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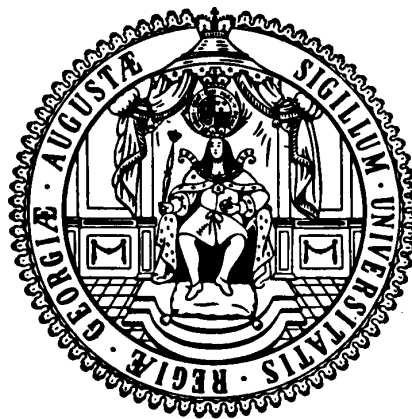
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**Economic Growth and Poverty Reduction: Measurement  
Issues using Income and Non-Income Indicators**

**Stephan Klasen**

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# **Economic Growth and Poverty Reduction: Measurement Issues using Income and Non-Income Indicators**

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## **Abstract**

This paper addresses two issues concerning the measurement of pro-poor growth, a central concept for sustainable poverty reduction in developing countries. First, it attempts to clarify the debates about the definition and measurement of pro-poor growth distinguishing between a weak and a strong absolute as well as a relative definition. The relevance of each definition depends on the purpose of the analysis as well as the assumptions regarding growth-inequality trade-offs. Given the focus of existing measures of pro-poor growth on the income dimension, the second contribution is to present ways to apply the growth incidence curve and the Ravallion-Chen framework of measuring pro-poor growth to non-income indicators. The analysis, which is applied to Bolivia for illustrative purposes, shows that the extension of the pro-poor growth toolbox to non-income dimensions greatly improves our understanding of the trends in non-income indicators along the entire distribution and thus greatly increases our ability to monitor progress towards the non-income Millennium Development Goals (particularly goals 2-6) and assess the linkages between income and non-income poverty along the entire distribution. This can be of critical importance for poverty monitoring as well as policy interventions including the relative merits of growth versus direct intervention to improve the non-income dimensions of poverty.

**Keywords:** Pro-Poor Growth, Inequality, Non-Income Poverty, Millennium Development Goals, Latin America, Bolivia

JEL classification: O12, I32, O46

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## **I. INTRODUCTION**

The United Nations Millennium Development Goals (MDGs) have moved to the centre stage of the development debate and reducing poverty and deprivation has become a main challenge for policy makers. Given that poverty reduction is maximized by high growth and pro-poor distributional change, achieving such 'pro-poor growth', i.e. growth that is particularly beneficial to the poor, is seen as critical for reaching the MDGs, particularly the poverty goal (MDG1).

Ideally, pro-poor growth combines high growth of average income with inequality reduction (income, asset, and gender inequality) in order to have a maximum impact on poverty. While everyone would agree that this case is the first-best option, there is some debate whether (or to what extent) growth is still "pro poor" when it is only accompanied by one of the two conditions, high growth or inequality reduction. Clarifying this debate is the first aim of this paper and will be addressed in section 2.

A somewhat unfortunate (and presumably unintended) side-effect of this debate has been that it is focused exclusively on the income dimension of poverty, and thus only concentrates on MDG 1<sup>1</sup>. Although one may hope that achieving the income goal will also help attain other goals, this is far from guaranteed. Moreover, non-income dimensions of poverty (such as poor health and education) are intrinsically valuable as development goals (hence their status as separate MDGs, see also Sen, 1998; Klasen, 2000). Finally, progress on non-income dimensions might also help achieve MDG 1. Fortunately, the toolbox developed to assess pro-poor growth is not exclusively applicable to income poverty but can be extended to examine education-poverty, health-poverty, and the like. A second aim of this paper will therefore be to extend the tools of pro-poor growth measurement to non-income dimensions of poverty. In particular, we will apply this approach to studying pro-poor growth in Bolivia in the dimensions of education, health, and nutrition between 1989 and 1999 and compare it to pro-poor growth in the income dimension. This will allow us to see the average progress as well as the distribution of that progress in these non-income dimensions and will additionally shed light on the relationship between income poverty reduction and reductions in non-income deprivation along the entire distribution of achievements.

## **II. Growth, inequality, poverty reduction and the measurement of pro-poor growth**

Theoretical and empirical research has shown that the pace of poverty reduction will depend on the rate of average income growth, the initial level of inequality, and changes in the level of inequality (see, for example, World Bank, 2000, 2005a; Bourguignon, 2003; Klasen, 2004). In particular, poverty reduction will be fastest in countries where average income growth is highest (see Dollar and Kraay, 2002), in countries where initial inequality is lowest (see World Bank, 2000, 2005a), and in situations where income growth is combined with falling inequality (see Bourguignon, 2003). There thus is a pay-off in poverty reduction from growth, but also of lower initial inequality and reductions in inequality during the growth process. In addition, there

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1. MDG 1 aims at the eradication of extreme poverty and hunger by halving the proportion of people who live on less than a dollar a day and suffer from hunger.

appear to be links between initial (income or asset) inequality and growth. The majority of studies seems to suggest that high initial inequality is harmful for overall economic growth, and thus for poverty reduction, at least in environments of very high (income or asset) inequality (see, for example, World Bank, 2000, 2005a; Deininger and Squire, 1998; Klasen, 2004; Ravallion, 2000). Similar results appear to hold true for gender inequality, particularly gender inequality in education (Klasen, 2002; Knowles *et al.*, 2002; World Bank, 2001). There consequently is a triple pay-off to lowering inequality: it reduces poverty immediately, it increases the poverty elasticity of growth, and it appears to increase economic growth, at least in some contexts.

The growth-enhancing effects of lowering inequality have been found using cross-country analysis (investigating the impact of initial inequality on subsequent economic growth, for example, Deininger and Squire, 1998). They confirm that different *levels* of inequality *between* countries have growth implications. They do not, however, necessarily imply that redistribution (i.e. changes in inequality *within* a country over time) will necessarily have a growth-enhancing effect. In fact, there are findings that suggest that redistribution can lower subsequent growth in the short-term (see, for example, Forbes 2000; Banerjee and Duflo, 2003). However, these findings are subject to methodological problems and are based on very weak data so that this important policy question (namely the impact of redistribution on growth) remains unanswered (see Klasen, 2004). This is largely due to the fact that there have been very few significant changes in inequality so that we do not have enough data points on which to base our assessment (see, for example, Forbes, 2000; Lundberg and Squire, 2003; Klasen, 2004; Banerjee and Duflo, 2003)<sup>2</sup>.

While it is quite likely that lower inequality will promote growth in the longer term (particularly in high-inequality countries), it is equally likely that the short-term effects of redistribution on growth depend greatly on the type of policy chosen for redistribution, the level of initial inequality, and the time horizon considered. At one extreme, redistribution policies that mainly operate by investing in poor people's human capital and their access to physical and financial assets is likely to have a positive impact on growth, even in the short term (World Bank 2005a; 2005b; Lopez, 2004). At the other extreme, arbitrary and violent asset redistribution of the style currently experienced in Zimbabwe reduces economic growth.

A useful way to summarize the above discussion is to point to a recent paper by Ravallion (2005) who investigates whether empirically there is a trade-off between poverty reduction and inequality change. He shows that in the 1990s, poverty reduction was faster in countries where inequality fell, and slower in countries where inequality rose. This shows that even if there might be short-term trade-offs between inequality and growth, they were not large enough to dominate the more important poverty reducing effects of inequality reduction.

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2. A recently completed country case study of Bolivia (as part of a larger project on Operationalizing Pro-Poor Growth) suggests that short-term trade-offs exist for certain policies while other policies improve growth and distribution. See Klasen *et al.* (2004). More generally, the OPPG work program did find that in a number of fast-growing countries in the 1990s, inequality increased suggesting that the importance of some short-term trade-offs. See World Bank (2005b) for details.

Therefore it is entirely appropriate to focus policy attention on promoting pro-poor growth to accelerate poverty reduction, a subject to which I now turn.

Despite an emerging consensus on the relationship between growth, inequality and poverty reduction, there continues to be significant debate on how to conceptualise and measure pro-poor growth. While there are a number of definitions that have been proposed for pro-poor growth which differ along several dimensions (see, for example, Ravallion and Chen, 2003; Son, 2004; Kakwani and Pernia, 2000; Hanmer and Booth, 2001; McCulloch and Baulch, 1999; White and Anderson, 2000; Klasen, 2003; Duclos and Wodon, 2004), in the policy community the debate seems to have boiled down to an “absolute” and “relative” camp (see OECD, 2004). The “relative” camp is easier to characterise. It suggests that growth can only be called pro-poor if the growth rate of income of the poor (suitably aggregated) exceeds the average income growth rate. In other words, growth needs to have a relative bias in favour of the poor in the sense that the income growth of the poor exceeds the average, and that inequality (at least between the poor and the non-poor) must have come down<sup>3</sup>. The main justification for this type of approach is that, based on the research findings mentioned in the introduction, if one succeeds with biasing growth in this relative sense and (holding average growth constant), this will lead to faster poverty reduction. As mentioned for example by Datt and Ravallion (2002) on India, poverty reduction would have been faster if India had succeeded in biasing its relatively high growth during the 1990s more towards the poor (or at least the states where the poor are concentrated; see also Ravallion and Datt, 2002). Once again, the Ravallion (2005) finding is suggestive as he shows that poverty reduction in the 1990s was faster in countries where inequality fell.<sup>4</sup> Members of this camp are the contributions by Kakwani and Pernia (2000), McCulloch and Baulch (1999), and both the suggestions by Klasen (2004) as well as by Ravallion and Chen (2003)<sup>5</sup> can be interpreted in this way, as well, if one compares their proposed rates of pro-poor growth with the average growth rate.

As far as the “absolute” camp is concerned, there are two different kinds of “absolutes” one could have in mind. One is to say that growth is pro-poor only if the *absolute* income-gain of the poor is larger than those on average (or those of the rich). We call this “strong absolute” pro-poor growth. As shown empirically by White and Anderson (2000), this would be a rather difficult requirement to meet as it would mean that the growth rate of the poor would have to be larger by a factor equal to the initial income ratio of the non-poor to the poor. Thus, growth must

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3. There are complications here as well such as the question whether growth for every poor group (or every poor quantile) must have exceeded average growth, or whether this is only true in average (see Duclos and Wodon, 2004 for a discussion and proposed axioms to resolve it).

