Chapter 4

Does The Quality of Income Growth Affect Child Nutrition Status?

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1. Introduction

The goal of this paper is to explore the relationship between the quality of income growth and child nutrition status. Understanding more about the relationship between income growth and nutrition status is important for a number of reasons. There are currently 162 million stunted children under 5 (Black et al. 2013). These children have standardized heath-for-age scores (HAZ) that fall below a threshold (i.e. they are stunted) for which there are serious consequences for them and their societies. In addition to the moral case for protecting and respecting children's rights to food, care and a safe health environment, there are severe functional consequences of stunting. Black et al. (2013) estimate that 45 percent of child deaths under the age of 5 are due to child undernutrition. The economic consequences are also severe. Children who are stunted are more likely to learn less in school and to live in poverty as adults (Adair et al. 2013; Hoddinott et al. 2013).

Knowing the features of income growth that make it more likely to improve child nutrition status helps to invest strategically in nutrition programmes to reduce undernutrition. The smaller the magnitude of the income effect, the more strategic and proactive the scale-up of direct (nutrition specific, such as breastfeeding promotion, Bhutta et al. 2013) and indirect (such as social protection, Ruel and Alderman 2013) nutrition interventions needs to be for a given nutrition reduction target.

Estimating the relationship between income growth and nutrition status has a long history (Behrman, Deolalikar and Wolfe 1988, Strauss and Thomas 1998, Haddad et al. 2003, Headey 2012, Smith and Haddad 2014). However, there is no literature assessing the *quality* of income

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growth on nutrition outcomes (Gillespie et. al. 2013). This paper aims to make an early contribution. The main challenge the paper faces is how to define the quality of growth in an empirically practical way. To generate sufficient variation in the quality of growth, however defined, we opt for a cross-country descriptive approach.

We explore the quality of growth in three ways. The first two ways assess the relationship between economic growth and nutrition under different contexts. First, we survey the literature for comparable country-level estimates of the relationship between income growth and nutrition outcomes. We then describe the magnitude of the estimates by the level of income inequality in each country at the time. The relationship between income growth and poverty reduction is moderated by income inequality – the higher the inequality the lower the poverty reduction for a given rate of economic growth (see Ferreira and Ravallion 2008 for a review) – and this provides a useful clue for our paper. Second, we build on Smith and Haddad (2014) and employ cross-country econometrics to estimate the relationship between national income growth and stunting rates under different governance regimes. The third way of exploring the quality of growth uses measures of economic growth that fully embody some dimensions of quality. Unfortunately these data do not yet exist for many countries and so we are only able to undertake some preliminary descriptive analysis.

The paper is organized into the following sections. First, the paper presents the results of a systematic search of the literature estimating the relationship between income growth and z-score of height for age (HAZ) of children under 5. We identify several estimates and explore the association with income inequality as measured by the Gini coefficient. Second, we explore the role of governance in shaping the relationship between income and nutrition status using cross country regressions. Is the effect of income on nutrition larger (and therefore of higher quality) or smaller in different governance regimes? Third, for a small set of countries for which data are available, we compare the relationship between nutrition status and GDP per capita with the relationship between nutrition and the Inclusive Wealth Index (IWI). The IWI emerged from the post 2008 interest in measuring what matters, and represents an attempt to measure the quality of growth in terms of human development, equity and sustainable resource use (Smit and Steendjik 2014). The final section concludes with a discussion of the results and suggestions for further research in this area.

2. Income and nutrition elasticity estimates: do they vary by income inequality?

This section summarizes the findings of selected papers on the estimated magnitude of the relationship between height for age z-scores and traditional measures of income from household surveys. We searched the literature on income and nutrition, adopting the Rapid Evidence Assessment (REA) method[1]. This method applies simple exclusion criteria and circumscribes the limits of the reviewed literature in such a way that the process is conducted much more quickly than in a standard systematic review. The selection of the reviewed papers went through three stages.

