Session Number: POSTER PAPER SESSION

Paper Prepared for the 29th General Conference of
The International Association for Research in Income and Wealth

Joensuu, Finland, August 20 – 26, 2006

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Measuring Pro-Poor Growth in Non-Income Dimensions

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March 2006

Abstract

Current concepts and measurement of pro-poor growth is entirely focused on the income dimension of well-being. This neglects non-income dimensions of poverty and the multidimensionality of poverty and well-being. In this paper we introduce the multidimensionality of poverty into the measurement of pro-poor growth measurement by applying the growth incidence curve to non-income indicators. We develop growth incidence curves and calculate the associated Ravallion-Chen Pro Poor Growth measures for a range of non-income indicators such as education, mortality, vaccinations, stunting, and a multidimensional well-being measure and are thereby able to study improvements in these dimensions of well-being at various points of the distribution of those indicators as well as at various points of the income distribution. This way we can determine whether improvements in non-income indicators were pro-poor in an absolute or relative sense. We illustrate this empirically for Bolivia between 1989 and 1998 and find that growth was relatively pro-poor in the non-income dimension; results for absolute improvements are less clear.

***JEL* Classification:** D30, I30, O10, O12.

Key words: Pro-Poor Growth, Multidimensionality of Poverty, Growth Incidence Curve, Bolivia.

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1 Introduction

Pro-poor growth has recently become a central issue for researches and policy makers, especially in the context of reaching the Millennium Development Goals (MDG). The various proposals to measure pro-poor growth have also allowed a much more detailed assessment of progress on reducing poverty as they explicitly examine growth along the entire income distribution.

However, one existing shortcoming of current pro-poor growth concepts and measurements is that they are completely focused on income, thus focused only on MDG1 which aim is to halve the incidence of poverty until 2015. The shortcoming of the one-dimensional focus on income is that a reduction in income poverty does not guarantee a reduction in the non-income dimensions of poverty, such as education or health. This means that finding income pro-poor growth does not automatically mean that non-income poverty has been also reduced. For this reasons, multidimensionality of poverty and pro-poor growth as two main research areas have to be combined.

The aim of this paper is to introduce the multidimensionality of poverty into the pro-poor growth measurement. The distribution of non-income welfare within countries has important policy implications, which will for example be a central issue of the World Development Report 2006 (Worldbank 2004b). The basic idea of this approach goes back to Sen (1988) who considers poverty as a multidimensional phenomenon. His capability approach focusses on non-income indicators for which income is only a means to obtain certain functionings. Thus he directly considers outcomes of poverty like being healthy or being well educated. Based on this approach many empirical poverty assessments including social indicators have been undertaken (e.g., Klasen 2000; Grimm, Guénard, and Mesplé-Somps 2002). However, non-income indicators are not considered in the pro-poor growth measurement so far.

We do this exemplarily by applying the growth incidence curve (GIC) by Ravallion and Chen (2003) to non-income indicators and call our approach non-income growth incidence curves (NIGIC). We illustrate this approach using microsurvey data for Bolivia for 1989 and 1998. We distinguish between ranking the sample by each non-income indicator and ranking the sample by income and investigate based on this income ranking the changes of the non-income indicator with respect to the position in the income distribution. In addition to investigate growth rates, we investigate absolute changes of the non-income indicators. We find that growth was pro-poor both in the income and in the non-income dimension, but results are less clear for the non-income development when the poor are ranked by income.

The paper is organized as follows. First, we briefly give an overview of the concept of pro-poor growth and the need to investigate it in a multidimensional perspective. Second, we explain our methodology to apply the GIC to non-income indicators and discuss some limitations. Third, we present the results of the GIC and the NIGIC for selected variables and for a composite welfare index. Last, we summarize and give an outlook for future research.

2 The Concept of Pro-Poor Growth

2.1 Definition of Pro-Poor Growth

According to some, pro-poor growth is simply economic growth that benefits the poor (e.g., UN 2000a; OECD 2001). This definition, however, provides little information how to measure or how to implement it. What remains to be specified is, first, if economic growth benefits the poor and, second, if yes to what extent. For example, Klasen (2004) provides more explicit requirements that a definition of pro-poor growth needs to satisfy. The first requirement is that the measure differentiates between growth that benefits the poor and other forms of economic growth, and it has to answer the question by how much the poor benefited. The second requirement is that

the poor have benefited disproportionately relative to the non-poor. The third requirement is that the assessment is sensitive to the distribution of incomes among the poor. The fourth requirement is that the measure allows an overall judgement of economic growth and not focuses only on the gains of the poor. Besides this approach there exist several other attempts conceptualizing pro-poor growth.[1]

Categorizing the different and conflicting definitions, we speak of three definitions of pro-poor growth in our paper: weak absolute pro-poor growth, relative pro-poor growth, and strong absolute pro-poor growth. Pro-poor growth in the weak absolute sense means that the income growth rates are above 0 for the poor. Pro-poor growth in the relative sense means that the income growth rates of the poor are higher than the average growth rates, thus, that relative inequality falls (i.e. in which some indicator measuring the relative gap between the rich and the poor). Pro-poor growth in the strong absolute sense requires that absolute income increases of the poor are stronger than the average, thus, that absolute inequality falls (i.e. some measure in which the absolute gap between the rich and the poor falls e.g., Klasen 2004).[2]

The latter definition is obviously the strictest definition of pro-poor growth and the hardest to be met as shown empirically by White and Anderson (2000). This is why most researchers concentrate in general on the weak absolute and relative definition. But this ignores that decreases in relative inequality might be – and often are – accompanied by increases in absolute

[1]For a detailed review on the different definitions and measures of pro-poor growth see for example Son (2003). Other approaches to define pro-poor growth are provided for example by White and Anderson (2000), Ravallion and Datt (2002), Klasen (2004), Hanmer and Booth (2001). The most common measures that have evolved in pro-poor growth measurement are the "poverty bias of growth" of McCulloch and Baulch (2000), the "pro-poor growth index" of Kakwani and Pernia (2000), the "poverty equivalent growth rate" of Kakwani and Son (2000), the "poverty growth curve" of Son (2003), and the "growth incidence curve" of Ravallion and Chen (2003).

[2]Most inequality measures, including the Gini, Theil, and Atkinson measures as well as decile or quintile ratios are relative inequality measures; for a discussion of the merits of also considering absolute inequality measures, see Atkinson and Brandolini (2004).

inequality which is seen as undesirable by many and can be an important source of social tension (e.g., Atkinson and Brandolini 2004; Duclos and Wodon 2004; Klasen 2004). Conversely, growth that is associated with falling absolute inequality would be particularly pro-poor and therefore it is useful to consider this strong absolute concept as well. This is particularly important when examining pro-poor growth in the non-income dimension of poverty where the even pro-poor growth in the relative definition might not be seen as sufficiently pro-poor.[3]

2.2 Multidimensionality of Pro-Poor Growth

The most glaring shortcoming of all attempts to define and measure pro-poor growth is that they rely exclusively on one single indicator which is income.[4] This means that they are only focussed on MDG1 but leave out the multidimensionality of poverty which is taken into account in the other MDGs. In this context, Kakwani and Pernia (2000) note that it would be "futile" if one operationalizes poverty reduction via pro-poor growth using just one single indicator because poverty is a multidimensional phenomena, and thus pro-poor growth is also multidimensional.

Income enables households and/or individuals to obtain functionings. This means, income serves to expand people's choice sets (capabilities) (Sen 1988) and is therefore an indirect measure of poverty. In contrast, non-income indicators measure the functionings of households and individuals directly. Measuring poverty only with income assumes that income growth is accompanied by non-income growth. However, the problem of focussing

[3]Consider the case where the poorly educated increased their education level from 1 to 2 years, an increase of 100 percent while the rich increased their education levels from 10 to 12 years, an increase of 20 percent; this would be pro-poor growth in the relative definition as relative inequality falls; but most observers would also note the rise in absolute inequality and might therefore not consider this type of educational expansion 'pro-poor'.

[4]In this paper, we only consider income as the money-metric measure of living standard and do not distinguish between income and consumption. For a detailed discussion on the debate of income versus consumption as a measure, see, for example, Deaton (1997).

only on MDG1 is that an improving income situation of households need not automatically imply an improving non-income situation, thus, reaching the other MDGs is not automatically guaranteed (for example, as shown in Klasen (2000) or Grimm, Guénard, and Mesplé-Somps (2002)). While non-income indicators have recently received more and more attention in the concept and measurement of poverty[5] they have not in the concept of pro-poor growth and no attempts have been made to measure pro-poor growth on the basis of non-income indicators.