4. One could, of course, also defend such an approach by arguing that pro-poor growth in this sense means that inequality must have been reduced (at least inequality between the poor and the non-poor). Such a reduction of inequality might be of value in its own right as suggested by many ethical and empirical approaches to welfare measurement (see Grün and Klasen, 2003)

<sup>5</sup> The Ravallion-Chen measure of pro-poor growth is the average of the income growth rates of centiles of the income distribution up until the poverty line in the initial period. Alternatively, it is the area under the growth incidence curve up until the poverty line (see also below). Klasen (2004) suggested using distribution-weighted growth rates to, giving higher weights to the lower end of the income distribution.

be biased in dramatic fashion in favour of the poor than proposed by the “relative” definition. While in practice hard to achieve, such definition has recently gained some proponents who argue that we too often think of inequality in relative terms and disregard that absolute inequality might be widening even if relative inequality is shrinking (see Atkinson and Brandolini, 2004; Duclos and Wodon, 2004; Klasen, 2004). As will be discussed below in some more detail, this absolute approach may be particularly suitable for assessing pro-poor growth in the non-income dimension. For example, while we might agree that 5 per cent growth for the poor is “pro poor” if it exceeds the average rate of 4 per cent even though the latter is much larger in absolute magnitudes, translating this to improvements in education sounds quite different. To illustrate this idea: it would be hard to argue that a 20 per cent increase in years of schooling is pro poor (because the increase of the non-poor was, say, only 10 per cent) if education of the poor only expanded by a quarter of a year and that of the non-poor by a whole year.

The other “absolute”, which has been the focus of much policy discussion, goes in an entirely different direction and suggests that we can speak of pro-poor growth if the growth rate of the poor (suitably aggregated) is greater than 0 (see OECD, 2004). One may call this “weak absolute” pro-poor growth. The main argument in support of this view is that, in the end, all that matters for poverty reduction is high income growth for the poor, not how that growth compares to the growth of the non-poor. The empirical argument used is that high but inequality-increasing growth in a country such as China over the past ten years should be viewed as preferable to low but equitable growth in a country such as Ghana, if the absolute income increases of the poor are larger in the former than in the latter. On the other hand, taking this argument to the extreme could be quite problematic (see World Bank, 2005b). Arguing that any income growth of the poor is pro poor even if it was much lower than average income growth (and thus distribution worsened) seems to hark back to old notions of “trickling down”<sup>6</sup>.

Table 1 below summarises the different definitions and illustrates the strength of the respective arguments (see also World Bank, 2005b for a related discussion). It shows a country where, in the initial situation, the poor earn \$100 and the rich \$500 on a per capita basis. In year 1, the incomes of the poor grow by 3 per cent while those of the non-poor grow by 2 per cent. This is pro-poor growth in the relative, and the weak absolute sense. In year 2, the incomes of the poor grow by 1 per cent, those of the non-poor by 10 per cent. Only under the weak absolute definition would this be called pro-poor growth, which nicely illustrates the weakness of this definition in that hardly any of the fruits of growth have trickled down to the poor. In year 3, the incomes of the poor grow by 6 per cent and those of the rich by 9 per cent. A comparison with year 1 shows the advantages of the weak absolute definition. In year 3 the poor gain a lot more than in year 1, yet only the weak absolute definition would call this situation “pro poor”. Instead, it would be called “anti-poor” in the relative definition (while lower growth in year 1 had been called pro poor using that definition). In year 4, not only do the poor enjoy the relative income gains, but also their absolute gains exceed those of the non-poor (20 versus 12). This would be a situation of relative, weak and strong absolute pro-poor growth, as the poor gain absolutely

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6. If focusing on the amount of pro-poor growth, the proposal by Ravallion and Chen (2003) as well as that of Klasen (2004) would fit into that camp.



more than the rich. Given that this situation requires an income growth rate of the poor of 18 per cent (compared to 2 per cent for the non-poor), it nicely illustrates how difficult it is to achieve pro-poor growth using the strong absolute definition.

Table 1. **Different Versions of Pro-Poor Growth: Some Illustrations**

| Year | Poor | Growth (%) | Non-Poor | Growth (%) | Pro Poor?                                |
|------|------|------------|----------|------------|--|
| 0    | 100  |            | 500      |            |  |
| 1    | 103  | 3          | 510      | 2          | relative, weak absolute                  |
| 2    | 104  | 1          | 561      | 10         | weak absolute                            |
| 3    | 110  | 6          | 611      | 9          | weak absolute                            |
| 4    | 130  | 18         | 623      | 2          | relative, weak absolute, strong absolute |

Ultimately, it appears that the question underlying this debate is whether there is a trade-off between growth and inequality reduction, an issue already discussed above. If there are ways to reduce inequality without compromising average income growth (or even enhancing it), then it is perfectly plausible to say that, for example, China could have had higher poverty reduction in the 1990s if it had pursued policies that would have prevented the rise in inequality without compromising its overall growth rate. This would therefore argue for a relative definition. If, however, reducing inequality will invariably have a negative growth effect, then the thought experiment underlying the relative definition (i.e. if growth had been accompanied by inequality reduction, there would have been more poverty reduction) does not make any sense as inequality reduction would have led to smaller growth (and thus smaller poverty reduction). As discussed above, we know relatively little about such trade-offs (whether in the short or long term, in different countries, or associated with different policies) which should therefore be a major focus of policy research<sup>7</sup>.

From a policy point of view, it may be best not to get bogged down in these definitional issues, but to use an operational approach that is closely aligned to the policy goals regarding poverty reduction, which is the first MDG. In order to maximise poverty reduction, one wants to maximise the rate of income growth among the poor. Maximising the Ravallion-Chen (2003) rate of pro-poor growth would be a useful indicator for that, which averages the income growth rates of the centiles of the income distribution that were poor in the initial period. While this approach

7. Here, the work by the OPPG work program (World Bank, 2005b) and Ravallion (2005) are interesting contributions. Also note that there really is no need to choose between this weak absolute and the relative version of the definition but it is instead useful to combine the two as they seem to be answers to two different questions. If the question is whether growth has been pro-poor or not, it appears plausible to stick to the relative definition as one would presume pro-poor involves some bias in favour of the poor. It also gives us a sense of how much the opportunities afforded by a given rate of growth have been used to reduce poverty. If the question is about the rate of income growth of the poor, then some aggregation of the income-growth rate of the poor, such as the one inherent in the Ravallion and Chen measure would give the answer. It would then tell us how much the poor were benefiting from whatever growth happened to be in a country. Thus one could usefully make a distinction between the existence of pro poor growth, measured in the relative sense and the rate of poverty-relevant growth using an absolute measure. As shown below, one can nicely illustrate this intuition by examining the shape and position of growth incidence curves for the income and non-income dimensions.

implicitly<sup>8</sup> follows the “weak absolute” definition, it is clear from the discussion above that maximising the Ravallion-Chen rate of pro-poor growth will be greatly enhanced if growth was also pro-poor in the relative or strong absolute sense. In these cases, growth was accompanied by declining inequality and thus has a larger impact on the incomes of the poor, which then increases the Ravallion-Chen rate of pro-poor growth. Thus even if we chose a policy target maximizing the rate of “weak absolute” pro-poor growth, striving for pro-poor growth in a relative (or even strong absolute sense) will help us achieve our target.<sup>9</sup>

### III. MEASURING PRO-POOR GROWTH IN A NON-INCOME DIMENSION

So far, the entire literature on pro-poor growth (including the discussion above) has focused exclusively on the income dimension. This is highly lamentable as this debate has therefore effectively narrowed to the income dimension of poverty and MDG 1, thereby neglecting all the progress made in taking a broader view of poverty which considers the non-income dimensions as well (see World Bank, 2000; Sen 1998).<sup>10</sup> This is also quite contrary to the spirit of the MDGs which consider non-income dimensions of well-being (particularly education, health and gender equity) as being of equal importance to income poverty. Thus it would be extremely useful to extend this debate to include non-income dimensions of poverty.

There are three further reasons to explore measuring pro-poor growth in the non-income dimension. One great methodological advantage of the pro-poor growth debate has been the use of the growth incidence curve. This curve plots the income growth by centile of the population (in the initial period) and thus allows policy makers to track changes along the entire income distribution. In contrast, progress towards non-income goals is usually monitored by looking at mean achievement levels (e.g. mortality or enrolment rates) which neglects to examine the *distribution* of changes in achievement. Extending the methods from the pro-poor growth literature to non-income dimensions thus offers new insights for policy makers concerned about tracking the non-income MDGs (particularly MDGs 2-6<sup>11</sup>). Secondly, it allows careful consideration of relationships between income and non-income dimensions of poverty along the entire distribution.<sup>12</sup> Thus, we can learn whether achieving income poverty and health poverty goals are complementary along the entire distribution, or whether one needs to tackle the two

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8. If one compared the Ravallion-Chen rate of pro-poor growth with the average income growth rate, it can also be used for an assessment of pro-poor growth in the relative definition.

<sup>9</sup> One should note that the Ravallion-Chen measure of pro-poor growth translates directly into poverty reduction if poverty is measured using the Watts Index. If poverty is measured using the more familiar FGT poverty measures (headcount, gap, and severity), the Ravallion-Chen rate of pro-poor growth will not map directly into a rate of poverty reduction of these measures as the pace of poverty reduction will depend on initial inequality (see discussion above).

<sup>10</sup> The recently completed OPG work program also focused exclusively on the income dimension of poverty. See World Bank (2005b).

11. MDGs 2-6 concern education, gender equality, child mortality, maternal health, and diseases such as HIV/AIDS and malaria.

<sup>12</sup> See Grosse et al. (2005) for a detailed assessment of pro-poor progress towards the MDGs along the entire income distribution.

separately at some point in the distribution (e.g. the very poor). This will also give some guidance regarding the respective roles of income growth versus direct intervention to make progress in these non-income MDGs.