In stage one, we searched the published literature on income and nutrition using the Citation Indexes at the Web of Science database (ISI) through Endnote software. This limited the search to papers that were published in peer-reviewed journals. We searched for all publications in English from 2000 to beginning of July 2012 using the following search strings: income OR expenditure AND nutrition OR undernutrition. This search delivered 1,836 papers. We then read all paper titles and removed all papers that were not from low and middle income countries by the World Bank classification, and that were not looking at the relationship between income and nutrition in an obvious way. This process reduced the number of publications to 307.

In stage two, we read all 307 abstracts and removed all publications that did not estimate the relationship between income (measured by either household income or expenditure) and nutrition (measured by height for age Z-scores). At this point we increased the number of selected studies in two ways: (1) by back-referencing we included studies referenced by the latest publications that escaped our search, and (2) by consulting experts. In stage 3 we downloaded all studies and removed those whose methodology did not address fundamental issues for the correct "identification" of income elasticities (i.e. they did not allow for unbiased independent effects of the association between income and nutrition status). This left us with the 6 papers in the Appendix Table,

1. UK Civil Service 2012. http://www.civilservice.gov.uk/networks/gsr/resources-and-guidance

yielding 14 elasticity estimates which are presented in Table 1.

The explanatory variable employed by the 6 studies reviewed is almost invariably the log of per capita expenditure. This specification allows for the calculation of a semilogarithmic elasticity that varies with the value of the dependent variable (various indicators of undernutrition). The outcome nutrition indicator used varied greatly by study. We chose standardized height-for-age Z-scores (HAZ) among under-5s (6 papers, 14 estimates) as the preferred indicator. We choose HAZ because we have the most estimates for this indicator and it has become the preferred nutrition status indicator, largely because it more accurately predicts long short and long term consequences of undernutrition (Adair et. al. 2013).

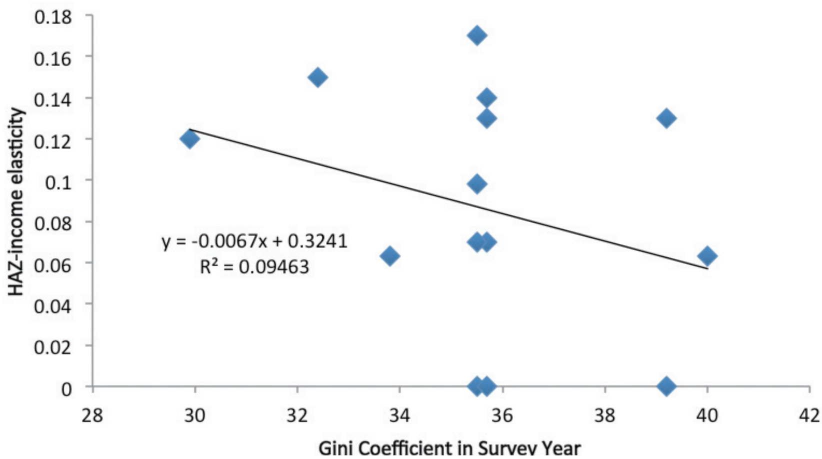
From Table 1 the miroeconometric HAZ-pc income (or expenditure) elasticities range from 0 (not significantly different from zero) to 0.17. A doubling of income will, at most, raise height for age z-scores by 17%. For more detail on the studies and the calculations of the elasticities, see the Annex Table.

Table 1. Summary of elasticities from the microeconometric and cross-country studies, by nutrition outcome indicator

Nutrition indicator	Microeconometric studies
Z-score Height for age (HAZ level)	0 (n.s.) (China 1991-1993/Osberg et. al. 2009) 0 (n.s.) (China 1997-2000/Osberg et. al. 2009) 0 (n.s.) (China 1997/Chen et. al. 2007) 0.063 (Ethiopia 1995-98/Christiansen et. al. 2004) 0.063 (Tanzania 1991-94/Alderman et. al. 2006) 0.07 (Vietnam 1993/O'Donnell et. al. 2009) 0.07 (China 1993/Chen et. al. 2007) 0.098 (Vietnam 1998/O'Donnell et. al. 2009) 0.12 (China 1989/Chen et. al. 2007) 0.13 (China 2000/Chen et. al. 2007) 0.13 (Vietnam 1993/Wagstaff et. al. 2003) 0.14 (China 1993-97/Osberg et. al. 2009) 0.15 (China 1991/Chen et. al. 2007) 0.17 (Vietnam 1998/Wagstaff et. al. 2003)

