UNITED NATIONS UNIVERSITY
UNU-WIDER
World Institute for Development Economics Research

Working Paper No. 2010/47

Concepts and Operationalization of Pro-Poor Growth

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May 2010

Abstract

Growth that reduces poverty is often considered pro-poor regardless of whether the poor benefit from it more than the non-poor. Such growth could simply be termed poverty-reducing growth. This paper argues that for growth to be pro-poor it should disproportionally benefit the poor. The paper proposes an operational definition of pro-poor growth that restricts it to the cases in which the mean income of the poor increases proportionally more than that of the non-poor. A new index is proposed based exclusively on the redistributional component of poverty-gap changes obtained through an exact decomposition. It is then shown that this component measures how pro-poor growth is over a given period based on the above mentioned definition. The paper further presents several indicators for evaluating and monitoring the 'pro-poorness' of growth over time and concludes with an empirical illustration for the case of Honduras.

Keywords: pro-poor, growth, income, inequality, poverty decomposition, Honduras

JEL classification: C16, D31, D63, I32, O15, O54

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This study has been prepared within the UNU-WIDER project on New Directions in Development Economics, directed by Augustin Kwasi Fosu and the UNU-WIDER Internship Programme.

UNU-WIDER acknowledges the financial contributions to the research programme by the governments of Denmark (Royal Ministry of Foreign Affairs), Finland (Ministry for Foreign Affairs), Sweden (Swedish International Development Cooperation Agency—Sida) and the United Kingdom (Department for International Development).

ISSN 1798-7237 ISBN 978-92-9230-284-9

Acknowledgements

This paper was presented at the UNU-WIDER conference on Frontiers of Poverty Analysis and later reviewed while on internship at the Institute. I would like to express my gratitude to Tony Shorrocks, Amelia Santos-Paulino, and Luc Christiaensen for their insightful comments.

Abbreviations

ECLAC	Economic Commission for Latin America and the Caribbean
FGT	Foster-Greer-Thorbecke
G	Growth component of poverty changes
GDP	Gross domestic product
H	Headcount index
MDG	Millenium development goals
PBG	Poverty bias of growth
PEGR	Poverty equivalent growth rate
PG	Poverty gap
PGC	Poverty growth curve
PPG	Pro-poor growth
R	Redistribution component of poverty changes

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Typescript prepared by Janis Vehmaan-Kreula/Lisa Winkler at UNU-WIDER

1 Introduction

Poverty can be reduced through economic growth and improvements in income distribution. For decades, growth has remained the main target whereas redistribution has been largely neglected under the conception that the benefits of growth would trickle down from top to bottom of the income ladder.

Growth is, however, a necessary but not a sufficient condition for poverty reduction. Moreover, inequality expanding distributional shifts erode and often cancel out the impact that average income increases could have on the extent of poverty. This is why the mainstream development economics debate has been slowly moving into focusing on shared growth or pro-poor growth.

This paper, while strongly arguing in favour of the relative approach to pro-poor growth (PPG), purports to show a comprehensive review of the main methodologies to characterize and measure PPG that can be found in the literature. Most importantly, it presents a new pro-poor growth index and rate that evaluate growth in terms of whether growth has disproportionally benefited the poor and by how much. This index is unique in its intuitive interpretation and its ability to measure the extent to which growth is pro-poor without incurring problems previous indices presented and which are discussed below. In addition, a series of indices to evaluate and monitor the type of growth are proposed which can be useful for policy formulation and assessment.

The concept of pro-poor growth is not exempt from controversy, as we shall see in the following section where the two main different approaches are discussed. Section 3 reviews the main literature and exposes the positive and negative aspects of the different methodologies up to date. Section 4 proposes a new pro-poor growth index and rate that can characterize the type of growth that has taken place over a period and measure how pro-poor it has been, which effectively allows for comparison between different periods and countries. Section 5 presents some indices, derived from the one defined in the previous section, which can help evaluate and monitor the extent of poverty reduction due to redistributional shifts. The paper finishes with the case study of Honduras where the new indices are used to explain its pro-poor performance between 1992 and 2007, followed by the conclusion and three methodological appendices.

2 Defining pro-poor growth

The current debate on the topic concentrates on two different approaches regarding the definition of PPG, namely the absolute and the relative approach. The former is based on a definition of pro-poor growth exclusively linked to a growth that reduces poverty. The latter considers growth to be pro-poor only when it disproportionately benefits the poor.