Third, the income poverty measure is particularly weak in measuring gender differentials as it is usually based on household incomes and says little about the distribution of that income (see, for example, Klasen, 2004b; Klasen, 2005).<sup>13</sup> Looking at the non-income measures of well being allows policy makers to track progress by gender along the entire distribution which is impossible using income indicators. Thus, it is worth exploring to what extent the toolbox developed for pro-poor growth can be applied to non-income dimensions of poverty.

Fortunately, it is perfectly possible to extend the pro-poor growth toolbox to non-income measures of poverty. Below, we will illustrate this using the Ravallion and Chen (2003) approach and applying it, for purely illustrative purposes, to non-income indicators in Bolivia between 1989 and 1999<sup>14</sup>. The purpose of this Section is to examine whether this yields new insights into the performance of non-income indicators as well as their connection to income measures.<sup>15</sup>

As with the income measures, we use the growth incidence curve (GIC) as the basic building block for the analysis and then calculate pro-poor growth rates using the Ravallion and Chen (2003) approach. We consider growth incidence curves for education, child survival, child vaccination, nutrition, and a composite welfare index made up of these components and call these non-income growth incidence curves (NIGIC). The data we use are from the 1989 and 1998 Demographic and Health Survey for Bolivia. As income data are not available in that survey, they have been added using methods described in detail in Klasen *et al.* (2004)<sup>16</sup>. We will always present two kinds of NIGICs, which we call *unconditional* and *conditional* NIGICs, and also calculate the respective pro-poor growth rates. In the unconditional indicator, we will line up centiles according to the non-income indicator in question, e.g. from the *education-poor* to the *education-rich*, and then plot the growth of education on the y-axis. In the conditional NIGIC, we will line up centiles according to their *per capita income*, but also plot the growth of the non-

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<sup>13</sup> Due to the presence of household-specific public goods (such as housing and durable goods and many services with public goods character, it is very difficult to allocate all incomes to individual members and thus the study of gender inequality in income poverty is not only empirically but also conceptually very difficult. See Klasen (2004b and 2005) for further discussion.

14. As the OPPG case studies were entirely focused on income poverty, what we present here complements our analysis done in that process.

<sup>15</sup> See also related papers by Grosse, Harttgen and Klasen (2004, 2005).

16. The imputation is based on an adaptation of the poverty mapping methodology used by the World Bank. For details, refer to Klasen *et al.* (2004). The results are not entirely in agreement with the results in Klasen *et al.* (2004) as there we used another survey for the final year, but the analysis here is purely for illustrative purposes and not meant to focus particularly on Bolivia. The data base has the advantage of containing detailed non-income data. It has the disadvantage that this data is only available for selected members of the household. For example, education is not available for children living in the household, and nutrition, immunisation, and survival information is only available for children.

income indicator on the y-axis to see how their non-income growth compares to their income position (in the initial period).

A number of problems and issues need to be solved when designing growth incidence curves in these non-income dimensions. Beginning with education, our basic indicator is the average years of schooling of respondents (all of whom are women aged 15-49) and their partners in a household. A potential problem with this indicator is that it has a considerable amount of in-built inertia which is less of a problem when one considers household incomes. As most people do not accumulate more years of schooling once they reach age 25, 30 year-old women in 1989 (who will be 39 years old in 1998) will not have experienced any change in their education so that virtually all change will come from a replacement of older cohorts by younger cohorts. In order to reduce this problem, we also do an analysis where we simply concentrate on the education of female respondents who are 20-30 years old in both surveys. Secondly, while from a welfare point of view the education of all members of the household is relevant, for the economic opportunities of the household, the education of the best educated member may be most relevant (Basu and Forster, 1998). Thus, we also use the maximum education of all adult members of the household and of respondents aged 20-30 in both survey years. Third, we will consider percentage increases in years of schooling (analogously to the income growth rate) but also *absolute* increases in the years of schooling. It may be of little consolation to the poor that their years of schooling expanded by 30 per cent if that means going from an average of 0.5 years to an average of 0.65 years. Examining the absolute increases will help us to see whether education growth was pro poor in the absolute sense. Fourth, there are two issues which we can do very little about. One is that *a priori* it is not clear if one can treat years of education in a similar cardinal fashion as income. For example, the increase from one year to two years of education may do little if that means a person is still illiterate. On the other hand, an increase from five years to completed primary (six years) education might be much more valuable. Also, we only measure years of schooling, but ignore educational quality. This last problem could, in principle, be remedied with better data (such as test scores that are comparable over time and linked to household income data).

Matters are more difficult with the survival indicator. We use the one-year and five-year survival probability (the inverse of the infant and under five mortality rates) as well as the vaccination rate (of eight possible vaccinations against polio, DPT and measles) of children 1-5 years old<sup>17</sup> as our indicators. The first problem is that it is difficult to devise a reliable survival indicator at the household level. Mortality probabilities within households are relatively low and contain a lot of randomness. In our sample, 13 per cent of households had experienced the death of a child before age 5 in 1989, and only about 10% in 1998. As a result, the unconditional growth incidence curve for the richest eight deciles will be flat as there is no change in survival in these households in either period. Thus, they will not yield very interesting information in those ranges and all action is in the first quintile, but it is still useful to examine the conditional growth incidence curves as they show how mortality is linked to incomes. The problem is similar, but somewhat less acute, with vaccination rates. There, children in the top

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17. We only include one-year old children as the usual vaccination schedule of eight vaccinations is only complete at about 9-12 months. We have to stop at age 5 as data for older children is not available.

two deciles have all eight vaccinations (for polio, DPT and measles) in 1989 and thus no potential for further growth. The conditional growth incidence curves (sorted by incomes) might also be more interesting here than the unconditional ones.

As far as nutrition is concerned, we use the average height for age Z-score of the last born child between 1-5 years in a household, as an indicator of stunting or chronic under-nutrition<sup>18</sup>. With this indicator we first face the problem that the Z-Score ranges from about -6 to +6. We remedy this in the calculation of growth incidence curves by simply adding the lowest Z-score in both data-sets to all Z-Scores to get strictly positive numbers. Two substantive problems remain. First, the Z-score is a purely probabilistic assessment of nutritional status. While it is most likely that a low Z-score is due to nutritional problems, individual children might have small Z-scores simply because they have genetically short parents<sup>19</sup>. Conversely, chronically malnourished children might appear to be well-nourished simply due to the fact they have genetically taller parents. This can influence the ranking of households and thus make the interpretation more difficult. Lastly, it is not clear that nutritional status linearly improves with the score. In fact, children above a Z-score of 2 are extremely tall for their age and it is unclear that they are any better off than children with a Z-Score of 0<sup>20</sup>. The nutrition indicator consequently also has to be treated with some caution.

The results of the illustrative analysis are shown in Tables 2-6 and the associated Growth Incidence Curves are shown in Figures 1-10. Tables 2 and 3 show descriptive statistics for the income and non-income indicators by decile in Bolivia where the deciles are sorted according to the relevant non-income indicator in Table 2, and the income indicator in Table 3. Several points are worth noting. First, the disparity in the income indicator is larger than in all non-income indicators. While the ratio from the tenth to the first decile in incomes is nearly 40:1, it is about 30:1 for the education indicators, and the differentials are even smaller in the undernutrition and survival indicators<sup>21</sup>. This is partly related to the fact that, contrary to the income indicator, many of the non-income indicators are bounded above; i.e. it is impossible to have more than a 100 per cent survival rate and not useful to have more than eight vaccinations. While education is, in principle, unbounded, in practice there are limits to the number of years of schooling a person might want to acquire. With indicators that are bounded, inequality is likely to be lower as the

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18. The Z-score is calculated as the actual height of a child at a certain age minus the median of the reference population (the WHO reference standard), divided by the standard deviation of the reference population. We only include children over age 1 as stunting usually does not set until about 6-12 months. There will remain an age bias problem as 1-year old children are, on average, less stunted than 3-4 year old children.

19. For a related discussion, see Klasen (1999).

20. One could just treat all Z-scores over 0 as well-nourished and just consider those with numbers below 0 as undernourished. This is currently under investigation. Fortunately, there are very few children that are far above a Z-score of 0 for their age, so that a different treatment of this group will not greatly affect the results.

21. For the vaccination indicator, the differential is also very large, at 100:1. For the mortality indicators, the ratios are not defined as mortality is 0 in the top 6-7 deciles.

rich have already reached the upper limit and the poor are moving towards it. This can explain some (but not all) of the smaller differences in non-income indicators<sup>22</sup>.

Second, in all income and non-income indicators, there has been an improvement in all deciles. In the education and health indicators, the improvements are particularly noticeable at the lower end, suggesting that improvements were percolating down to these groups, a considerably achievement for Bolivia.<sup>23</sup> This last point need not be true in other places, in which overall education and health achievements are much lower and improvements might be larger for richer groups. For example, it is quite likely that the situation in some African countries looks much worse where particularly poorer sections of the population have suffered the most from overall declining education opportunities and health care access<sup>24</sup>.

Third, Table 3 suggests that there is a considerable differential in some non-income indicators (especially health, nutrition and education) when households are sorted by the income indicator. The disparity is much smaller than in Table 2, suggesting that some households, which are income-poor, are not doing so badly on some non-income dimensions and vice versa (see also Klasen, 2000); in the case of under 1 survival, they are hardly visible in 1989 but become more pronounced in 1998. One needs to be careful when drawing policy implications from these findings. While it is clear that there is a relatively close (but far from perfect) correlation between income poverty and education poverty (and much less so between income poverty and health or nutrition poverty), this does not say anything about causality nor does it necessarily imply that income growth is the only or even the first-best policy strategy to ensure that education poverty is reduced. In particular, the correlation could be due to reverse causation (educated people are richer rather than prosperity affords greater education), or pro-rich education policies which give more education benefits (in terms of quantity or quality) to richer population groups. In the Bolivian case, there is support for both these arguments (see Klasen *et al.*, 2004). These findings could consequently be used to make a case for focusing public resources and interventions in the education sector on the income poor precisely to weaken the observed linkages between income growth and education growth.