Figure 1 plots the elasticities by Gini coefficient in the survey year and we can see a downward slope: as inequality increases elasticities decline. Note that the R-squared is low at approximately 0.095 and that we cannot reject the hypothesis that the estimated slope coefficient is zero.

Figure 1. Elasticities (absolute values, vertical axis) for HAZ levels and PC expenditure by Gini coefficient in survey year (horizontal axis)



Data source: http://data.worldbank.org/indicator/SI.POV.GINI?page=2

3. Does governance affect the nutrition-income relationship?

Having too few elasticity estimates to explore conclusively the relationship between elasticities and the Gini coefficients, we turn to more plentiful sources of data, national level GDP per capita and stunting rates. The twist in our analysis is that we intend to explore the cross-country relationships between these two variables in different governance contexts.

In the past decade, governance more broadly has risen up the agenda in terms of both health (Halleröd et. al. 2013; Farag et. al. 2013) and nutrition (Nishida 2009; Pelletier et. al. 2012; Mejia-Acosta and Fanzo 2012; Haddad 2012; Gillespie et. al. 2013). This reflects an increased recognition that the ability of governments to be responsive and responsible has a profound influence on a number of factors that determine nutrition status. Smith and Haddad 2014 found that nearly all the governance variables were associated with reductions in stunting, even when GDP per capita was included in the regressions.

To measure the quality of governance for the countries in our sample we employ International Country Risk Guide (ICRG) indicators published by the Political Risk Services Group (PRS 2013). The indicators are indexes corresponding to five dimensions of governance: (1) bureaucratic quality; (2) law and order; (3) political stability; (4) restraint of corruption; and (5) democratic accountability.[2] The data are available from 1982 onwards and, to render them comparable across countries and over time, are compiled based on PRS experts' subjective analyses of political information organized on the basis of pre-specified "risk components".

How might these five dimensions be relevant to facilitate or impede efforts to accelerate reductions in child undernutrition? [3] Smith and Haddad (2014) briefly surveyed the literature and concluded the following:

- *Bureaucratic quality* concerns the quality of public services and the civil service, including policy formulation and implementation, and regulation of the private sector. It is important for effectively providing public services and programs that support child nutrition status such as safe water, sanitation, education and public food safety net programs. Effective functioning of countries' bureaucracies is particularly important to child undernutrition because addressing it requires a multisectoral effort and vertical integration of different levels of government. It thus puts strong demands on public agencies. Similarly, a strong regulatory environment is necessary as the private sector produces a number of products that if marketed irresponsibly can harm the nutrient consumption of children under two years of age—effective regulation and enforcement of that regulation is vital for the nutrition status of the most vulnerable.

- A strong system of *law and order* is founded on a solid and impartial legal system in conjunction with popular observance of the law.

- *Political stability* rests on a government's ability to carry out its declared programs when in office and to gain office and stay in office through constitutional and non-violent means. Both are

2. The actual names of the ICRG indicators are: bureaucracy quality, law and order, government stability, corruption, and democratic accountability.

3. The definitions and descriptions of each dimension given here are from PRS (2013).

essential for providing reliable public services, creating an environment conducive to the economic stability of households, and the functioning of markets for essential nutrition inputs such as food. Much like natural disasters, violence due to conflict is estimated to have large and permanent effects on nutrition status. Both law and order and political stability allow governments to fulfill their role of protecting citizens from such violence.

- *Restraint of corruption*, that is, restraint of the exercise of public power for private gain, is important as many nutrition interventions involve the transfer of valuable commodities, such as food and drugs, at subsidized rates, which creates multiple opportunities for leakage.