Following Sen (1988) our conceptual approach to introduce non-income indicators in the pro-poor growth measurement starts with the selection of non-income indicators determining the most important functionings of human welfare. In line with the MDGs (UN 2000a) we select education, health, nutrition, and mortality as non-income indicators of poverty and follow the most prominent multidimensional poverty indices like the Human Development Index, the Human Poverty Index, and the Physical Quality of Life Index by UNDP (1991, 2000). After having selected the indicators and defined related variables we investigate whether non-income growth was pro-poor between two periods. We do this exemplarily in applying the methodology of the GIC to non-income indicators, but non-income pro-poor growth can also be applied to other pro-poor growth measures. Next, we compare the results based on non-income indicators with those based on income.

[5]Examples for recent studies examining the multidimensional casual relationship between economic growth and poverty reduction are Bourguignon and Chakravarty (2003), Mukherjee (2001), and Summer (2003). Also international organizations point to the importance of the direct outcomes of poverty reduction such as health and education (e.g. Worldbank 2000; UN 2000a; UN 2000b).

3 Methodology

3.1 The Growth Incidence Curve

To answer the question if and to what extent growth was pro-poor one can investigate the growth rates of the poor, i.e. those percentiles in the poverty line who were below the poverty line in the initial period.[6]. A useful tool for this purpose is the GIC (Ravallion and Chen 2003) which shows the mean growth rate g_t in income y at each centile p of the distribution between to points in time, t–1 and t. The GIC links the growth rates of different percentiles and is given by

$$GIC : g_t(p) = \frac{y_t(p)}{y_{t-1}(p)} - 1. \tag{1}$$

By comparing the two periods, the GIC plots the population centiles (from 1–100 ranked by income) on the horizontal axis against the annual per capita growth rate in income of the respective centile. If the GIC is above 0 for all centiles ($g_t(p) > 0$ for all p), then it indicates weak absolute pro-poor growth. If the GIC is negatively sloped it indicates relative pro-poor growth.

Starting from the GIC Ravallion and Chen (2003) define the pro-poor growth rate (PPGR) as the area under the GIC up to the headcount ratio H. The PPGR is formally expressed by

$$PPGR = g_t^p = \frac{1}{H_{t-1}} \int_0^{H_t} g_t(p)dp \tag{2}$$

which is equivalent to the mean of the growth rates of the poor up to the headcount. What is normally done in poverty assessments is to compare the PPGR with the growth rate in mean (GRIM). The GRIM is defined by

$$GRIM = \gamma_t = \frac{\mu_t}{\mu_{t-1}} - 1 \tag{3}$$

where μ is mean income. If the PPGR exceeds the GRIM growth is declared to be pro-poor in the relative sense.

[6]We assume anonymity throughout, i.e. we consider the growth rates of percentiles, even though they contain different households in the two periods. For a discussion of this and results when the anonymity axiom is lifted, see Grimm 2005

Examining pro-poor growth in the strong absolute sense one has to concentrate on the absolute changes in income of the population centiles between the two periods. We define the absolute GIC or by

$$absoluteGIC : c_t(p) = y_t(p) - y_{t-1}(p) \tag{4}$$

which shows the absolute changes for each centile. By comparing the two periods, the absolute GIC plots the population centiles on the horizontal axis against the annual per capita change in income of the respective centile on the vertical axis. If the absolute GIC is negatively sloped it indicates strong absolute pro-poor growth.

Starting from the absolute GIC we define the "pro-poor change" (PPCH) as the area under the absolute GIC up to the headcount H. The PPCH is formally expressed by

$$PPCH = c_t^p = \frac{1}{H_{t-1}} \sum_{1}^{H_t} c_t(p) \tag{5}$$

which is equivalent to the mean of the changes of the poor up to the headcount. We compare the PPCH with the change in mean (CHIM) which is defined by

$$CHIM = \delta_t = \mu_t - \mu_{t-1}. \tag{6}$$

If the PPCH exceeds the CHIM growth is declared to be pro-poor in the strong absolute sense.

3.2 The Non-Income Growth Incidence Curve

3.2.1 Concept

The calculation of the non-income growth incidence curves (NIGIC) broadly follows the concept of the GIC. Instead of income (y) we apply formulas (1) to (6) to selected non-income indicators to measure pro-poor growth directly via outcome-based welfare indicators. Thus, the NIGIC measures

pro-poor growth not in an income sense but in a non-income sense, e.g., the improvement of the health status or the educational level between two periods for each centile of the distribution.

We calculate the NIGIC in two different ways. The first way we call the unconditional NIGIC in which we rank the individuals by each respective non-income variable and calculate based on this ranking the population centiles. For example, using average years of schooling of adult household members, the "poorest" centile is now not the income-poorest centile but the one with the lowest average household educational attainment.

The second way we call conditional NIGIC in which we rank the individuals by income and calculate based on this income ranking the population centiles of the non-income variable. With the conditional NIGIC, we capture the problem that the assignment of the households to income centiles on the one hand (GIC) and to non-income centiles on the other hand (unconditional NIGIC) might not be the same. For example, the income-poorest group might not be the education-poorest group at the same time. This means that, in the conditional NIGIC, the centiles are income centiles, thus that the poorest centile is the one with lowest income, but that the growth rates are non-income growth rates, thus are calculated for, e.g., years of schooling of the income centiles. With the conditional NIGIC, we measure how the development of the non-income indicators is distributed for the income groups.

Both ways of calculating the NIGIC are of particular relevance for policy making. The unconditional NIGIC mirror the development of the social indicators that are relevant for human welfare. Thus it can monitor how the non-income MDGs have developed over time for different points of the non-income distribution. Improvements will be particularly important for those at the lower end of the non-income achievements and the NIGIC allows such an assessment. The conditional NIGIC give an additional tool to investigate

how the progress in non-income dimensions of poverty was distributed over the income distribution. This is also of relevance when evaluating distributional impacts of aid and public spending. Standard benefit incidence studies for example analyze the impact of public spending by calculating shares of the total spendings to each centile and comparing the shares of the income poorest with the income richest centile (see, e.g., Van de Walle 1998; Van de Walle and Nead 1995; Lanjouw and Ravallion 1998; Roberts 2003). But the share of public spending for the poor serves only as a proxy for a real welfare impact in terms of non-income achievements. With the conditional NIGIC it is than possible to analyze the actual improvements in the particular social sector over the income distribution. For example it provides an instrument to assess if public social spending programs has reached the targeted income-poorest population groups and if the public resources are effective allocated. In this respect the conditional NIGIC might be a useful tool in the pro-poor spending analysis to understand who benefits from public spending and to what extent.

When interpreting the NIGIC, three issue need to be discussed. First, in comparing the GIC and the NIGIC, one cannot deduce any causality between income and non-income indicators. For example, from the curves we can neither say that an improvement in income causes an improvement in the health status nor that an improvement in the health status causes an improvement in income. They simply show how improvements in income and non-income indicators are related to each other, which might be due to causal or spurious correlations. Second, one cannot compare the absolute values of the growth rates of income and non-income variables because the variables are measured in different dimensions such as monthly income and years of schooling. One can only compare if the growth rates are positive or negative and by how much the PPGR exceeds the GRIM. Lastly, due to the different dimensions of the income and non-income indicators, and the

fact that many of the non-income indicators are bounded above (i.e. there is an upper limit to survival prospects or to educational achievements), it may well be plausible that different definitions of 'pro-poor growth' would be appropriate for different indicators. While one may be satisfied that income growth was pro-poor if it met the relative definition (the poor had higher income growth rates than the rich), one may only call growth in educational achievements pro-poor if the poor had higher absolute increments than the non-poor.[7]

3.2.2 Specification of the Non-Income Indicators

We calculate the unconditional and conditional NIGIC for education, health, nutrition, and for a composite welfare index (CWI) as described below. We are working with DHS data for Bolivia from the years 1989 and 1998 that do not contain information on income or consumption due to its focus on demographics, health, and fertility. However, in our DHS data set, we use simulated incomes based on a dynamic cross-survey microsimulation methodology (Grosse, Klasen, and Spatz 2005).[8] The basic idea of this simulation methodology is the following. The authors use two kinds of surveys: first, the DHS (of 1989 and 1998) and, second, the Bolivian household surveys (the 2nd EIH of 1989 and the ECH of 1999). Then they estimate an income correlation in the household survey, apply the coefficients to the DHS, and

[7] A different way to deal with this problem would be to re-scale the non-income variables by, for example, transforming the education indicator into a percentage shortfall from a maximum level, say 16 years of education, and then define growth as the percentage reduction in that shortfall. With such an indicator one may well decide to choose the relative definition as sufficient to define pro-poor growth. As discussed below, this issue will also arise when comparing the Gini coefficients of incomes with Gini coefficients in non-income indicators

[8] For the calculation of the PPGR in the next chapter, we use the headcount of 77 percent as found in Klasen et al. (2004) for the moderate poverty line. We use the same headcount for the calculation of the PPGR of all non-income indicators. Note that for the GIC we always use the same household sample as for the NIGIC, thus, having different GIC in all figures.

predict, i.e., simulate, incomes in the DHS.[9]