Table 4 shows Gini coefficients and correlations between the income and the various non-income indicators. As to be expected from the above discussion, Gini coefficients in non-income achievements are considerably smaller than those of the income indicator. In the case of mortality, they are very small due to the low incidence of mortality concentrated in some households. Gini-coefficients have also decreased significantly in education, vaccination and

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22. The impact of bounded variables will also depend on the situation in the country. In a poor country where the rich are still far away from the upper bound, the existence of the upper bound should not affect inequality and thus this bias would not be relevant.

23 See Klasen *et al.* (2004) for a discussion of policies that led to these favourable outcomes. Progress regarding vaccinations is an exception where growth has been much lower in general and negligible among the poor.

24. Also, one would imagine that in a country with poor overall education achievements, advances in education initially favour the rich and then trickle down to other groups. As Bolivia happens to be more advanced here, we are in a stage where the poor are catching up to the rich.

nutrition indicators, while the improvement is much smaller in the income indicator. While there are positive and significant correlations between per capita income and the various non-income indicators, they are smallest for the under 1 survival indicator suggesting that random factors are more important than incomes for infant mortality outcomes in Bolivia.<sup>25</sup> On the other hand, they are largest for education and quite significant for under 5-survival (see also Klasen, 2000).

Figure 1 shows a growth incidence curve for the income indicator (GIC) and an unconditional and (original and smoothed) conditional average educational growth incidence curve (NIGIC), calculated as the average years of education of the (female) respondent and her (male) partner. Figure 2 uses the same indicator, but now plotting absolute increases in years of education (NIGIC) and per capita incomes (GIC) rather than growth rates. In line with the discussions of Section I, the curves can be interpreted as follows. If they are downward sloping in Figure 1, they indicate pro-poor growth in the relative dimension; i.e. the growth rates of the poor exceeded those of the non-poor. If the curve is downward-sloping even in Figure 2, then growth in education was absolutely larger for the poor than the non-poor, which consequently meets the “strong absolute” criterion of pro-poor growth. If the growth rates or absolute improvements are above 0 among the poor (in either Figure) the growth could be called pro poor according to the “weak absolute” definition.

The following findings are particularly noteworthy. First, according to the income indicator, there seems to have been considerable pro-poor growth in Bolivia in the 1990s using both the relative and the weak absolute criterion (Figure 1). When switching to the education indicator, growth was also strongly pro poor using the relative and the weak absolute criterion. This is not true for the least educated households whose adult members have no education at all in the first and the second period. As indicated by the absolute NIGIC in Figure 2, this affects the 2 per cent worst-educated households<sup>26</sup>.

The educational growth rates of the education-poor (above the worst-off 2 per cent) have indeed been very high. However, this is largely related to the low base from which they have started. This aspect is brought out nicely by comparing the curves showing absolute and percentage increases in education in Figures 1 and 2. The absolute educational growth incidence curve does not show a clear pro-poor trend, suggesting that the education poor have not been able to expand their education by more than the rich; in fact, middle education groups have been

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<sup>25</sup> This finding is largely driven by the low overall infant and child mortality rates where the share of total deaths among infants and children due to causes that are largely unrelated to poverty (e.g. genetic diseases, birth difficulties, sudden infant death, accidents, etc) is quite high. In higher mortality societies, we would expect a much stronger income-mortality link.

26. This might partly reflect that in some households with no education all adults were already in 1989 beyond the age one (in the absence of adult education programs) usually acquires education and thus it is not surprising that they still have no education in 1998. This would certainly provide visible support to adult education initiatives to ensure that those who were left out from education in the past are able to make up for the short fall later on. Note that for those centiles who had zero average education in the first period but positive education levels in the second year, the growth rate is not defined and thus not shown in Figure 1. This affects about 6-7 per cent of the worst-educated households in the initial period (2 per cent of which still had zero education in the second period).

able to expand their education by more than the rich or the poor. Education growth has therefore not been pro-poor in this strong absolute sense. The same is true, in much more dramatic fashion, for income growth. Figure 2 shows that the absolute income GIC is upward sloping, suggesting that the absolute increments of incomes of the rich were much larger than those of the poor so that growth was pro-rich in the strong absolute sense. Lastly, Figure 1 also shows the educational growth incidence curve when households are sorted by income (conditional NIGIC, smoothed and unsmoothed). That curve is much more volatile, but still shows pro-poor educational growth, albeit at a lower level, in both the relative and the weak absolute sense. It thus appears that the income-poor did experience faster educational growth rates, a positive finding for Bolivia which is unlikely to be replicated in many poorer developing countries with lower overall education levels.

Figure 3 disaggregates the education indicator by sex to demonstrate that these non-income growth incidence curves can be disaggregated by gender in ways that income growth incidence curves cannot. In the particular case, they show that relative educational growth has been larger for females than males, but that this is driven by lower female initial levels of education. Figure 4 shows absolute growth rates. While generally showing similar absolute growth rates (and thus indicating little gender bias in the educational expansion), there are considerably more women who began and ended the period 1989-98 with no education, an issue of particular policy relevance<sup>27</sup>.

Figures 5 and 6 examine the same curves now applied to vaccination rates. Here the curves oscillate a lot, but we generally see pro-poor growth in the weak absolute and the relative sense while the worst-off (the 8 percent worst off) are left out in terms of vaccinations. Specifically, their children had no vaccinations in the first period and none in the second<sup>28</sup>. Figure 4 also shows that the absolute growth of vaccinations is particularly high in deciles 3-8. For the top decile, the (unconditional) relative or absolute NIGIC is again flat at zero. These households already had all eight vaccinations per child in 1989 and there was no further scope for improvement. This is an example of an indicator having reached its upper bound in these groups.

Figures 7 and 8 examine survival. Using the unconditional NIGIC, growth has been strongly pro-poor in the weak absolute and relative sense. For the top six deciles, the unconditional curve is flat as there was 100 per cent survival of infants and children in the first and second period in these households. The conditional NIGIC shows no real pattern, suggesting that mortality changes were largely unrelated to the position in the income distribution. In the Bolivian context where infant and child mortality is already quite low and apparently largely

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27. The decline in absolute levels of education in decile 8 for males and females is mostly due to a change to the number of years of schooling required to attain a degree. This points to the potential bias of using years of schooling as the indicator of educational output.

28. It is important to note here that the 8 per cent worst off in terms of vaccination rates need not be the same households. As with the income growth incidence curve and the Ravallion-Chen framework, these assessments are based on cross-section surveys and the results refer to percentiles of the distribution, not particular households. For a discussion of this issue, see Grimm (2005).



driven by random factors (e.g. genetic diseases, prematurity or accidents), these survival NIGICs are therefore not very informative. This is likely to be different if applied to more high-mortality environments (such as those prevailing in large parts of Africa).

Figures 9 and 10 examine the stunting indicator. Again, reductions in stunting appear to have been pro poor in a weak absolute and relative sense. In particular, those who were among the 10 per cent worst nourished have been able proportionately to improve their nutrition the most, but the absolute improvements (Figure 10) were similar across all groups. When sorting households by income (conditional NIGIC), the pro poorness of nutritional improvements are much less clear; in fact, the very income-poor did not experience much improvement in their nutritional status at all.

We thus generally find that using the unconditional NIGIC, growth was generally quite pro-poor in a weak absolute and relative sense. This is, however, generally not the case when we consider the conditional NIGICs (sorted by initial incomes). The contrast between these two findings suggests that improvements in non-income indicators were generally more focused with individuals performing initially poorly on those indicators (with the exception of the very worst performers), while they were not particularly focused on the income-poor. From the perspective of achieving the non-income MDGs (2-6), this focus of improvements in non-income achievements on the initially more deprived in that achievements is generally good news with the strong caveat that the very worst-off have been left out of these improvements. From the point of view of the allocation of public spending and public interventions, the results suggest that improvements in non-income indicators have not particularly favoured the income-poor; if that was a focus of intervention, a lot more could be done. It is also clear that these two perspectives are somewhat in conflict with each other. Focusing interventions in health and education on the income-poorest will not necessarily reach the households most deprived in those health and education indicators. This is an important and new finding of this type of analysis puts into the question the standard use of expenditure incidence analysis for health and education spending as the only relevant tool to assess whether public interventions help the most deprived (see below).

Based on these growth incidence curves, Tables 5 and 6 calculate rates of pro-poor growth using the Ravallion and Chen (2003) approach for the various income and conditional and unconditional non-income indicators (using a moderate poverty headcount of 77 per cent and an extreme poverty headcount of 56% which was the income poverty headcount in Bolivia in 1989). Table 5 shows that growth in income and non-income dimensions has been pro poor in a relative sense as the rates of pro-poor growth are larger than the mean growth rates for all non-income indicators. It also shows that growth has been pro poor in a weak absolute sense as the rates are all above 0. When households are sorted by incomes (conditional), pro-poor growth has been much smaller and sometimes below the mean growth rate (e.g. in vaccinations, under 1 and under 5 survival using the moderate poverty line); in those cases, growth was pro poor only in the weak absolute, but anti-poor in the relative sense. Table 6 calculates the pro-poor growth measures using absolute improvements. In line with the graphs, the results show that improvements were pro poor using the strong absolute definition in the health and nutrition indicators, but not particularly pro poor in the education measures. When sorting households by

income, the pro-poor growth measures are usually similar to overall absolute growth, with some indicators showing a bias in absolute improvements towards the rich and others towards the poor. This record regarding non-income indicators is certainly much more positive than with the income indicator. The absolute income gains to the rich were much larger than those of the poor.

As far as Bolivia is concerned, these illustrative findings on the non-income growth incidence curves and associated pro-poor growth rates present a rather favourable picture of improvements in non-income dimensions of well-being in the 1990s. Not only was Bolivia able to improve its record in social indicators in general, but much of these improvements were focused on those particularly deprived in these non-income achievements. If we sort households by income, the improvements were somewhat less pro poor, but also here the record is not too bad with the income poor generally benefiting about as much as the non-poor (depending on the indicator). As the Bolivian case was a mere illustration of the general method, it is, however, more important to make some general observations on this method and its potential application which will be taken up in the next section.