Due to its income raising nature, growth is *poverty reducing* ‘per se’, unless its appropriation is so unequal along the different percentiles that the poor do not benefit from it, or unless it is accompanied by regressive changes in distribution favouring the non-poor and offsetting its benefits. Thus, most growth will be *poverty reducing* without disproportionally helping the poor. The kind of growth that Ravallion (2004) defines as pro-poor is in fact a growth that simply reduces poverty, and it could thus be named

poverty reducing growth instead. Following, inter alia, Kakwani and Pernia's (2000) understanding of the term, for growth to be *pro-poor* it should benefit the poor disproportionately more than the non-poor or should 'harm them less' (Duclos 2008) in the case that per capita growth is negative—for instance when population grows faster than the economy.

The latter approach is based on the semantic understanding of the term 'pro' as in 'favour of', as argued by Son (2007). Following this, the concept of *pro-poor*, in terms of growth absorption, should favour the poor at the expense of the non-poor's share. Arguably, it makes little sense that a poverty reducing growth is considered *pro-poor* while benefiting the non-poor more than or as much as the poor. Following a *reductio ad absurdum*, we could also call such a growth *pro-nonpoor*, which would lead us to a definition of *pro-poor growth* that is equivalent to that of *pro-nonpoor growth.*

Going beyond the semantic juggling, the present paper proposes that *pro-poor growth* be distinguished from *poverty reducing growth* and focuses exclusively on the so-called relative approach to *pro-poor growth* involving disproportionately favourable benefits for the poor. The following section looks at the different practices in the operationalization of PPG that can be found in the specialized literature with a view to establishing a general overview.

3 Pro-poor growth operationalization

There are two different approaches to estimate whether growth is pro-poor in a relative sense. They coincide with the distinction proposed in Kakwani and Son (2006) between the *partial* and the *full* approach. The former has the advantage that it does not require specifying neither a poverty line nor a poverty measure. The downside is that it is not able to provide conclusive results in all cases, nor does it provide, in most cases, a measure of how much pro-poor growth is. The full approach instead, despite requiring a choice of poverty line and index, does have the potential to provide conclusive results. Moreover, and contrary to the first methodology, it does not take into account distributional changes that affect only the upper part of the distribution, focusing strictly on the effects in terms of poverty.

In both cases, the pro-poor evaluation functions are expected to possess several properties. Duclos (2008) defines a set of axioms coinciding with those generally envisaged in the earlier literature (see Appendix 1), which can be taken as an intuitive ground on which to build any pro-poor measure.

A number of authors have proposed ways to detect whether income changes during a given period have been pro-poor based on the relative and absolute approaches described above.

Duclos (2008) starts with the above mentioned relatively general ethical axioms and proposes graphical methods to test whether distributional changes are pro-poor both under the relative and absolute approach. He considers 'classes of pro-poor evaluation functions which show varying distribution sensitivity to the assessment of the impact of growth' and, contrary to most methodologies, studies ranges of poverty lines instead of focusing on a fixed income level below which incomes are deemed poor.

Based on stochastic dominance, he derives tests for first and second order pro-poor judgements that allow for a categorization of distributional changes for a range of choices as regards the specific criterion by which a change is called pro-poor. First order judgements require all poor quintiles to grow above the average growth. Second order judgements represent a less strict case in which the poor as a group grow less than average but the poorer among the poor grow actually above average, i.e. a redistributional shift among the poor occurs.

This type of evaluation provides a strong methodological framework as it considers a general pro-poor evaluation function. It also allows for a ranking of different distributional changes although it does not provide a measure of how much pro-poor these are.

Essama-Nssah (2004) generalizes some of the prominent methodologies to operationalize PPG by means of imposing desired and progressively restricting properties on the coefficients of a general poverty measure or other indicator of social welfare. Taking poverty as the indicator of social welfare he derives the following measures:

(i) The Growth Incidence Curve (GIC) Ravallion and Chen (2003) divide by the headcount to use as a PPG index. It requires Lorenz-dominance of the final distribution over the initial one.

(ii) The Poverty Growth Curve (PGC) Kakwani and Son (2006) base their rate of PPG on defining it as the area that falls beneath the PGC. Again, Lorenz-dominance is required for the criterion to be unequivocal.