For each non-income indicator, we identify alternative variables to capture different trends and dynamics. For education, we specify eight different variables. We calculate average years of schooling for all adult household members and for males and females separately.[10] Furthermore, we restrict the sample to women aged between 20 and 30 as only this age group is likely to have experienced a change in their educational achievement (the 20-30 year in 1999 represent a new cohort of women who were educated later than the other cohorts; in contrast, the education of 30-40 year olds in 1989 should not be be very different from the education levels of the 40-50 year olds in 1999). Then, we calculate the maximal education per household instead of the average for all adults, males, females, and females aged between 20 and 30. The idea behind using these variables as an indicator is that it might be sufficient that one household member is well educated to generate income for the whole household and to provide a stimulating atmosphere for other members (i.e., intra-household externalities) (Basu and Foster 1998).[11]

[9]To provide some more detail, the authors estimate an income/consumption expenditure model in the 1999 LSMS data restricting the set of covariates to those which are also available in the 1998 DHS data and interacting all variables with a rural dummy. They then use the regression to predict incomes in the DHS and add a randomly distributed error term. They then repeat the procedure for the EIH of 1989, which is only available in urban areas. When imputing incomes in rural areas, they use the model for urban areas in 1989 and add the results of the rural interaction terms from 1999, thus assuming that the difference in the impact of income correlates between 1989 and 1999 did not change over time. While the results work well in a validation test for 1999, there is a tendency that the simulated income growth is higher than the observed one. This overprediction should not bias the results in this paper, but it might be useful to test the results generated here with a survey that contains detailed information both on income and on non-income variables.

[10]The DHS only includes households with at least one woman in reproductive age, i.e., aged between 15 and 49 who serve as respondents in the DHS. The education for the male household members has to be taken from the memory of the respondents concerning the education of their husband or partner (with the age of the men being unknown). Households without women in reproductive age are excluded and unmarried men in the households as well.

[11]In important issue is to be noted here: An overall problem of years of schooling as a variable for educational attainment is that years of schooling do not a priory say anything about educational quality and thus, the indicator should be treated with some caution. This problem might be solved by using other data such as education test scores (like Pisa scores). However, these data are not always available and if, not in the same data sources.

For health we specified three different variables. We calculate infant survival rates of children aged under 5 years and also for children aged under 1 year.[12] Furthermore, we take the average vaccinations of children aged between 1 and 5 per household, with a maximum of 8 possible vaccinations for each child.[13] The vaccination rate is a variable that represents access to health care and preventive medicines. A similar variable has for example been used in the monitoring of the health sector reform project in Bolivia in 1999 (Montes 2003).

For nutrition we use stunting z-scores as the variable that measures chronical undernutrition for children aged between 1 and 5 years. The stunting z-scores are defined as the difference of height at a certain age and the median of the reference population for height at that age divided by the standard deviation of the reference population. It takes values between approximately -6 and 6, where values below -2 are considered as being moderately undernourished and below -3 as being severely undernourished (see, e.g., Klasen 1999). Problematic might be that the z-score contains a lot of "genetic noise" in the sense that for example a low z-score interpreted as being undernourished might simply appear because the parents are genetically short but the child is small but well nourished and vice versa.

An alternative possibility to address the issue of the multidimensionality is to aggregate several indicators to a composite welfare index (CWI). Here, we follow the methodology of the Human Development Index (HDI) to address the problem of difference scales of the variables (UN 1998). Each variable that enters the index is normalized to be between 0 and 1 in sub-

[12] In our calculation, we use household child survival rates instead of child mortality rates. An improvement in child mortality comes out as a lower value but this lower value is mathematically interpreted as a deterioration. The linear transformation used is: survival rate = (mortality rate $- 1) * (-1)$. This means for example that a reduction of child mortality from 80 percent to 60 percent is transformed into an increase in child survival from 20 percent to 40 percent.

[13] The possible vaccinations are 3 against polio, 3 against DPT, 1 against measles, and 1 against BCG.

tracting the individual value from the minimum value observed in the dataset divided by the subtracting the maximum value from the minimum value

$$CWI = \frac{1}{n} \sum_{i=1}^{n} \frac{individual_n - minimum}{maximum - minimum} \tag{7}$$

The CWI is constructed by simply averaging the sum of the selected variable scores n. It includes four of the above explained variables: average education of all adult household members, stunting z-scores, under 1 survival, and average vaccinations.[14]

As not all variables are given for all households (e.g., health and nutrition variables are only available for households who have children), we calculate the CWI for two different samples. The first sample, called small sample, is the one for which all variables are available for all households. This reduces the sample size enormously (in 1989, e.g., from 6,053 to 1,306 households) and, more importantly, in a non-random fashion. The second sample, called big sample, includes all households, but the index is averaged over fewer variables for those households which do not have data for nutrition and/or health variables. The advantage of creating the CWI based on the big sample is the higher number of observations but the disadvantage is that the results for some centiles are driven by very few or only one variable. The smaller sample has fewer observations but contains for all households the same number of variables. For both the small and the big sample, we in addition augment the indices by also including simulated income as a fourth indicator.

3.3 Limitations of the Indicators

While we show below that these indicators yield important information, one has to be aware of a number of inherent limitations which we want to high-

[14]The latter two variables do not enter separately but form a health sub-index as the simple average of the two scores. In contrast to the HDI, we use the maximum and minimum values defined by the data sets and do not use fixed maximum and minimum values.

light. The first limitation is the informational value of the calculated growth rates of the NIGIC, where we interpret an ordinal relation in a cardinal fashion. Examining an ordinally scaled variable one can say that 6 years of schooling is better than 3 years but one cannot be sure to that the household is twice as well- educated.[15] This ordinal scaling leads to two different kinds of interpretation problems.

First, averaging an ordinally scaled variable leads to a ranking problem when assuming that education is one of the most important determinants to generate income and reduce poverty (Osberg 2000). For example, comparing two households A and B with two adults in each household where the household members of A have 0 and 12 years of schooling and of B have 6 and 7 years of schooling, household B has a higher average education than A. Now, when B is ranked higher than A one ignores any kind of educational degrees and the resulting differentials in returns to education. This means that the person with 12 years of schooling might earn disproportionally more income than both members of household B together, thus, household A should be ranked higher than B. We address this problem in also using maximal education per household.

Second, concerning increases in years of schooling, just comparing growth rates might be misleading. For example, Table 1 shows for average education an increase of 71 percent for the 2^{nd} decile compared to 8 percent of the 9^{th} decile which might be overstating the improvement for the poor because the years of schooling of the poor increase from 1.74 to 2.97 years of schooling and those of the non-poor from 11.61 to 12.54. We address this problem in calculating absolute NIGIC and pro-poor changes. However, even when we use absolute changes which equal approximately 1, a further question remains open. An increase of 1.23 years of schooling of the 2^{th} decile might

[15]The same problem exists when interpreting income in a cardinal fashion, despite the lacking foundation for such an interpretation, but this issue is normally neglected applied discussions.

be less beneficial, because perhaps the persons are still more or less illiterate, compared to the increase of 0.93 years of schooling in the 9^{th} decile, which means completing secondary schooling and getting a degree.

Third, many of the non-income indicators are bounded above, i.e. there are firm or likely upper limits on such achievements. 100 percent survival in the first year is the upper limit for health, more than 20 years of education is very rare, more than eight vaccinations is not recommended, etc. This generates two problems. First, it may be the case (and indeed is the case in Bolivia) that some households have reached the upper limit and further growth is not possible. Moreover, one may assume 'declining marginal returns' to improvements in non-income indicators which would suggest that a marginal year of schooling or another vaccination is less valuable when the level of schooling or vaccinations is already high. There are ways to address this problem, but we refrain from making any adjustments and just want to highlight this potential issue.[16]

The fourth type of problem in comparing relative changes relates to the stunting z-score. In our data sets, it ranges roughly from -6 to 6. Relative changes in the stunting z-score cannot be calculated because of the coexistence of negative, positive and 0 values in the variable range. For example, how to compare the relative improvement from -2 to -1 with an improvement from 1 to 2 from the year 1989 to 1998? We reduce this problem by transforming the z-score in such a way that all values are positive, that means by adding the minimum value of both data sets (in our case -5.89) to each z-score to get a range of only positive numbers.

Another limitation is the problem of weighting which we illustrate with the example of child mortality. For example, comparing two households A and B where A has 1 child and B has 10 children the households should be weighted differently when in each of the two households 1 child dies. House-

[16]One way to address this would be a logarithmic transformation of non-income achievements as is done for the income component of the HDI.

hold A has a child mortality rate of 100 percent whereas B of "only" 10 percent. From an intrinsic point of view, it is obvious that both deaths are equally lamentable. In this case one could think of just counting the death per household independently of the total number of children. However, it is less obvious from an economic point of view where children can be partly considered as investment goods. Here, a higher mortality rate mirrors the more heavy loss of one child in the one-child household A compared to the 10-children household B. The investment-good character comes from absence or lack of social security systems in which case the children care for the parents in the cases of unemployment, sickness, and old age (e.g., Ehrlich and Lui 1997).[17] Following these two extreme points of view, one might think of weighting the death of children in households taking both arguments somehow into account. But any weighting would, however, be quite arbitrary and induce difficulties in justifying it with economic or welfare-theoretical judgments. Keeping this critical issue in mind we use unweighted child survival rates (leaving the weighting problems unsolved).