#### **IV. CONCLUSION**

This paper has reviewed the findings about growth, inequality and poverty reduction. A particular innovation of the paper was to clarify the debates about the definition of pro-poor growth from a policy perspective. In line with achieving MDG 1, it appears useful to maximize a measure such as the Ravallion-Chen measure of pro-poor growth as a policy objective. But maximising this weak absolute measure of pro-poor growth implies that measures to further pro-poor growth in a relative (or even strong absolute) dimension would be particularly useful (unless there are large trade-offs involved).

A second innovation was to extend the measurement techniques of pro-poor growth to the non-income dimension. The discussion has generated important new insights for measurement and monitoring as well as policy priorities. Turning first to the new insights for measurement and monitoring, the discussion has shown that it is possible and worthwhile to extend the concepts of the Growth Incidence Curve and the Ravallion and Chen measure of pro poor growth to non-income dimensions. While some conceptual and practical difficulties need to be addressed when extending this framework (particularly with respect to the mortality indicators), it usefully shifts the focus from average achievements in these dimensions to the distribution of improvements which is critically important for monitoring progress in the non-income MDGs. The NIGICs show where the largest improvements and setbacks have occurred along the income distribution as well as the distribution of non-income measures, which is critical in order to identify the priority policy interventions for meeting the MDGs.

Second, extending this framework has the additional advantage of explicitly examining how improvements in income and non-income dimensions are related at different points of the income distribution. This is of importance as a tool for monitoring whether policies to improve poverty in non-income dimensions are reaching the income-poor.

Third, the non-income growth analysis can also be extended to examine gender differentials. While it is exceedingly difficult to say much about gender and income poverty (Klasen, 2004, 2005), it is perfectly feasible to analyse non-income growth incidence curves for

education and health by gender and to see how gender differentials can be observed at different points of the distribution of these non-income indicators. This is of critical importance for monitoring progress and identifying problems regarding MDG 3. It is equally important since gender differentials are pivotal in order to address most MDGs (certainly MDGs 1-6, see Klasen, 2005).

Fourth, the discussion suggests to not only considering growth rates in achievements but also absolute improvements, particularly when it comes to non-income achievements. Thus, all three senses of pro-poor growth (weak and strong absolute as well as relative) generate interesting insights about changes in the distribution of non-income well-being. Their inter-relationship has been particularly interesting in the Bolivian case. In Bolivia, income growth was pro poor in the relative and weak absolute sense, but strongly anti-poor in the strong absolute sense (as it is likely to be in most other countries). When considering non-income dimensions of pro-poor growth, the picture is generally more favourable while growth has been pro poor even in the strong absolute sense for some indicators, with the important exception of the extremely poor, who often experienced no improvements in their education or vaccination indicators. Examining how this differs across countries would be particularly worthwhile.

Regarding policy priorities, the findings from this paper also yield new insights. First, the analysis can be used for targeting purposes. With this framework, the priority beneficiaries for policy interventions can be identified. With this tool, targeting can now be done using non-income indicators as well as income indicators (the traditional focus in much targeting analysis). As the impact of past policies on the entire distribution of the population is immediately visible lessons from the past can be incorporated in the design of new programmes that can be better targeted towards the most deprived.

Second, the analysis yields new insights about linkages between policies favouring income growth for the achievement of non-income objectives and those that favour targeting these non-income indicators directly. While there is a clear correlation between the income and non-income dimensions of pro-poor growth, the correlation is far from perfect. Relying on income growth to solve the non-income poverty problem is unlikely to be the most effective approach to addressing non-income poverty. Moreover, targeting policy interventions in the health and education field on the income-poor – a major current policy focus and a major goal of policy research (e.g. through incidence analyses and public expenditure reviews) – is also not necessarily the best approach to target non-income dimensions of poverty. While focusing such interventions on the income-poor would go some way towards addressing non-income poverty, focusing interventions on those who are particularly deprived in the respective dimension would likely be more effective for combating non-income poverty and helping to achieve the non-income MDGs. Only if one thought income poverty reduction is the overriding goal, and improvements in health and education are seen as merely means to achieve that goal, then a focus of such interventions on the income-poor is well justified. But this might not be in the spirit of the MDGs which treat all of the goals as separately and equally valuable and do not prioritise a particular one. Thus this toolbox opens the possibility of designing and monitoring programs in non-income dimensions (such as health and education) targeted at those most deprived in that indicator which might be of particular relevance for those wanted to prioritise policy action to reach MDGs 2-6.

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**Table 2. Non-Income Achievements by Non-Income Decile (“unconditional”) for Bolivia 1989 and 1998**

| Indicator   | 1     | 2     | 3      | 4      | 5                                     | 6      | 7      | 8      | 9      | 10      | Mean   |  |
|---|-------|-------|--------|--------|---------------------------------------|--------|--------|--------|--------|---------|--------|--|
| Income  | 21.88 | 40.27 | 57.50  | 77.33  | 100.61                                | 132.39 | 177.08 | 246.12 | 368.36 | 863.39  | 213.39 |  |
| Education   |       |       |        |        | Mean of deciles (unconditional), 1989 |        |        |        |        |         |        |  |
| Average education of respondents and partners             | 0.22  | 1.31  | 2.26   | 3.20   | 4.28                                  | 5.61   | 7.32   | 9.38   | 11.73  | 15.20   | 6.03   |  |
| Average education of respondents (aged 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   |  |
| Maximal education of respondents and partners             | 0.48  | 2.52  | 3.52   | 4.82   | 5.88                                  | 7.50   | 9.78   | 11.99  | 13.87  | 16.98   | 7.64   |  |
| Maximal education of respondents (aged 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   |  |
| 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  |  |
| 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  |  |
| Average vaccination of children (aged between 1 and 5)    | 0.08  | 1.88  | 3.49   | 4.67   | 5.67                                  | 6.46   | 7.10   | 7.98   | 8.00   | 8.00    | 5.30   |  |
| Nutrition   |       |       |        |        |                                       |        |        |        |        |         |        |  |
| Stunting z-score of children (aged between 1 and 3)       | -4.17 | -3.01 | -2.50  | -2.11  | -1.70                                 | -1.33  | -0.90  | -0.25  | -0.00  | 0.88    | -1.54  |  |
| Income  |       |       |        |        | Mean of deciles (unconditional), 1998 |        |        |        |        |         |        |  |
| Education   | 36.37 | 63.60 | 89.26  | 119.22 | 155.89                                | 203.15 | 269.64 | 369.20 | 555.27 | 1242.66 | 312.10 |  |
| Average education of respondents and partners             | 0.87  | 2.37  | 3.51   | 4.78   | 6.06                                  | 7.34   | 8.70   | 9.81   | 12.43  | 16.04   | 7.21   |  |
| Average education of respondents (aged 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   |  |
| Maximal education of respondents and partners             | 1.47  | 3.48  | 4.87   | 6.44   | 8.23                                  | 9.01   | 10.00  | 10.71  | 15.76  | 17.04   | 8.74   |  |
| Maximal education of respondents (aged 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   |  |
| 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  |  |
| 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  |  |
| Average vaccination of children (aged between 1 and 5)    | 0.09  | 2.13  | 3.74   | 4.92   | 5.88                                  | 6.74   | 7.14   | 8.00   | 8.00   | 8.00    | 5.48   |  |
| Nutrition   |       |       |        |        |                                       |        |        |        |        |         |        |  |
| Stunting z-score of children (aged between 1 and 3)       | -3.61 | -2.43 | -1.92  | -1.55  | -1.19                                 | -0.79  | -0.30  | -0.00  | 0.05   | 1.11    | -1.06  |  |

*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.

*Source:* Own calculations.

**Table 3. Non-Income Achievements by Income Decile (“conditional”) for Bolivia 1989 and 1998**

| Indicator   | 1     | 2     | 3     | 4      | 5      | 6      | 7      | 8      | 9      | 10      | Mean   |
|---|-------|-------|-------|--------|--------|--------|--------|--------|--------|---------|--------|
| Income  | 21.88 | 40.27 | 57.50 | 77.33  | 100.61 | 132.39 | 177.08 | 246.12 | 368.36 | 863.39  | 213.39 |
| Education   |       |       |       |        |        |        |        |        |        |         |        |
| Average education of respondents and partners             | 3.04  | 3.48  | 4.11  | 4.47   | 5.54   | 6.07   | 6.99   | 7.94   | 9.37   | 11.47   | 6.03   |
| Average education of respondents (aged 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   |
| Maximal education of respondents and partners             | 4.41  | 4.77  | 5.52  | 5.91   | 7.08   | 7.75   | 8.70   | 9.73   | 11.23  | 13.29   | 7.64   |
| Maximal education of respondents (aged 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   |
| 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  |
| 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  |
| Average vaccination of children (aged between 1 and 5)    | 5.19  | 4.79  | 5.07  | 5.35   | 5.09   | 5.47   | 5.77   | 6.82   | 6.16   | 6.39    | 5.30   |
| Nutrition   |       |       |       |        |        |        |        |        |        |         |        |
| Stunting z-score of children (aged between 1 and 3)       | -1.75 | -1.73 | -1.89 | -1.71  | -1.52  | -1.57  | -1.27  | -1.26  | -1.18  | -0.82   | -1.54  |
| Income  | 36.37 | 63.60 | 89.26 | 119.22 | 155.89 | 203.15 | 269.64 | 369.20 | 555.27 | 1242.66 | 312.10 |
| Education   |       |       |       |        |        |        |        |        |        |         |        |
| Average education of respondents and partners             | 3.92  | 4.47  | 5.20  | 6.45   | 6.45   | 7.10   | 8.09   | 8.82   | 9.85   | 12.35   | 7.21   |
| Average education of respondents (aged 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   |
| Maximal education of respondents and partners             | 5.34  | 5.86  | 6.63  | 6.97   | 7.99   | 8.78   | 9.72   | 10.46  | 11.44  | 13.79   | 8.74   |
| Maximal education of respondents (aged 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   |
| 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  |
| 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  |
| Average vaccination of children (aged between 1 and 5)    | 5.19  | 5.26  | 5.02  | 5.17   | 5.34   | 5.40   | 5.74   | 5.99   | 5.93   | 6.43    | 5.48   |
| Nutrition   |       |       |       |        |        |        |        |        |        |         |        |
| Stunting z-score of children (aged between 1 and 3)       | -1.56 | -1.48 | -1.30 | -1.37  | -1.17  | -1.15  | -1.01  | -0.90  | -0.79  | -0.44   | -1.06  |

Notes: For the explanation of the variables, see Table 2.