- Finally, *democratic accountability*, including respecting and protecting the rights and civil liberties of all citizens, represents how responsive a government is to its people. The irreversibility of early childhood undernutrition means that public responsiveness in supporting families to meet the needs of young children is vital. Democratic accountability and its herald, transparency, are particularly important for nutrition as most forms of undernutrition are invisible, both because the clinical signs are not obvious unless at their most extreme and because of infrequent collection of nutrition data. Hence public awareness of the magnitude and consequences of the problem is low, and voice is essential to stimulate timely action. In addition, nutrition resource flows, being fragmented across multiple authorities, are also notoriously nontransparent, undermining accountability mechanisms.

To test whether the relationship between income and stunting rates differs by governance indicator level, we estimate panel regression coefficients (using instrumental variables when necessary) for variants of the form:

Stunting = f (lnGDP per capita, governance indicator,
*lnGDP per capita*governance indicator, demographic variables)*

While Smith and Haddad (2014) found that governance and income have separate effects on stunting, interactions were not explored. The five governance indicators are too correlated with each other to simultaneously include all of them and their interactions within the regression framework. So first we include an aggregated governance indicator (of the five components) and its interaction with income. Then we include each of the five-component governance indicators and their interactions, one by one.

We find that none of the interaction terms are significantly different from zero (regressions not reported). In other words, the governance variables we include do not seem to modify the relationship between stunting and income. This may be because the relationship does not exist, or the variables are too crude, or the model is incorrectly specified. To address the last possibility we conduct a range of specification tests, we use spline methods to detect any nonlinearities and we run the regressions for separate sets of observations described by different combinations of governance variables. Our specification tests do not signal misspecification and our spline and subset analyses yielded no significant estimates on the interaction terms. These results suggest no governance modification to the stunting-income relationship. Whether this signals an absence of a relationship or insufficiently refined indicators remains to be determined by future studies.

4. Comparing stunting with GDP per capita and the Inclusive Wealth Index

The Inclusive Wealth Index has been developed by UNEP and the UNU and comprises human capital, produced capital, natural capital and health capital. Prices are assumed to be constant so changes in wealth reflect real changes not short term price bubbles (UNU-IHDP and UNEP 2012, Smits and Steendjik 2014). This stock of wealth is then adjusted by taking into account (a) carbon damages (estimated emissions multiplied by social costs), (b) oil capital gains (i.e. gains stemming from oil price increases into account and (c) total factor productivity—the gains in output that cannot be accounted for by increases in inputs. Comparisons of the growth of IWI per capita over the past 2 decades with GDP per capita growth show that IWI per capita does not grow as fast as GDP per capita and that the correlation between the two is low (UNU-IHDP and UNEP 2012).

The IWI has only been calculated for 20 or so countries. Of these, only a few have significant undernutrition issues. Table 3 identifies these countries, and for the last two years in which they have had nutrition surveys it matches stunting data with GDP per capita and IWI per capita. It is clear that the percentage change in IWI per capita is smaller than the percentage change in GDP per capita. It is also clear that in Nigeria, Colombia and Venezuela, all mineral extracting countries, IWI per capita actually declines despite increases in per capita GDP, indicating non sustainable growth.

Table 2. Stunting, GDP per capita and IWI per capita for countries with significant undernutrition

Country	Year	Stunting, (Countdown country profiles or WHO Global Database)	GDP/cap, PPP (World Bank, in 000s)	Inclusive Wealth Index/cap (IWI report in 0,000s)	% change in stunting	% change in GDP/ cap	% change in IWI/cap
Brazil	1996	14	5.11	3.449			
Brazil	2006	7	5.79	3.806	-50.00	13.31	10.35
China	2000	18	0.95	1.203			
China	2008	10	3.41	1.503	-44.44	258.95	24.94
Colombia	1995	20	2.53	2.707			
Colombia	2005	16	3.39	2.6	-20.00	33.99	-3.95
India	1999	54	0.46	0.45			
India	2005	48	0.74	0.483	-11.11	60.87	7.33
Kenya	1998	36	0.48	0.305			
Kenya	2008	35	0.79	0.319	-2.78	64.58	4.59
Nigeria	2003	43	0.51	0.644			
Nigeria	2008	41	1.38	0.592	-4.65	170.59	-8.07
South Africa	1999	30	3.1	3.64			
South Africa	2008	24	5.6	3.743	-20.00	80.65	2.83
Venezuela	1996	19	3.03	10.99			
Venezuela	2006	16	6.75	10.91	-15.79	122.77	-0.73