(iii) The Equally Distributed Equivalent Growth Rate (EDEGR) is defined by Essama-Nssah (2004) as the growth rate of the mean income when there is no change in the distribution plus a weighted average of changes in the slope of the Lorenz Curve. It does not entirely focus on the poor as distributional changes benefitting the upper part of the distribution can also account as pro-poor.

To determine not only if, but also how much pro-poor growth is on the grounds of distributional changes specifically – but not only – affecting the poor, there exists a third methodology based on the decomposition of changes in poverty into growth and redistribution effects.

A chosen poverty index of a given population can vary due to either overall gains in income or changes in the way this is appropriated, i.e. redistributional changes. The following two sections describe how to disentangle both effects in order to capture to what extent growth is pro-poor.

3.1 Poverty decomposition

Different methodologies exist to assess the contributions of income growth and redistribution to the variation of poverty. Both components can be studied through regressions based on international data panels, time series for a given population and the calculation of differential elasticities.

Cross-country comparison presents great disadvantages, in spite of its repeated use for the justification of the trickle down development model, because it only estimates the average trends of their respective individual experiences. Furthermore, these experiences generally emerge from very different initial conditions of inequality and mean income (Kakwani and Pernia 2000; Kakwani et al. 2003). For this reason, it seems more appropriate to develop a PPG index that is based on case studies for each country.

There are mainly three ways of quantifying the effects produced on the poverty measure by changes in the income mean and the distribution. The first one calculates elasticities by means of just one temporal observation (Kakwani et al. 2003), whereas the other two decompose poverty through observations corresponding to two points in time. Decomposing changes in poverty over a period, however, provides far more reliable information than these elasticities because no *a priori* distributional pattern is imposed on changes in income.

Datt and Ravallion (1992) decompose poverty into growth and redistribution effects, plus a residual. Despite the presence of this residual of dubious interpretation and the arbitrary choice of the initial period as base for the decomposition, this method is still favoured by authors like Kraay (2004), although most later authors agree on the better suitability of the Kakwani–Shorrocks approach (Kakwani 2000; Mazumdar and Son 2002; Son 2003b; Baye 2004, 2005; Dhongde 2005; Kolenikov and Shorrocks 2005; López Bóo 2006).

The latter approach performs a decomposition based upon the Shapley method (1953) for Game Theory, and was applied by Kakwani (1993) to decompose poverty variations into growth and redistribution effects. Subsequently, it was formulated under a more general scope by Shorrocks (1999) for any kind of decomposition, including that into population subgroups. This approach decomposes the variation of poverty into an exact sum—without residual—of both effects by means of calculating their respective contributions when they are kept alternatively constant and the sum is centred on the mean values (Kakwani 1993; Shorrocks 1999) instead of on the initial ones (Datt and Ravallion 1992). In essence, the Shapley method calculates the marginal impact on poverty of 'eliminating each contributing factor in sequence, and then assigns to each factor the average of its marginal contributions in all possible elimination sequences' (Shorrocks 1999).

By imposing a set of desirable axioms for the decomposition**,** Kakwani (1993) obtains the mean values of the growth and redistribution components, given by:

$$(1) \qquad G_{ij} = \frac{1}{2}\left[P(z,\mu_j,L_j(p)) - P(z,\mu_i,L_j(p)) + P(z,\mu_j,L_i(p)) - P(z,\mu_i,L_i(p))\right]$$

$$(2) \qquad \mathrm{R}_{ij} = \frac{1}{2}\left[P(z,\mu_i,L_j(p)) - P(z,\mu_i,L_i(p)) + P(z,\mu_j,L_j(p)) - P(z,\mu_j,L_i(p))\right]$$

where P is the chosen poverty index, z the poverty line and μ_i the mean income of income distribution $L_i(p)$.

The decomposition can then be expressed as follows:

(3) $\Delta P = G + R$

Muller (2007) further contextualizes poverty decomposition methods within the frame of integral approximation for the decomposition into key drivers of any temporal change of a quantity. He points out that the Shapley-value method for poverty decomposition assumes changes in growth and distribution to be linear over time, AN assumption that seems reasonable as one can reduce the studied period down to what the availability of surveys allows.

All this considered, it seems clear that the Shaply-value method presently provides the most reliable approximation to the decomposition of changes in poverty into growth and redistribution effects.