Source: Own calculations.

**Table 4. Gini-Coefficients and Correlations of Income and Non-Income Indicators for Bolivia, 1989 and 1998**

| Indicator   | Gini-coefficient |      | Correlation |
|---|------------------|------|-------------|
|   | 1989             | 1998 | GIC         |
| Income  | 0.56             | 0.54 | –           |
| Education   |                  |      |             |
| Average education of respondents and partners             | 0.43             | 0.35 | 0.64        |
| Average education of respondents (aged between 20 and 30) | 0.39             | 0.31 | 0.44        |
| Maximal education of respondents and partners             | 0.38             | 0.31 | 0.56        |
| Maximal education of respondents (aged between 20 and 30) | 0.40             | 0.32 | 0.43        |
| Health  |                  |      |             |
| Under 5 child survival rate (%)                           | 0.11             | 0.08 | 0.60        |
| Under 1 child survival rate (%)                           | 0.07             | 0.06 | -0.01       |
| Average vaccination of children (aged between 1 and 5)    | 0.28             | 0.26 | 0.15        |
| Nutrition   |                  |      |             |
| Stunting z-score of children (aged between 1 and 3)       | 0.19             | 0.16 | 0.05        |

Notes: For the explanation of the variables, see Table 2.

Source: Own calculations.

**Table 5. Pro-Poor Growth Rate and Growth Rate in Mean for Bolivia, 1989-1998**

|   | Mean<br>Growth<br>Rate | NIGIC 1989-1998<br>(unconditional) |                                 | NIGIC 1989-1998<br>(conditional) |                                |
|---|------------------------|------------------------------------|---------------------------------|----------------------------------|--------------------------------|
|   |                        | PPG Rate,<br>moderate<br>poverty   | PPG Rate,<br>extreme<br>poverty | PPG Rate<br>moderate<br>poverty  | PPG Rate<br>extreme<br>poverty |
| Income  | 3.88                   | 4.54                               | 4.63                            | 4.54                             | 4.63                           |
| Education   |                        |                                    |                                 |                                  |                                |
| Average education of respondents and partners             | 1.80                   | 3.89                               | 4.88                            | 2.00                             | 2.24                           |
| Average education of respondents (aged between 20 and 30) | 1.87                   | 3.47                               | 4.75                            | 1.75                             | 2.02                           |
| Maximal education of respondents and partners             | 1.36                   | 2.60                               | 3.74                            | 1.55                             | 1.73                           |
| Maximal education of respondents (aged between 20 and 30) | 1.73                   | 3.42                               | 4.66                            | 1.64                             | 1.89                           |
| Health  |                        |                                    |                                 |                                  |                                |
| Under 5 child survival rate (%)                           | 0.40                   | 0.70                               | 0.96                            | 0.37                             | 0.40                           |
| Under 1 child survival rate (%)                           | 0.12                   | 0.14                               | 0.19                            | 0.11                             | 0.15                           |
| Average vaccination of children (aged between 1 and 5)    | 0.34                   | 0.66                               | 0.91                            | 0.15                             | 0.20                           |
| Nutrition   |                        |                                    |                                 |                                  |                                |
| Stunting z-score of children (aged between 1 and 3)       | 1.05                   | 1.63                               | 1.87                            | 0.82                             | 0.78                           |

Notes: For the explanation of the variables, see Table 2. 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. GRIM: Growth rate in mean. PPGR: Pro-poor growth rate.

Source: Own calculations.



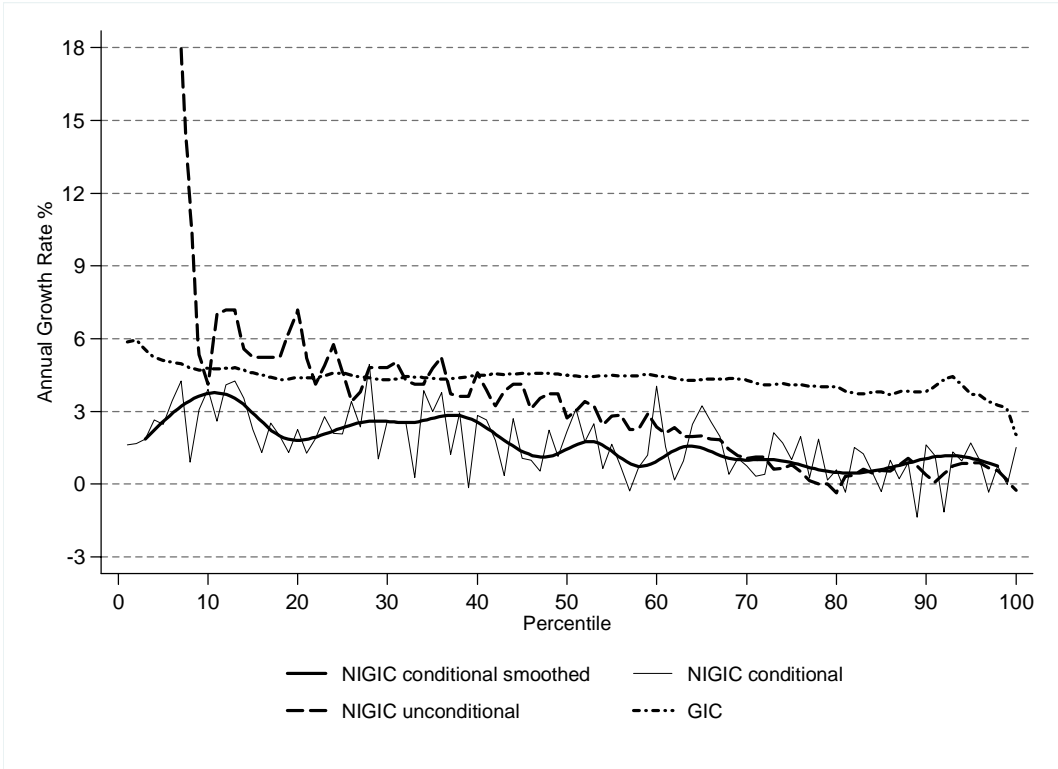
**Table 6. Absolute Pro-Poor Change and Change in Mean for Bolivia, 1989-1998**

|  | Mean<br>Change<br>(abs.) | NIGIC 1989-1998<br>(unconditional) |                                | NIGIC 1989-1998<br>(conditional) |                                |
|--|--------------------------|------------------------------------|--------------------------------|----------------------------------|--------------------------------|
|  |                          | Pro Poor<br>Change,<br>moderate    | Pro Poor<br>Change,<br>extreme | Pro Poor<br>Change,<br>moderate  | Pro Poor<br>Change,<br>extreme |
| Income   | 98.71                    | 53.82                              | 37.02                          | 53.82                            | 37.02                          |
| Education  |                          |                                    |                                |                                  |                                |
| Average education of respondents and partners              | 1.18                     | 1.30                               | 1.34                           | 1.01                             | 1.01                           |
| Average education of respondents (aged between 20 and 30)  | 1.36                     | 1.38                               | 1.74                           | 1.03                             | 1.09                           |
| Maximal education of respondents and partners              | 1.10                     | 1.08                               | 1.58                           | 1.01                             | 1.03                           |
| Maximal education of respondents (aged between 20 and 30)  | 1.23                     | 1.27                               | 1.58                           | 0.92                             | 0.95                           |
| Health   |                          |                                    |                                |                                  |                                |
| Under 5 child survival rate (*100)                         | 3.57                     | 4.54                               | 6.25                           | 3.19                             | 3.45                           |
| Under 1 child survival rate (*100)                         | 1.07                     | 1.29                               | 1.78                           | 1.00                             | 1.35                           |
| Average vaccination of children (aged between 1 and 5)     | 0.18                     | 0.21                               | 0.27                           | 0.07                             | 0.09                           |
| Nutrition  |                          |                                    |                                |                                  |                                |
| Stunting z-score of children (aged between 1 and 3) (*100) | 47.71                    | 54.60                              | 55.38                          | 35.12                            | 32.32                          |

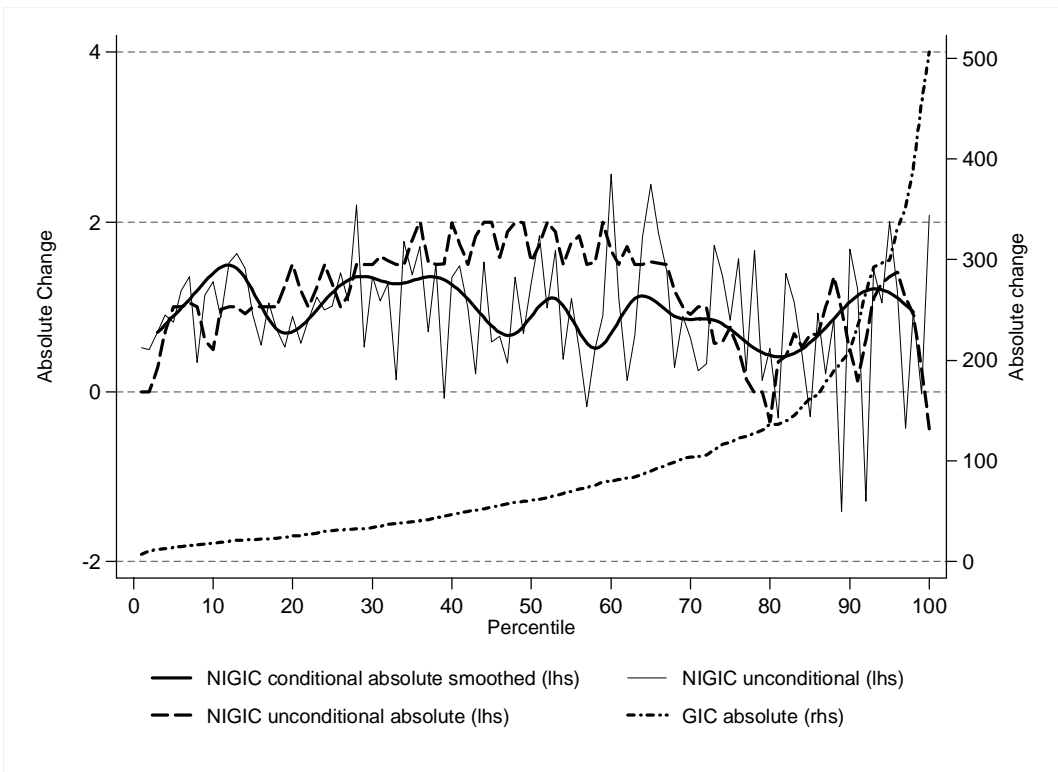
*Notes:* For the explanation of the variables, see Table 2. We are using two poverty lines. The moderate poverty line leads to an income headcount of 77 and the extreme poverty line to an income headcount of 56 which we also use for the non-income indicators. CHIM: Change in mean. PPCH: Pro-poor change. Changes are for the entire period and not annualized.