Table 2 calculates the arc elasticities for stunting with respect to GDP per capita and IWI per capita. The population weighted mean arc elasticities show that the stunting-IWI per capita elasticity is more negative than the stunting-GDP per capita elasticity. This suggests that when we measure economic growth more fully we are measuring something that is more strongly associated with undernutrition (specifically, stunting).

Table 3. Arc elasticities, stunting, GDP per capita and IWI per capita

Country, time period	arc elasticity, stunting/GDP pc	arc elasticity, stunting/IWI pc
Brazil 1996-2006	-3.76	-4.83
China 2000-2008	-0.17	-1.78
Colombia 1995-2005	-0.59	5.06
India 1999-2005	-0.18	-1.52
Kenya 1998-2008	-0.04	-0.61
Nigeria 2003-2008	-0.03	0.58
South Africa 1999-2008	-0.25	-7.07
Venezuela 1996-2006	-0.13	21.69
Arc elasticity, population weighted mean	-0.38	-1.16

However, these arc elasticities are problematic for at least two reasons. First, while there is no nutrition component within IWI, there are health related components, so the stronger correlation might be driven by this. Second, the IWI per capita elasticities are higher because IWI per capita does not grow as fast as GDP per capita, but the effort of increasing GDP per capita and IWI per capita by the same percentage is not equivalent. So while intriguing, the IWI per capita arc elasticities need to be interpreted with extreme caution. Until we have IWI per capita for more countries, single country observations will continue to exert a large influence and we need to continue to rely on more convention measures to explore the relationship between growth and nutrition status.

5. Conclusions

We have undertaken an exploratory analysis of the association between economic growth and its quality on nutrition outcomes. First, we conducted a systematic search for estimates of the elasticity between height for age of under 5s and income. We found several estimates and tried to identify pattern for their magnitude with reference to income inequality. Second, we explored the role of governance dimensions in shaping the relationship between income and nutrition status using cross country regressions to examine whether the effect of income on nutrition was larger or smaller under different governance regimes. Finally, for the same set of countries, we compared the patterns of changes in nutrition status and GDP per capita with those of nutrition status and the Inclusive Wealth Index per capita.

Our conclusions are as follows:

First, there are very few studies published in peer-reviewed journals, with good methodologies, estimating the relationship between nutrition status and income. This is a pity, because the lack of studies prevents some potentially interesting meta analyses, exploring an area that would be useful for policy making. Given only 14 elasticity estimates (from only 6 studies and 4 countries) we were restricted to undertaking scatter plots with Gini coefficients. Elasticities do reduce in magnitude as inequality increases but the relationship is not statistically significant.

Second, we find that different governance levels do not modify the relationship between GDP per capita and stunting rates. Income growth seems to be important in reducing stunting rates over a wide range of governance dimensions and levels.

Third, the arc elasticities between stunting and GDP per capita look very different when we substitute IWI per capita for the latter. The IWI estimates are much larger, but with so few country-level observations we are reluctant to draw any conclusion other than this is an avenue of analysis worth pursuing as more IWI per capita estimates become available.

From these three different types of analysis, the relationship between the quality of income growth and child growth, at least in the ways we have defined quality, is weak. From the cross-country regressions, there is no indication that the relationship between economic growth and stunting is modified by governance. There may be some sets of observations where governance does modify the stunting-income relationship, but we have not been able to identify them in this paper. The other two avenues of analysis will become more revealing when the IWI is calculated for more countries and when more HAZ-income elasticities are generated. More research is needed along all three lines.