Weighting problems are also difficult with the nutrition indicator. A negative stunting z-score indicates malnourishment. But the z-score should not be interpreted as a linear variable in the sense that an increasing z-score is always equivalent to an improvement in the nutritional status. From a certain threshold onward, increasing z-scores might reflect no longer improvements of the nutritional status but indeed quite the opposite. For example a child with a very high z-score of 3 might not be better off as one with 0 because she might be too tall for her age. This problematic holds even stronger if one would consider wasting z-scores (weight over age). Here, increasing z-scores strongly above 0 reflect instead overnourishment that affects the health status in a negative manner.

[17] One complicating aspect arises when taking gender preferences for the children into account. The loss of one child when considered as an investment good might depend on the cultural habits (e.g., labor market opportunities for females and males, marriage agreements, and the question who takes care of the parents in old age).

Another limitation calculating the NIGIC is that some variables of the non-income indicators do not vary much between households. This holds especially for under 5 and under 1 survival which is very low in Bolivia at the household level. For both years, Table 1 shows that up from the 2nd decile, the maximum value 100 percent is already reached in both years, so that no improvement is possible any more. This translates into growth rates of 0, so that the unconditional NIGIC becomes flat and takes the value of 0 from the 2nddecile onward. The problem of flat curves always arises when the variable values are bounded (as for example a maximum of 19 years of schooling or 8 vaccinations).

Dealing with this limitation in a more general way the discussed variables have a more discrete character in the sense that one either has survived or not which makes it difficult to observe relative differences among individuals, households, and over time. This is why these indicators (such as mortality rates) are mostly generated and interpreted at an aggregate level. The only, but small, variation evolves from taking household averages instead of individual data. This is why these variables – and all kinds of dummy variables – show little (and highly erratic, as shown below) variation for the pro-poor growth analysis using GIC.

More interesting to examine are in these cases the conditional NIGIC, in which we link the survival rates and vaccination to income. Here, low or 0 variation is less problematic than for the unconditional NIGIC because the variables are ranked by income. As Table 2 and all figures show there is no flat part any more. Now we generate interesting information regarding the changes on the non-income indicators when ranked according to their income situation and how improvements are distributed.

4 Empirical Illustration

4.1 Inequality

Bolivia is one of the countries with a very unequal income distribution in Latin America. We find high and persisting income inequality as measured with the Gini coefficient that falls from 0.56 in 1989 to 0.54 in 1998 (Table 1). This high inequality is also reflected in the high and only slightly falling 90:10 ratio. Turning from inequality to growth we find that all deciles increased their incomes. Especially in the 1990s, Bolivia experienced relatively high growth rates (which also were pro-poor in urban and rural areas). However, Bolivia was and is one of the poorest countries of the region, and the positive economic trend has reversed since 1999 combined with some episodes of social and political turmoil. As concerns social indicators such as life expectancy or literacy, Bolivia used to show much worse outcomes compared to other countries in the region. However, there have been notable and sustained improvements in many social indicators since the late 1980s which continued to improve during the recent economic slowdown (see, e.g., Klasen et al. 2004).

The Ginis for education variables are all in the range of 0.40. As stated above, due to the boundeness of the variable, one cannot infer directly from this that educational inequality is in some sense substantively smaller than income inequality.[18] For all educational variables the Ginis fall between 1989 and 1998, which is likely due to the fact that the rich have already reached high levels of education and the poor are catching up. Interesting to note is that the highest Ginis exist for the group of all respondents both for average and maximal education indicating a gender bias in educational achievements. These findings are also reflected in the 90:10 ratio. The conditional deciles

[18] One should also be aware of the fact that the calculation of the Ginis of the social indicators are based on discrete variables. Thus no continuous Lorenz curve exists, so the simple Ginis should be interpreted with caution. An attempt to face this problem would be to follow the methodology of Thomas, Wang, and Fan (2000) who calculate Gini coefficients for education.

also show that the level of schooling increases with increasing income for all educational variables, but the 90:10 ratio is much lower than in the unconditional case. We find that an improvement has been made for all educational variables in all deciles for both the unconditional and the conditional case (Tables 1 and 2).

The extremely low Ginis for the under 1 and under 5 survival rates can be explained by the low overall incidence of child mortality in Bolivia at the household level. For both age groups, child mortality is about 10 percent. The conditional deciles indicate that the risk of child mortality is higher for the income-poor compared to the income-rich. For vaccination we find only little improvements over time for the lower deciles and also for the higher deciles, which is also due to the fact that the best vaccinated deciles had only limited room for improvements. The inequality of the stunting z-score is relatively low and falls slightly. Malnutrition decreases with an increasing position in the income distribution, but the differences for the income deciles are lower but clearly existing. The CWI reflects the findings from above where the Gini coefficients decrease for the selected variables (Table 3). Both for the CWI excluding and including income the Gini coefficient is higher for the big sample than for the small sample indicating between-group inequality.[19]

4.2 Pro-Poor Growth

Figure 1a shows the unconditional and conditional (normal and smoothed[20]) NIGIC for average education per household and the GIC. Figure 1b shows for this variable the absolute changes measured both unconditionally and conditionally and the absolute changes in income.

[please insert Figure 1a and 1b here]

[19] This between-group inequality is driven by the higher degree of homogeneity in the small sample.

[20] As the conditional are very volatile, we additionally include the smoothed conditional NIGIC in the figures to show the major trend of the curves.

The GIC shows weak absolute (curve lies above 0) and relative pro-poor growth (negative slope) for Bolivia between 1989 and 1998. For the unconditional NIGIC, we find weak absolute as well as relative pro-poor growth.[21] The relative pro-poorness of average education is reflected comparing the PPGR with the GRIM where the PPGR for moderate poverty is 3.89 percent and the PPGR for extreme poverty 4.88, both higher than the GRIM of 1.80 percent (Table 4). The conditional NIGIC is more volatile than the unconditional NIGIC and also shows weak absolute and relative pro-poor growth but to a lower extent. Thus, the conditional NIGIC shows that the income-poor have experienced slightly higher educational growth than the average. This is also reflected in the higher PPGR (2.00 percent for moderate and 2.24 percent for extreme poverty) compared to the GRIM (1.80 percent).

Figures 2a and 2b show the results for average vaccination. The unconditional NIGIC shows pro-poor growth in the weak absolute and is also slightly negatively sloped. Table 4 confirms the pro-poorness in the relative sense. Here both PPGR exceed the GRIM. However, improvements are relatively low which was also shown in Table 1.

[please insert Figure 2a and 2b here]

The conditional NIGIC shows no clear pro-poor growth trend. In addition, the PPGR are lower than the GRIM and for some deciles we even find a deterioration. The same findings also hold for the absolute curves. This finding reveals that the relative pro-poor growth might not be enough for the poor and that absolute increases (the amount of additional vaccinations) are of particular weight. Finally it is essential for the health status of children

[21] A noteworthy point appears when looking at the upper part of the unconditional NIGIC and their absolute changes. In the range of the 7^{th} and 8^{th} decile, all curves fall below 0 and become positively sloped afterward. This reduction might not be a deterioration but might be due to a reform of the schooling system.

and the country as a whole to have all possible vaccinations. The conditional absolute NIGIC shows that the improvements are relatively equally distributed amongst the income groups.

When examining the high relative growth in the unconditional NIGIC for education and vaccinations, Figures 1a and 2a do not report growth rates for the very poor deciles. This is due to two reasons. First, the very poor began and ended with no education and no vaccinations (see discussion below). Second, the slightly between off started with no education or no vaccination and ended up having positive levels of education and vaccinations in the second period. But in this case the growth rate is not defined and thus not reported. The very high growth rates that appear on the graphs at the left are thus based on percentiles who had some small amount of education and vaccinations and even a moderate expansion translates into a very high growth rate.

Turning to the absolute growth incidence curves, the absolute GIC clearly shows that income growth in Bolivia was strongly anti-poor using the strong absolute definition. The absolute increments of the rich far exceed those of the poor, as is the case in most countries.

