	0.983	5,061
Egypt	2014	0.971	0.977	0.983	13,698	Kenya	2014	0.916	0.926	0.937	8,946
Jordan	1997	0.855	0.872	0.890	5,559	Lesotho	2004	0.905	0.931	0.956	1,348
Jordan	2002	0.864	0.882	0.901	4,854	Lesotho	2009	0.922	0.943	0.965	1,600
Jordan	2007	0.971	0.979	0.988	4,399	Lesotho	2014	0.865	0.897	0.930	1,308
Jordan	2009	0.888	0.907	0.925	4,359	Liberia	2007	0.955	0.966	0.977	4,270
Jordan	2012	0.876	0.892	0.908	6,243	Liberia	2013	0.949	0.963	0.977	3,165
Morocco	1992	0.860	0.879	0.898	4,492	Madagascar	1997	0.931	0.946	0.961	2,875
Morocco	2003	0.935	0.949	0.962	5,342	Madagascar	2003-04	0.933	0.946	0.959	4,395
						Madagascar	2008-09	0.973	0.981	0.988	4,856
Asia						Malawi	1992	0.925	0.940	0.956	3,168
Bangladesh	1996-97	0.898	0.915	0.931	4,660	Malawi	2000	0.945	0.954	0.962	9,117
Bangladesh	1999-00	0.876	0.892	0.908	5,289	Malawi	2010	0.937	0.949	0.962	4,515
Bangladesh	2004	0.858	0.874	0.890	5,888	Mali	1995-96	0.961	0.970	0.979	4,633
Bangladesh	2007	0.859	0.876	0.893	5,245	Mali	2001	0.948	0.957	0.965	9,261
Bangladesh	2011	0.861	0.875	0.889	7,601	Mali	2006	0.959	0.966	0.973	10,735
Bangladesh	2014	0.869	0.883	0.898	6,940	Mali	2012-13	0.963	0.973	0.983	4,307
Cambodia	2000	0.952	0.964	0.975	3,476	Mozambique	1997	0.911	0.928	0.945	3,047
Cambodia	2005	0.894	0.912	0.930	3,572	Mozambique	2003	0.897	0.910	0.923	7,906
Cambodia	2010	0.898	0.916	0.935	3,681	Mozambique	2011	0.914	0.924	0.935	9,228
Cambodia	2014	0.898	0.915	0.931	4,297	Namibia	1992	0.882	0.906	0.931	2,455
India	1998-99	0.918	0.924	0.931	24,921	Namibia	2006-07	0.865	0.886	0.907	3,646
India	2005-06	0.906	0.912	0.917	41,071	Namibia	2013	0.884	0.910	0.936	1,754
Kazakhstan	1999	0.892	0.935	0.978	565	Niger	1998	0.936	0.948	0.960	3,847
Kyrgyz Rep.	1997	0.928	0.957	0.985	970	Niger	2006	0.942	0.956	0.969	3,685
Kyrgyz Rep.	2012	0.951	0.963	0.974	4,002	Niger	2012	0.957	0.967	0.978	4,702
Maldives	2009	0.898	0.924	0.949	2,229	Nigeria	2003	0.900	0.916	0.932	4,263
Nepal	1996	0.906	0.922	0.937	3,710	Nigeria	2008	0.944	0.951	0.957	18,841
Nepal	2001	0.899	0.912	0.926	6,153	Nigeria	2013	0.892	0.900	0.908	24,418
Nepal	2006	0.855	0.872	0.888	5,217	Rwanda	2000	0.927	0.940	0.953	5,992
Nepal	2011	0.850	0.878	0.906	2,325	Rwanda	2005	0.916	0.932	0.948	3,625
Pakistan	2012-13	0.878	0.900	0.922	3,064	Rwanda	2011-12	0.878	0.896	0.914	4,056
Tajikistan	2012	0.939	0.953	0.967	4,523	Rwanda	2014-15	0.844	0.868	0.891	3,514
Timor Leste	2009-10	0.980	0.985	0.991	7,501	Sao Tome and Principe	2008	0.904	0.930	0.955	1,435
Uzbekistan	1996	0.971	0.986	1.000	952	Senegal	2005	0.904	0.924	0.943	2,779
						Senegal	2010-11	0.923	0.939	0.954	3,485
Eurasia						Sierra Leone	2008	0.979	0.989	0.999	1,979
Albania	2008-09	0.937	0.961	0.984	1,295	Sierra Leone	2013	0.969	0.979	0.988	4,043
Armenia	2000	0.885	0.915	0.944	1,514	Swaziland	2006-07	0.895	0.919	0.943	2,011
Armenia	2005	0.905	0.931	0.957	1,226	Tanzania	1996	0.898	0.912	0.927	5,164
Azerbaijan	2006	0.942	0.959	0.976	1,921	Tanzania	2004-05	0.888	0.901	0.914	7,115
Moldova	2005	0.858	0.893	0.929	1,297	Tanzania	2010	0.905	0.917	0.929	6,755
Turkey	1993	0.837	0.859	0.882	3,134	Togo	1998	0.934	0.948	0.963	3,478
Turkey	1998	0.847	0.870	0.892	2,770	Togo	2013-14	0.924	0.942	0.960	3,167
Turkey	2003-04	0.845	0.865	0.885	4,020	Uganda	1995	0.923	0.937	0.951	4,458
						Uganda	2000-01	0.890	0.907	0.923	5,073
Regional NMI Means						Uganda	2006	0.924	0.942	0.961	2,360
						Uganda	2011	0.915	0.935	0.956	2,058
						Zambia	1996	0.921	0.935	0.949	5,478
Latin America and the Caribbean:		Mean NMI lower bound 0.805	Mean NMI Central 0.825	Mean NMI upper bound 0.844	Total 30	Zambia	2001-02	0.921	0.933	0.946	5,393
Middle East and North Africa:		0.925	0.937	0.949	12	Zambia	2007	0.947	0.958	0.969	5,084
Sub-Saharan Africa:		0.927	0.941	0.956	92	Zambia	2013-14	0.947	0.955	0.963	11,336
Asia:		0.901	0.918	0.935	24	Zimbabwe	1994	0.936	0.953	0.971	2,078
Eurasia:		0.882	0.907	0.931	8	Zimbabwe	1999	0.957	0.971	0.986	2,593
						Zimbabwe	2005-06	0.955	0.966	0.978	3,873
						Zimbabwe	2010-11	0.937	0.949	0.961	4,276