*Source:* Own calculations.

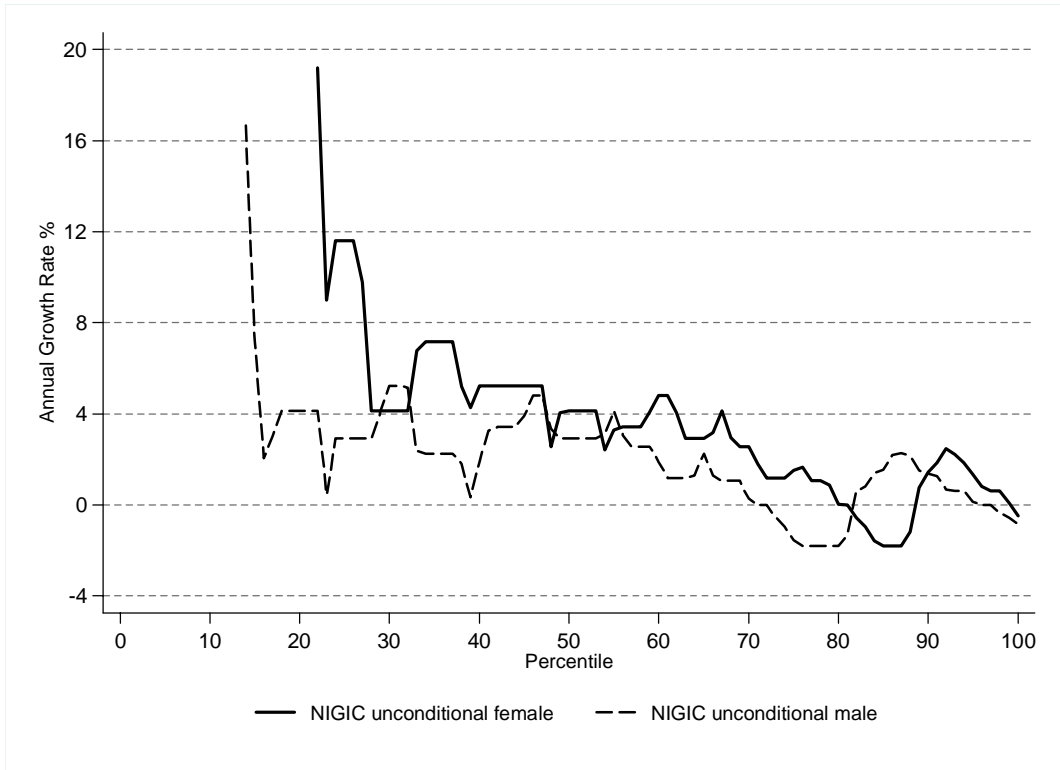
**Figure 1. GIC versus Conditional and Unconditional NIGIC for Average Education**



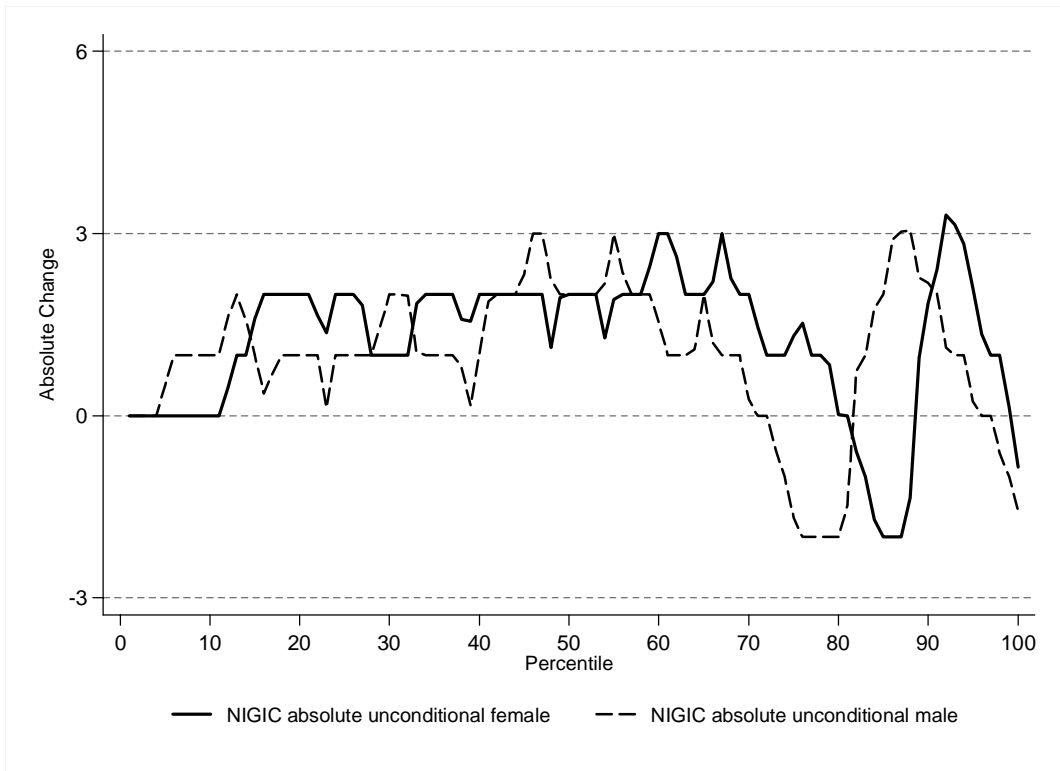
**Figure 2. Absolute Change of Unconditional NIGIC for Average Education versus Absolute Change in Income**



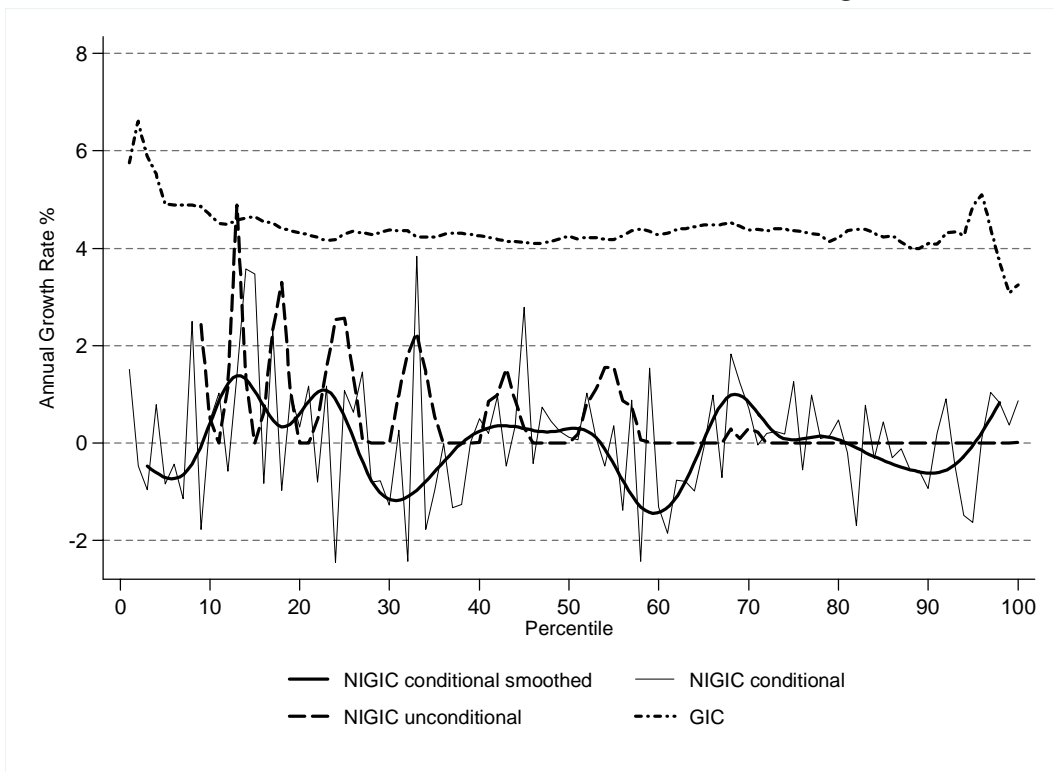
**Figure 3. Unconditional NIGIC for Male and Female Average Education**