We do not find strong absolute pro-poor growth because for both the absolute unconditional NIGIC for education as the slope is not negative, but even positive for the poorest deciles. This is quite interesting because it puts the findings of the unconditional NIGIC in Figure 1a in perspective where we have found high relative pro-poor growth for the first 3 deciles. This seemingly contradictory finding is largely due to the high growth rates for the lower deciles which results from the very low base in 1989. The absolute conditional NIGIC is virtually flat, meaning that the income-poor have not been able to improve their educational attainment by more than the average. These findings are also reflected in comparing the PPCH with the CHIM. As Table 4 shows the unconditional pro-poor change is still larger than the

change in mean, however, only slightly: the average years of schooling only increased by 1.18 years in mean and by 1.30 years for the moderately poor and 1.34 for the extremely poor. For the absolute conditional changes and for both poverty lines, the CHIM is higher than the PPCH of 1.01.

Examining the absolute unconditional NIGICs for education and vaccinations also reveal an important finding regarding the very low tail of the distribution. As Figures 1b and 2b show, the very education and vaccination-poor had no education (vaccinations) in the first period and this continued to be the case in the second period. This is true for the first few deciles in the education indicator and nearly the entire first decile in the vaccination indicator. Thus whatever expansion has taken place in non-income improvements, it bypassed a core group of very poor.[22]

For all the other educational variables we confirm the findings above.[23] Comparing the results for females with males, we again find signs for gender inequality which are most obvious in the lower percentiles. But we find that the gender inequality seems to have been reduced because the average and maximal education for females increased by more years than for the other groups, especially for males (Tables 1 and 4). However, the women in the all respondents sample started from a lower level and are on average still worse educated.

For both survival variables the unconditional NIGIC and the absolute NIGIC are only interpretable for the first few deciles where they show clear improvements, but they become flat from the 4^{th} decile onward in the case of under 5 survival since 100 percent survival is already reached as shown in Figures 3a and 3b. Also the conditional NIGIC, which oscillate closely to 0

[22]The findings with the education indicator have to be treated with some caution as they may simply say that adult women that had no indication in the first survey continue to have no education in the second survey which is to be expected in the absence of adult education programmes. This is not the case, however, with the vaccination indicator as it refers to children between ages 1 and 5 and thus it is indeed worrying that a new cohort of children has grown up without any vaccinations.

[23]Graphs are not shown here but available on request.

but always above, reflects the moderate and more or less equally distributed mortality risk for the income groups. However, the deciles of Table 2 show an income gradient of mortality risk.

[please insert Figure 3a and 3b here]

Figures 4a and 4b show the NIGIC for stunting. The unconditional NIGIC indicates weak absolute and relative pro-poor growth. For the conditional NIGIC we only find weak absolute but no relative pro-poor growth. These results are also found when looking at the PPGR and the GRIM for the stunting z-score. Both absolute NIGIC show that the absolute changes are distributed nearly equally over the sample.

[please insert Figure 4a and 4b here]

Aggregating the several variables in the CWI, Figures 5a and 5b summarize the development of the social indicators in one single NIGIC.

[please insert Figure 5a and 5b here]

As expected we find pro-poor growth in the weak absolute and relative sense for the unconditional NIGIC. Looking at Table 4 we find very high relative pro-poor growth as both PPGR clearly exceed the GRIM. As being somewhat more volatile the conditional NIGIC shows also pro-poor growth in the weak absolute but not in the relative sense. Asking for pro-poor growth in the strong absolute sense we find a anti-poor trend for the lower end of the distribution for the unconditional absolute NIGIC and a more or less equally distributed trend for the conditional absolute NIGIC.

Altogether, for nearly all variables, we find the strongest increases in the unconditional absolute NIGIC for some medium groups and not for the poorest groups. For most of the centiles, we find weak absolute pro-poor growth, but we do not find relative pro-poor growth, especially not for the poorest. These outcomes mirror the findings of previous analysis about poverty

in Bolivia (Bolivia 2001; INE 2004; Worldbank 2004a) which also find improvements in income and non-income poverty but not for the very poor.[24] Nevertheless, Bolivia remains one of the poorest countries in Latin America in the income as well as in the non-income dimension.

5 Conclusion and Outlook

We introduced the multidimensionality of poverty into pro-poor growth measurement. The purpose is to overcome the major shortcoming of the existing pro-poor growth measurements which are exclusively focussed on income but give no information on how social indicators changed over time for poor population groups. The aim is to better monitor the MDGs and not only to focus on the income dimension of poverty.

In our approach, we apply the methodology of the GIC to non-income indicators and investigate pro-poor growth of non-income indicators. We analyze how income and non-income indicators changed in favor of the poor. Also we analyze how social indicators have developed when they are linked to position in the income distribution. This is of special interest when evaluating distributional welfare impacts of aid and public spending. Furthermore we take absolute inequality explicitly into account and analyze if absolute improvements are large enough for the poor to catch up. Reducing absolute inequality in social indicators is crucial for sustainable development and for equal choices.

We exemplarily illustrate this approach using data for Bolivia from 1989 to 1998. We find improvements both in the income and non-income dimensions of poverty which is a common finding for Bolivia. Growth was pro-poor in the weak absolute and the relative sense both for income and non-income indicators whereas we find no pro-poor growth in the strong absolute sense

[24] Most of the improvement furthermore benefited mainly the urban population with little improvement in the rural areas.

for income and only limited strong absolute pro-poor growth for the middle centiles for non-income indicators. Summarizing the results when social indicators are linked to income, we find that improvements are more or less equally distribution over the income groups.[25] Thus, there is not at all a perfect overlap of income-poor and of non-income-poor households. The absolute changes show that the poor have not benefited disproportionately from the improvements. This means that relative pro-poor growth does not automatically mean that the poor catch-up with the non-poor in absolute terms because we find that relative income and non-income inequality have fallen but not absolute inequality.

One should bear in mind that the findings regarding the NIGIC come from a period when there were great advances made in social indicators, particularly among middle and lower income groups. When translating these measures to other countries (particularly in Africa) it could well be that the NIGICs would show there that growth was anti-poor also in the relative sense (and maybe even in the weak absolute sense in some countries).

When calling for pro-poor growth as the most significant policy measure to achieve the MDGs policy makers should not only focus on income pro-poor growth rather on multidimensional dimensions of pro-poor growth and thus take non-income indicators explicitly into account. We have shown the income-poor are not automatically the ones that benefit most from growth in social indicators. In addition, policy makers should also give attention to pro-poor growth in the strong absolute sense in order to accelerate progress in meeting the MDGs.

[25] One has to note again that the data used is not panel data. Additionally, for the two-dimensional view of the conditional NIGIC it is even more crucial to keep in mind that we do not consider the same households and that the trends of social indicators of the income-poor have nothing of a panel character (Grimm 2005).

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Table 1
Non-Income Indicators and Related Variables
(Unconditional, Bolivia, 1989 and 1998)

	1	2	3	4	5	6	7	8	9	10	Mean	90:10	Gini
	Mean of the Deciles (unconditional), 1989												
Income	21.88	40.27	57.50	77.33	100.61	132.39	177.08	246.12	368.36	863.39	213.39	39.46	0.56
Education													
Average education	0.22	1.31	2.26	3.20	4.28	5.61	7.32	9.38	11.73	15.20	6.03	69.09	0.43
Average education of all respondents	0.00	0.00	1.29	2.27	3.34	4.72	6.24	8.58	11.56	15.13	5.31	n.d.	0.51
Average education of respondents (between 20 and 30)	0.13	1.72	2.95	4.10	5.18	7.01	8.92	11.25	12.00	14.48	6.69	111.38	0.39
Average education of partners	0.00	1.35	2.83	4.13	5.30	6.52	8.57	11.35	12.70	16.77	6.95	n.d.	0.42
Maximal education per household	0.48	2.52	3.52	4.82	5.88	7.50	9.78	11.99	13.87	16.98	7.64	35.36	0.38
Maximal education per household of all respondents	0.00	0.00	1.29	2.27	3.34	4.72	6.24	8.58	11.56	15.13	5.40	n.d.	0.51
Maximal education per household (between 20 and 30)	0.11	1.67	2.90	3.86	5.00	6.64	8.65	11.11	12.00	14.70	6.58	133.63	0.40
Maximal education of partners	0.00	1.37	2.85	4.25	5.40	6.75	8.88	11.64	12.84	16.89	7.09	n.d.	0.42
Health													
Under 5 child survival rate (%)	38.43	64.06	75.81	94.64	100.00	100.00	100.00	100.00	100.00	100.00	87.04	2.60	0.11
Under 1 child survival rate (%)	41.51	88.31	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	92.55	2.41	0.07
Average vaccination per child (age>=1)	0.08	1.88	3.49	4.67	5.67	6.46	7.10	7.98	8.00	8.00	5.30	100	0.28
Nutrition													
Stunting z-score	-4.17	-3.01	-2.50	-2.11	-1.70	-1.33	-0.90	-0.25	-0.00	0.88	-1.54	n.d.	0.19
	Mean of the Deciles (unconditional), 1998												
Income	36.37	63.60	89.26	119.22	155.89	203.15	269.64	369.20	555.27	1242.66	312.10	34.17	0.54
Education													
Average education	0.87	2.37	3.51	4.78	6.06	7.34	8.70	9.81	12.43	16.04	7.21	18.44	0.35
Average education of all respondents	0.00	1.36	2.72	3.95	5.16	6.68	8.34	9.42	10.75	16.39	6.48	n.d.	0.41
Average education of respondents (between 20 and 30)	0.99	3.45	5.00	6.45	7.98	8.99	9.99	9.99	13.71	16.59	8.05	16.76	0.31
Average education of partners	0.54	2.23	3.85	5.13	7.51	8.58	9.50	10.00	14.23	17.04	7.86	11.59	0.36
Maximal education per household	1.47	3.48	4.87	6.44	8.23	9.01	10.00	10.71	15.76	17.04	8.74	11.60	0.31
Maximal education per household of all respondents	0.00	1.36	2.72	3.95	5.16	6.68	8.34	9.42	10.75	16.39	6.58	n.d.	0.41
Maximal education per household (between 20 and 30)	0.89	3.00	4.45	5.35	7.08	8.40	9.28	10.00	12.70	16.46	7.82	18.49	0.32
Maximal education of partners	0.54	2.25	3.89	5.19	7.64	8.73	9.66	10.00	14.69	17.04	7.96	31.56	0.36
Health													
Under 5 child survival rate (%)	46.03	70.36	90.70	100.00	100.00	100.00	100.00	100.00	100.00	100.00	90.62	2.16	0.08
Under 1 child survival rate (%)	43.67	93.29	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	93.63	2.29	0.06
Average vaccination per child (age>=1)	0.09	2.13	3.74	4.92	5.88	6.74	7.14	8.00	8.00	8.00	5.48	88.89	0.26
Nutrition													
Stunting z-score	-3.61	-2.43	-1.92	-1.55	-1.19	-0.79	-0.30	-0.00	0.05	1.11	-1.06	n.d.	0.16