3.2 Pro-poor growth indices

3.2.1 Kakwani and Pernia's pro-poor growth index

Kakwani and Pernia's approach (2000) is based on a pro-poor growth definition that involves an absorption of growth disproportionately in favour of the poor. The pro-poor growth index in terms of the Shapley decomposition seen earlier is defined as:

(4) $$\phi = \frac{G + R}{G}$$

It assesses the type of growth depending on the values taken by Φ as follows:

$\Phi > 1$	Pro-poor growth
$0 < \varphi < 1$	Trickle down growth
$\varphi < 0$	Pro-nonpoor growth

The authors propose a different definition of the index in case of recession and argue that during a recession the growth rate is negative and so is the growth component of changes in poverty. This misses, however, the fact that even during a period of growth a rapidly expanding population can outweigh the benefits of limited economic expansion and actually see its mean income shrink. Thus, the previous definition should be applied to periods with positive growth in the mean income whereas the following to periods in which per capita income has decreased:

(5) $$\phi = \frac{G}{G + R}$$

and the corresponding classification is:

$\Phi > 1$	Anti-nonpoor recession (mean income reduction)

$\Phi < 1$ Anti-poor recession (mean income reduction)

Kakwani et al. (2003) go further and propose a poverty equivalent growth rate (PEGR) that simultaneously takes into account the magnitude of the total growth rate and the redistribution benefit the poor receive from this growth. It is defined as the growth rate γ^* that would produce the same poverty reduction as the real growth rate γ had the growth process not been accompanied by a change in inequality—that is, had all individuals enjoyed the same proportional benefits from growth. Mathematically:

(6) $$\gamma^* = \phi\gamma$$

where $\Phi\gamma$ is the proportional rate of real poverty reduction.

It is important to note that in order to obtain a PEGR with a consistent meaning, the definition of the Kakwani index Φ to be used must be the one defined for the case of positive growth, regardless whether it is so or not.

3.2.2 Limitations of Kakwani and Pernia's PPG index and PEGR

Undoubtedly, the simplicity and easy interpretation of this index are clear advantages. Particularly as it can be then used to calculate the PEGR. Yet, it presents a series of shortcomings. First, the index is composed of two different definitions in case of expansion or contraction of the mean income over the period under study. This makes it somewhat little comparable with itself as the two formulae measure different things.

Second, and most importantly, the formula defined for periods with growth diverges to infinity as soon as the value of G approaches zero. Note that even big improvements in terms of redistribution would not outweigh the effects in the formula of values of G near to zero. The same applies to the formula proposed for the case of mean income reduction, this time with the asymptote located at $R = -G$, which, again, is a quite common occurrence. This renders the index largely ineffective because slight variations of the components produce enormously different numerical values and thus the potential for comparison, evaluation, and monitoring of ongoing policies remains weak.

Appendix 2 shows other grave operational shortcomings of this index as well as of the PEGR which, added to the limitations exposed in the above render them impractical as general tools for PPG assessment.

3.2.3 Poverty bias of growth

McCulloch and Baulch (1999) define the unadjusted Poverty Bias of Growth (PBG) as the poverty reduction keeping growth distributionally neutral minus the poverty change that actually occurred. That, in fact, coincides with the contribution of redistributional changes in income to changes in poverty, that is, what is represented here by R. They suggest that in order to avoid this magnitude depending on the length of the period during which changes in poverty take place, a more suitable index can be obtained by calculating the PBG as a proportion of the absolute value of the change that would have occurred with distributional neutral growth, i.e. the growth component of the poverty decomposition G:

(7) $$Normalized \quad PBG \quad = \quad \frac{-R}{|G|}$$

These authors rule out dividing the redistributional component R by the number of years of the period under study. They argue that 'this assumes that the reduction in poverty has been uniform between the two dates in question', which the Shapley decomposition they use anyway does. Instead, though, they divide by the absolute value of G, which, again, makes use of the same assumption but without making it explicit. Dividing by the absolute value of G, however, brings us back to a similar problem encountered with Kakwani and Pernia's PPG index, namely the asymptotic behaviour it presents for values of G near zero. Furthermore, they fall short from recognizing the significance the choice of the poverty measure being decomposed has as regards the interpretation of R in terms of pro-poor growth, an issue I shall raise further below.

4 A new pro-poor growth index and rate

Trying to find a PPG index that accounts for both the growth and redistribution components is basically a problem of expressing a two-dimensional magnitude with one scalar, something which is not possible. Dhongde (2005) overcomes this by representing both components within four quadrants and discussing the different possibilities. This, however, does not provide a unique comparable measure of pro-poor growth.