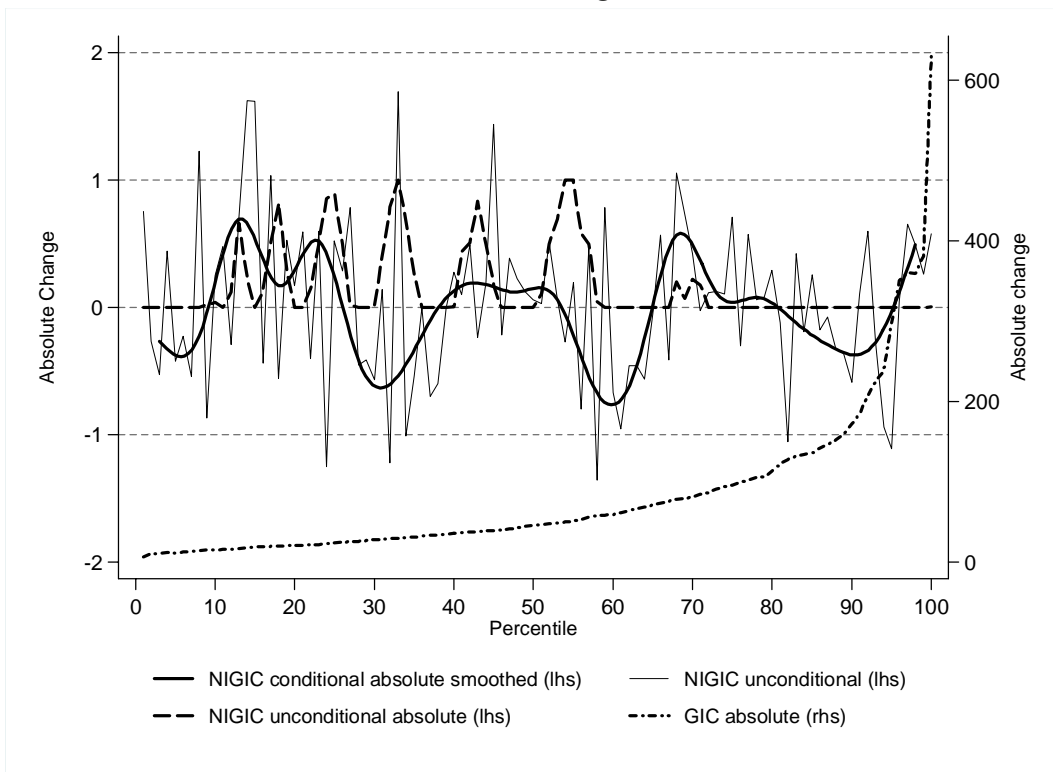
**Figure 4. Absolute Change for Male and Female Average Education**



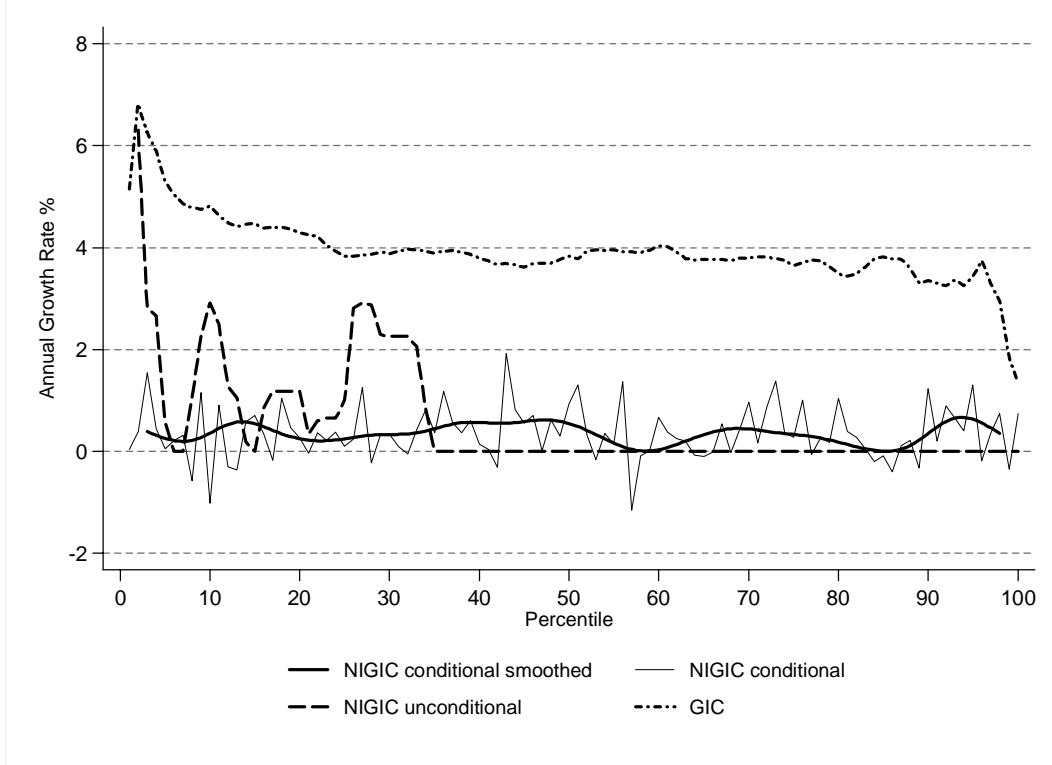
**Figure 5. GIC versus Conditional and Unconditional NIGIC for Average Vaccination**



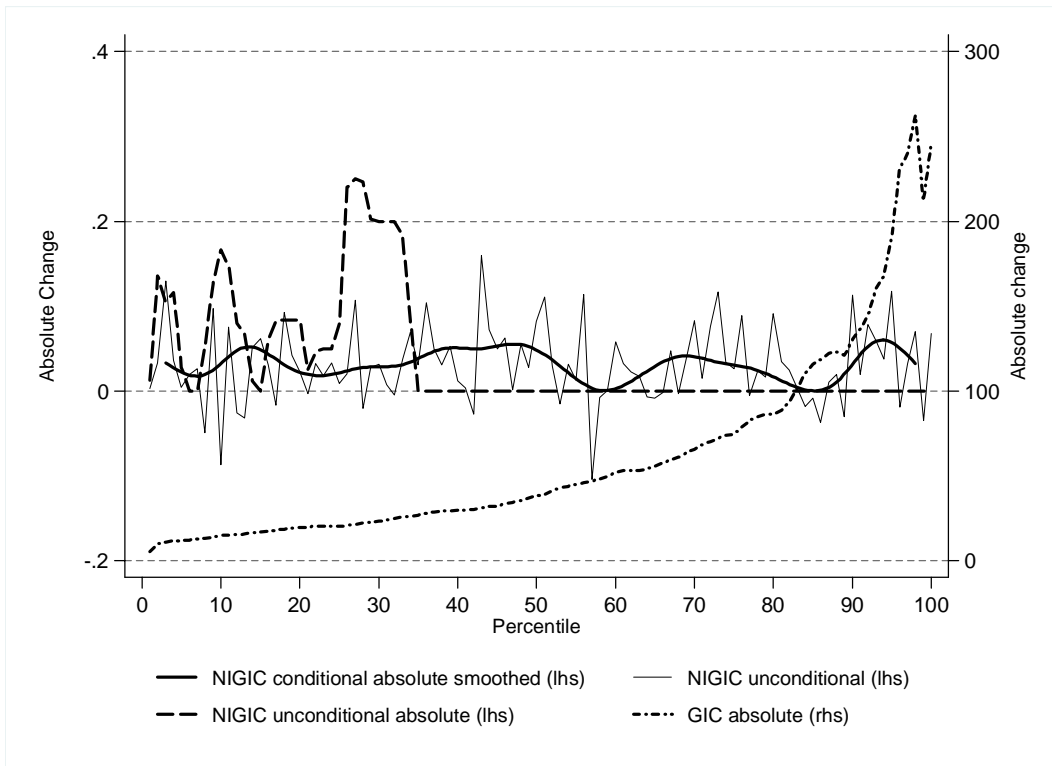
**Figure 6. Absolute Change of Unconditional NIGIC for Vaccination versus Absolute Change in Income**



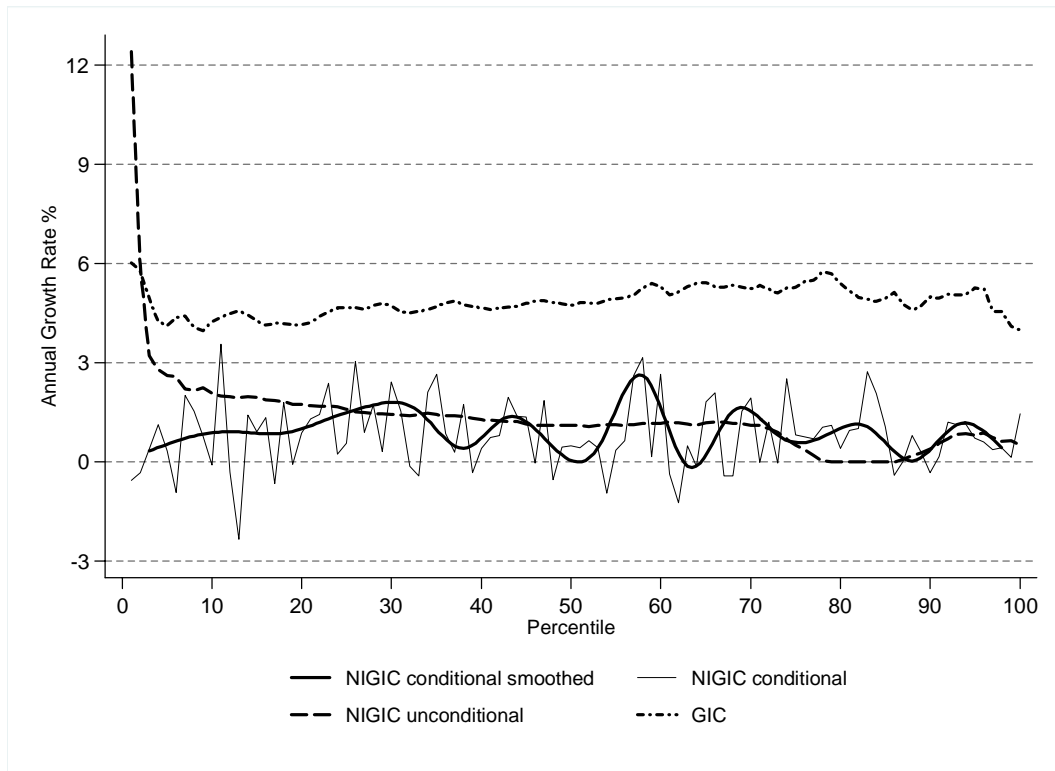
**Figure 7. GIC versus Conditional and Unconditional NIGIC for Under 5 Survival**



**Figure 8. Absolute Change of Unconditional NIGIC for Under 5 Survival versus Absolute Change in Income**



**Figure 9. GIC versus Conditional and Unconditional NIGIC for Stunting**



**Figure 10. Absolute Change of Unconditional NIGIC for Stunting versus Absolute Change in Income**