Notes: The explanation for the variables is the following. Income: Real household income per capita in Bolivianos per month (CPI of 1995=100). Education: All variables for education are measured in average single years per household. Respondents and partners are only couples, for which the respondent knows the education of her partner. Health: Under 5 (1) Survival are estimated with life table estimations and we take the sample of children born 10 (5) years prior to the sample. Survival rates are averaged over the household. Vaccinations: Average vaccinations of the children in the household older than 1, where the possible vaccinations are 3 against polio, 3 against DPT, 1 against measles, and 1 against BCG. Nutrition: Stunting z-score of the last born child of each respondent (averaged over the household) with a child defined to be stunted if her z-score is below -2. household.
Source: Own Calculations.

Table 2
Non-Income Indicators and Related Variables
(Conditional, Bolivia, 1989 and 1998)

	1	2	3	4	5	6	7	8	9	10	Mean	90:10
	Mean of the Deciles (conditional), 1989											
Income	21.88	40.27	57.50	77.33	100.61	132.39	177.08	246.12	368.36	863.39	213.39	39.46
Education												
Average education	3.04	3.48	4.11	4.47	5.54	6.07	6.99	7.94	9.37	11.47	6.03	3.77
Average education of all respondents	2.20	2.93	3.25	3.75	4.69	5.41	6.34	7.19	8.70	10.68	5.51	4.85
Average education of respondents (between 20 and 30)	3.30	4.62	5.20	5.91	6.78	8.06	8.32	8.84	9.24	10.47	6.69	3.17
Average education of partners	3.88	4.03	4.96	5.20	6.40	6.73	7.65	8.68	10.04	12.26	6.98	3.16
Maximal education per household	4.41	4.77	5.52	5.91	7.08	7.75	8.70	9.73	11.23	13.29	7.64	3.00
Maximal education per household of all respondents	2.20	2.93	3.25	3.75	4.69	5.41	6.34	7.19	8.70	10.68	5.63	4.85
Maximal education per household (between 20 and 30)	3.19	4.50	4.83	5.72	6.55	7.52	8.48	8.16	9.53	10.82	6.58	3.39
Maximal education of partners	4.00	4.10	5.02	5.31	6.52	6.91	7.84	8.85	10.18	12.40	7.11	3.10
Health												
Under 5 child survival rate (%)	84.54	86.94	86.83	85.02	85.82	87.44	88.16	88.41	91.06	91.00	87.04	1.08
Under 1 child survival rate (%)	91.46	91.03	91.96	92.74	92.34	93.85	93.45	94.35	93.39	92.43	92.55	1.02
Average vaccination per child (age>=1)	5.19	4.79	5.07	5.35	5.09	5.47	5.77	6.82	6.16	6.39	5.30	1.23
Nutrition												
Stunting z-score	-1.75	-1.73	-1.89	-1.71	-1.52	-1.57	-1.27	-1.26	-1.18	-0.82	-1.54	n.d.
	Mean of the Deciles (conditional), 1998											
Income	36.37	63.60	89.26	119.22	155.89	203.15	269.64	369.20	555.27	1242.66	312.10	34.17
Education												
Average education	3.92	4.47	5.20	6.45	6.45	7.10	8.09	8.82	9.85	12.35	7.21	3.15
Average education of all respondents	3.10	3.72	4.48	4.84	5.83	6.51	7.62	8.20	9.29	11.74	6.53	3.79
Average education of respondents (between 20 and 30)	4.59	5.35	6.22	7.35	7.91	8.71	9.28	9.88	10.43	11.84	8.05	2.58
Average education of partners	4.74	5.22	5.92	6.26	7.06	7.69	8.56	9.44	10.40	12.96	7.82	2.73
Maximal education per household	5.34	5.86	6.63	6.97	7.99	8.78	9.72	10.46	11.44	13.79	8.74	2.58
Maximal education per household of all respondents	3.10	3.72	4.48	4.84	5.83	6.51	7.62	8.20	9.29	11.74	6.63	3.79
Maximal education per household (between 20 and 30)	4.34	5.05	5.77	7.07	7.53	8.47	8.54	9.71	10.37	12.12	7.82	3.03
Maximal education of partners	4.79	5.29	5.99	6.32	7.18	7.78	8.68	9.56	10.55	13.06	7.92	2.73
Health												
Under 5 child survival rate (%)	86.98	90.13	89.29	88.94	90.82	89.76	90.44	93.06	92.21	95.24	90.62	1.10
Under 1 child survival rate (%)	92.42	94.43	94.15	93.21	92.01	94.19	92.61	95.22	94.69	96.09	93.63	1.03
Average vaccination per child (age>=1)	5.19	5.26	5.02	5.17	5.34	5.40	5.74	5.99	5.93	6.43	5.48	1.24
Nutrition												
Stunting z-score	-1.56	-1.48	-1.30	-1.37	-1.17	-1.15	-1.01	-0.90	-0.79	-0.44	-1.06	n.d.

Notes: The explanation for the variables is the following. Income: Real household income per capita in Bolivianos per month (CPI of 1995=100). Education: All variables for education are measured in average single years per household. Respondents and partners are only couples, for which the respondent knows the education of her partner. Health: Under 5 (1) Survival are estimated with life table estimations and we take the sample of children born 10 (5) years prior to the sample. Survival rates are averaged over the household. Vaccinations: Average vaccinations of the children in the household older than 1, where the possible vaccinations are 3 against polio, 3 against DPT, 1 against measles, and 1 against BCG. Nutrition: Stunting z-score of the last born child of each respondent (averaged over the household) with a child defined to be stunted if her z-score is below -2. household.
Source: Own Calculations.

Table 3
Deciles of the Composite Welfare Index
(Bolivia, 1989 and 1998)

	1	2	3	4	5	6	7	8	9	10	Mean	90:10	Gini
	Mean of the Deciles (unconditional), 1989												
Composite welfare index													
Small sample	0.29	0.35	0.39	0.43	0.47	0.50	0.54	0.59	0.64	0.74	0.49	2.55	0.15
Big sample	0.11	0.29	0.38	0.45	0.51	0.56	0.61	0.66	0.74	0.86	0.52	7.82	0.23
Composite welfare index (including income)													
Small sample	0.22	0.27	0.30	0.33	0.35	0.38	0.41	0.45	0.50	0.57	0.38	2.64	0.16
Big sample	0.07	0.19	0.26	0.31	0.34	0.38	0.41	0.45	0.51	0.60	0.35	8.57	0.24
	Mean of the Deciles (unconditional), 1998												
Composite welfare index													
Small sample	0.32	0.40	0.44	0.48	0.52	0.55	0.59	0.63	0.67	0.74	0.53	2.31	0.13
Big sample	0.18	0.36	0.43	0.49	0.53	0.58	0.63	0.68	0.74	0.86	0.38	4.78	0.19
Composite welfare index (including income)													
Small sample	0.24	0.30	0.34	0.37	0.39	0.42	0.45	0.48	0.51	0.58	0.41	2.42	0.14
Big sample	0.11	0.23	0.28	0.33	0.37	0.41	0.44	0.48	0.51	0.59	0.55	5.10	0.21
	Mean of the Deciles (conditional), 1989												
Composite welfare index													
Small sample	0.44	0.43	0.45	0.46	0.47	0.50	0.53	0.53	0.58	0.63	0.50	1.43	-
Big sample	0.45	0.45	0.46	0.48	0.51	0.53	0.56	0.59	0.61	0.68	0.53	1.51	-
Composite welfare index (including income)													
Small sample	0.33	0.33	0.34	0.35	0.36	0.38	0.41	0.41	0.45	0.50	0.38	1.52	-
Big sample	0.31	0.31	0.31	0.33	0.34	0.36	0.37	0.39	0.42	0.48	0.36	1.55	-
	Mean of the Deciles (conditional), 1998												
Composite welfare index													
Small sample	0.45	0.48	0.49	0.49	0.52	0.53	0.56	0.58	0.60	0.65	0.53	1.44	-
Big sample	0.46	0.48	0.48	0.50	0.52	0.54	0.58	0.59	0.63	0.69	0.55	1.44	-
Composite welfare index (including income)													
Small sample	0.34	0.36	0.37	0.37	0.39	0.40	0.43	0.44	0.46	0.52	0.41	1.53	-
Big sample	0.32	0.33	0.33	0.34	0.35	0.36	0.39	0.40	0.43	0.49	0.37	1.53	-