One thing is clear from the wider literature, however, namely that economic growth as currently measured, on average, is not sufficient for rapid stunting reductions. Just as "zero poverty" targets will prove to be increasingly difficult to attain as poverty rates decline (Bluhm et. al. 2014, this volume), so too will "zero stunting" targets, because stunting has an even weaker relationship with GDP per capita than does $1.25 a day poverty rates (Ruel and Alderman 2013). Identifying which components of growth are most important for stunting reduction, and the conditions under which they are most powerful, will be vital if the world is to meet and exceed the World Health Assembly target of reducing the number of stunted under 5s from 165 million today to 100 million in 2025.

Annex Table. Microeconometric estimates of the relationship between HAZ and income

Study	Country and year	Dependent and explanatory variable	Elasticity or other effect size	Other effects
HAZ levels				
Alderman et al. (2006)	4 wave panel Tanzania 1991-92-93-94	Under 5 height-for-age Z-scores Household per capita expenditure	The coefficient of log of per capita expenditure ranges from 0.1-0.2 depending on the specification. A doubling of household income would produce increase in Z-score of 0.1-0.2 SD Elasticity (OLS) =0.206/ mean HAZ (-1.64)=0.125 Elasticity of HAZ (preferred estimate)=0.103/ mean HAZ (-1.64)=0.063	In comparison the presence of a nutrition intervention in the communities increases the Z-scores by 0.3 SD
Christainsen et al. (2004)	3 survey rounds Ethiopia 1996-97-98	Under 5 Height-for-age Z-scores Log of per adult equivalent household expenditure	The coefficients of log of household income range from 0.16-0.19 depending on the survey round. Elasticity = 0.16/mean HAZ of 2.54 = 0.063	In comparison an additional year of education of the most educated female household member increases the Z-score by 0.03 SD. The community-level ability to detect stunting increases the Z-score by .24 SD

O'Donnell et al. (2009)	2 cross sections Vietnam 1993-98	Under 5 Height-for-age Z-scores Log of per capita household expenditure	The coefficients of the log of per capita expenditure increase the HA Z-scores by 0.14 (1993) and 0.16 1998). Elasticity1993=0.14/mean HAZ (-2.03) =-0.07 Elasticity1998=0.16/mean HAZ (-1.64)=-0.098	Decomposition analysis shows that 39% of the change in stunting occurring between the two rounds was the result of an increase in household consumption. Changes in water and sanitation and household structure had a smaller impact.
Osberg et al. (2009)	Three wave panel China 1991-93-97	Under 5 Height-for-age Z-scores Log of per adult equiv hh expenditure	The coefficient of log of per capita expenditure ranges from 0.0 to 0.17 depending on the survey period. Elasticity 1993-97=-0.17/ mean HAZ (-1.25) =0.135 Elasticities in 1991-93 and 1997-2000 = 0 as a zero estimated coefficient cannot be rejected	Additional years of education of mothers and fathers do not have a statistically significant impact
Chen et al. (2007)	5 survey rounds China 1989 19991-93-97 2000	Height for age Z-score. Log of household income	The coefficients of log of household income range from 0.09-0.19 depending on the survey round. Elasticity 1989 = 0.157/1.315=0.12 Elasticity 1991 = 0.192/1.315=0.15 Elasticity 1993 = 0.085/1.218=0.07 Elasticity 1997 = 0 Elasticity 2000 = 0.122/0.971=0.13	In comparison the coefficient of years of education of the head of household is only 0.01-0.02.
Wagstaff (2003)	2 wave panel Vietnam 1993-98	Under 5 Height-for-age Z score Log of per capita household expenditure	The coefficient of log of per capita expenditure is 0.26 and 0.27 depending on the survey period. Elasticity in 93= -0.26/mean HAZ (-2.036)=0.13 Elasticity in 98=0.27/mean HAZ(-1.608)=0.17	In comparison years of schooling of mothers and fathers & access to safe water do not have an impact.

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