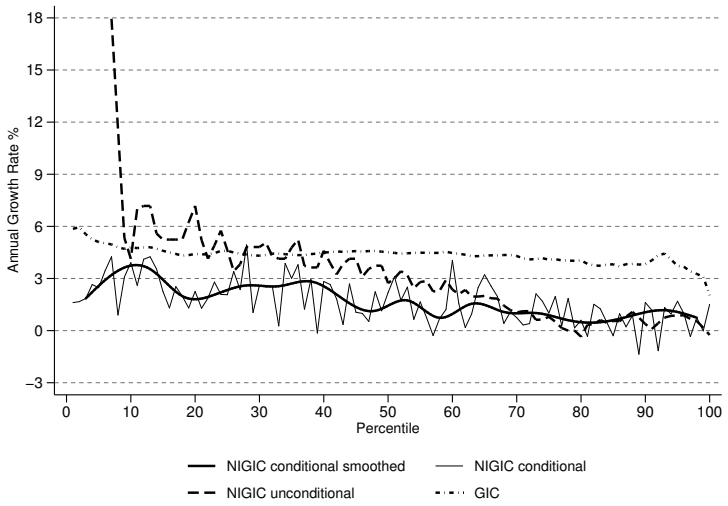
Notes: *The composite welfare index includes average education of household, under five survival rate, average vaccination per child (age>=1), and stunting.
Source: Own Calculations

Table 4
Mean Growth Rates, Mean Absolute Changes, Pro-Poor Growth Rates, and Absolute Pro-Poor Changes
(Bolivia, 1989 and 1998)

	NIGIC 1989-1998 (unconditional)		NIGIC 1989-1998 (conditional)		NIGIC 1989-1998 (unconditional)		NIGIC 1989-1998 (conditional)		
	GRIM	PPGR moderate	PPGR extreme	PPGR moderate	PPGR extreme	CHIM	PPCH moderate	PPCH extreme	PPCH moderate	PPCH extreme
Income	3.88	4.54	4.63	4.54	4.63	98.71	53.82	37.02	53.82	37.02
Education										
Average education	1.80	3.89	4.88	2.00	2.24	1.18	1.30	1.34	1.01	1.01
Ave. educ. of all respondents	2.30	4.84	6.08	2.48	2.80	1.33	1.59	1.38	1.07	1.06
Ave. educ. of respondents (20-30)	1.87	3.47	4.75	1.75	2.02	1.36	1.38	1.74	1.03	1.09
Ave. educ. of partners	1.41	2.65	3.61	1.66	1.86	1.03	1.11	1.33	0.95	0.95
Maximal education per household	1.36	2.60	3.74	1.55	1.73	1.10	1.08	1.58	1.01	1.03
Max. educ. per hh of all res.	2.24	4.69	5.88	2.37	2.69	1.31	1.52	1.37	1.05	1.04
Max. educ. per household (20-30)	1.73	3.42	4.66	1.64	1.89	1.23	1.27	1.58	0.92	0.95
Max. educ. of partners	1.35	2.55	3.57	1.57	1.76	1.00	1.05	1.34	0.91	0.92
Health										
Under 5 child survival rate (%)	0.40	0.70	0.96	0.37	0.40	3.57	4.54	6.25	3.19	3.45
Under 1 child survival rate (%)	0.12	0.14	0.19	0.11	0.15	1.07	1.29	1.78	1.00	1.35
Ave. vacc. per child (1-3)	0.34	0.66	0.91	0.15	0.20	0.18	0.21	0.27	0.07	0.09
Nutrition										
Stunting z-score	1.05	1.63	1.87	0.82	0.78	47.71	54.60	55.38	35.12	32.32
Composite welfare index (CWI)										
Small sample	0.82	1.08	1.16	0.72	0.72	0.04	0.05	0.05	0.33	0.34
Big sample	0.58	1.83	2.41	0.35	0.34	0.03	0.04	0.05	0.02	0.02
CWI (including income)										
Small sample	0.83	1.08	1.16	0.72	0.72	0.03	0.04	0.04	0.26	0.72
Big sample	0.63	1.62	2.03	0.44	0.44	0.02	0.03	0.03	0.01	0.01

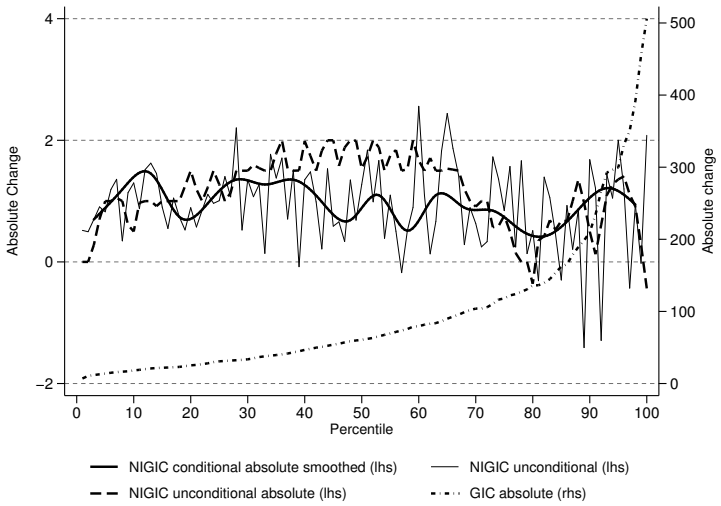
Notes: Notes: For the explanation of the variables, see Table 1. We are using two poverty lines. The moderate poverty line leads to an income headcount of 77 and the extreme poverty line to an income headcount of 56 which we also use for the non-income indicators. CHIM: Change in mean. PPCH: Pro-poor change. Changes are for the entire period and not annualized.
Source: Own Calculations.

Figure 1a
GIC, Conditional, and Unconditional NIGIC for Average Education



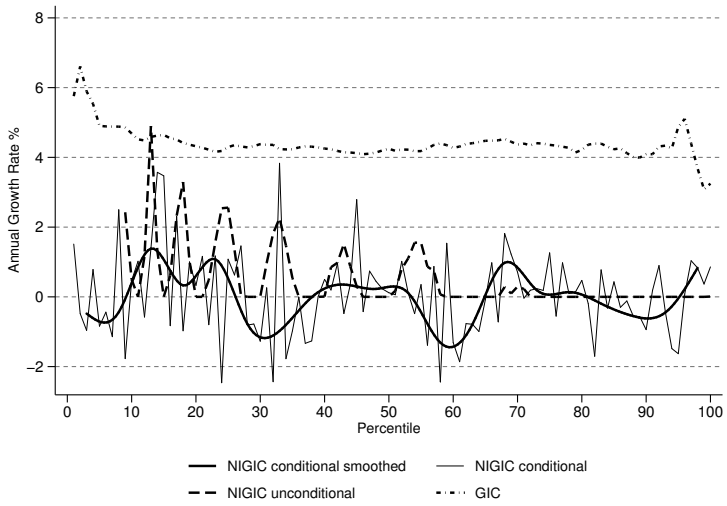
Source : Own Calculations

Figure 1b
Absolute Change in Income and Average Education



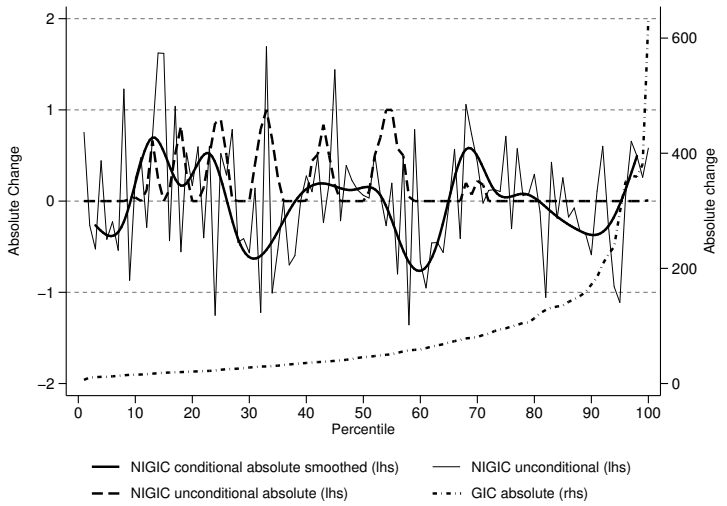
Source : Own Calculations

Figure 2a
GIC, Conditional, and Unconditional NIGIC for Average Vaccinations



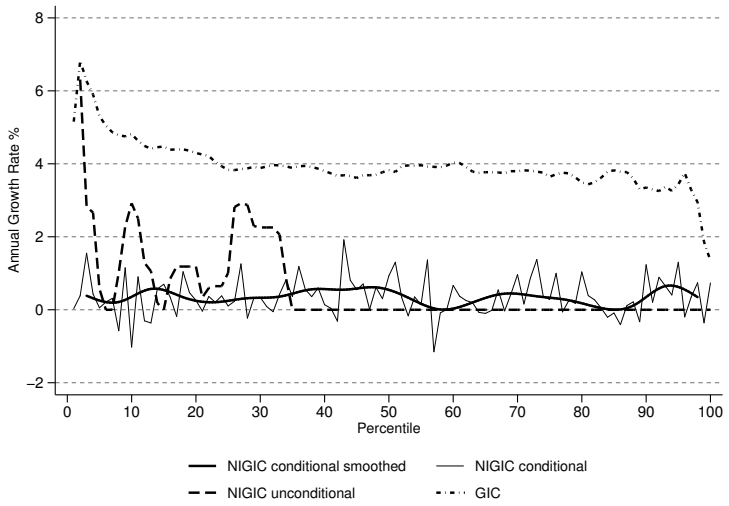
Source : Own Calculations

Figure 2b
Absolute Change in Income and Average Vaccinations



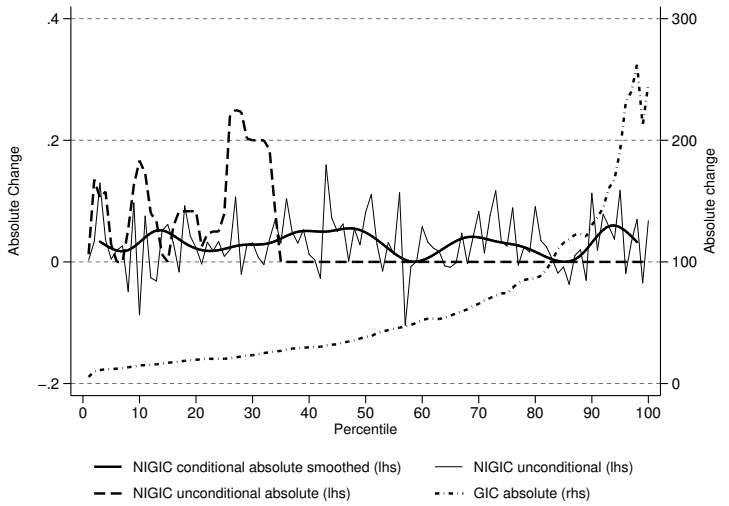
Source : Own Calculations

Figure 3a
GIC, Conditional, and Unconditional NIGIC for Under 5 Survival



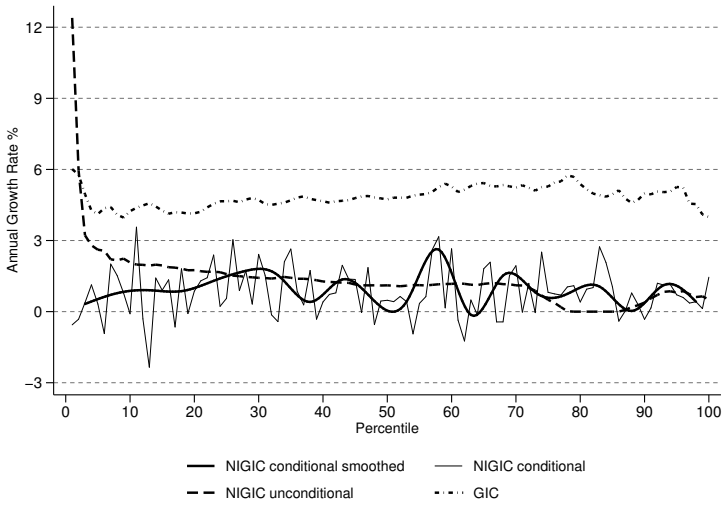
Source : Own Calculations

Figure 3b
Absolute Change in Income and Under 5 Survival



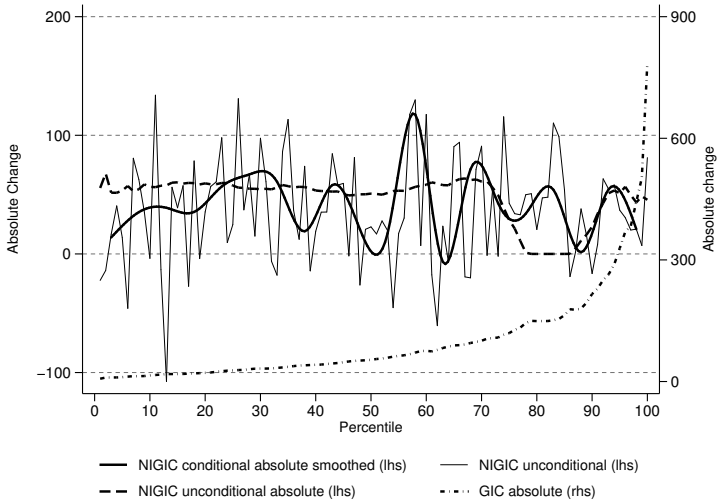
Source : Own Calculations

Figure 4a
GIC, Conditional, and Unconditional NIGIC for Stunting



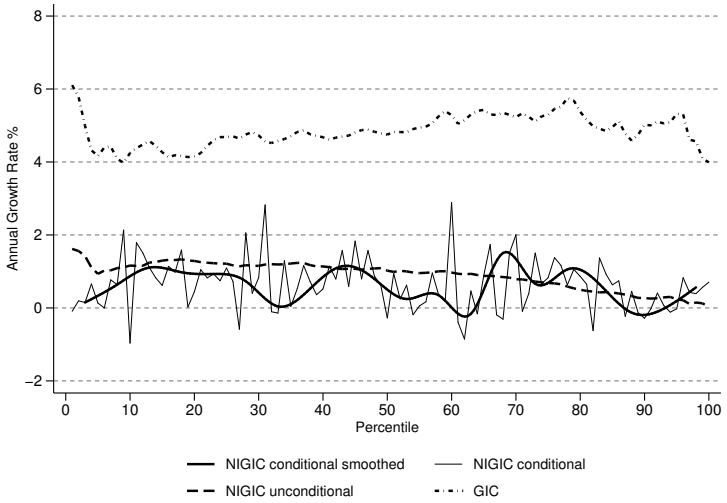
Source : Own Calculations

Figure 4b
Absolute Change in Income and Stunting



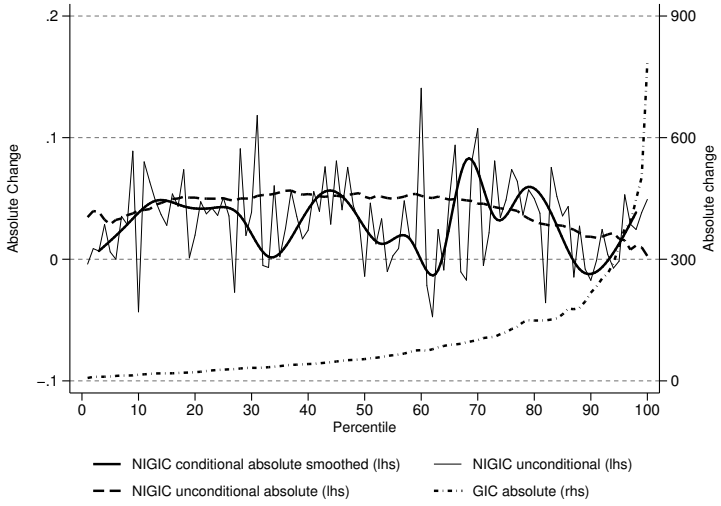
Source : Own Calculations

Figure 5a
GIC, Conditional, and Unconditional NIGIC for the CWI (Small Sample)



Source : Own Calculations

Figure 5b
Absolute Change in Income and CWI (Small Sample)



Source : Own Calculations