Economic growth is a crucial factor for poverty reduction. However, the redistribution effects of income changes are increasingly taken into account because they have the potential of either strongly fostering or hindering poverty reduction efforts[1]. To conduce to poverty reduction, growth alone is a sufficient but not a necessary condition. The point of looking for a PPG measure lies in the fact that redistributional changes should be taken into account if poverty is to be tackled in a more effective manner, and targets such as those set by the Millennium Development Goals are to be achieved on time. This suggests that an operational PPG index could be exclusively based on the redistributional effects on poverty and later combined with the actual growth rate in the mean income to obtain a measure accounting for both effects. Such an index could be simply based on the redistributional effects on poverty changes, i.e. what is here referred to as R. A PPG index could thus be based on the unadjusted poverty bias of growth:

(8) $$\Phi = -R$$

Note that unlike PBG, Φ is not normalized by the absolute value of G. Also, as it stands, the index is valid for any choice of a general additive poverty measure. By accounting only for changes in the distribution of income, asymptotic problems can be avoided.

The advantages of this choice are multiple, as will be showed further below when a concrete poverty measure is chosen. First, we have a fully comparable index, which

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1 For an excellent discussion on this issue, see UNU-WIDER's: 'Growth, Inequality and Poverty. Prospects for Pro-Poor Economic Development', edited by Shorrocks and van der Hoeven (2005).

does not diverge to infinity every now and then. Second, dividing R by the numbers of years of each period allows for setting, monitoring, and evaluating PPG targets, as we shall see in Section 5**.** Third, it can be easily calculated from income/expenditure surveys. Fourth, the index focuses entirely on how the poor fair in terms of poverty. Fifth, it does not only indicate whether growth has been pro-poor but also by how much it has been so. Sixth, its interpretation is intuitive and therefore potentially useful for policy assessment where there is a need for tools to be easily understandable for policymakers. Finally, it can be linked to the relative definition of pro-poor growth, as we shall see in the following.

Before proceeding to find this link, it is worth discussing the limitations of this index. Particularly, that unlike previous indices, the proposed measure does not provide a value comparable to the growth that would have occurred had changes in poverty been distributionally neutral. It simply provides a measure of how much poverty has varied due to distributional changes, which can then be used to modify the actual growth rate of the mean income to obtain a PPG rate.

Moving on, what follows explains the link between the index proposed for the operationalization of PPG and the definition of what pro-poor growth should be understood to be. As argued earlier, the relative PPG approach seems to be the most pertinent, implying that growth disproportionately benefits the poor. This criterion, however, is not completely specific. Arguably, an intuitively reasonable way to concretize this would be to declare growth pro-poor when the growth rate of the poor is higher than that of the non-poor or, equivalently, than that of the whole population:

(9) $$\gamma_{poor} > \gamma_{meanincome} > \gamma_{nonpoor}$$

A major problem is, however, that since some individuals will most likely make it out of or descend into poverty during this period, one cannot actually define a consistent group of poor. The composition of this group changes over time and it is not possible to simply calculate its growth over a period. Measurements based on the average growth among the poor percentiles compare the initial proportion of poor percentiles to the same proportion of lower income percentiles of the final income distribution, without this necessarily measuring how the poor grew. In order to do that, we should remove the anonymity axiom as Grimm (2007) proposes, but this is rather a tool for policy evaluation since it does not take into account the new poor or those born into poverty and arbitrarily relies on how the initial poor fare. As a complementary tool, however, it provides a useful insight into which groups benefited from growth if panel data were available.

3.2.4 A PPG index linked to the relative approach

A PPG index able to operationalize the relative PPG approach, implying by that a larger growth rate for the poor, shall satisfy two properties, namely that:

(i) it is positive (negative) when the growth rate of the poor is greater (smaller) than that of the non-poor; and

(ii) it is zero when the rates of income growth of these two groups are the same.

I show in the following that by using the poverty gap, this holds for the only case in which the group of the poor is defined: when marginal time periods are considered and neither the population nor the number of poor change. The new index is, however, applicable for the general case and fulfils the above mentioned desirable axioms specified by Duclos (2008) for a pro-poor judgement shown in Appendix 1.

Let us recall here the Foster-Greer-Thorbecke's (1984) class of poverty measures (FGT) defined as follows:

$$P_\alpha = \left(\frac{1}{n}\right)\sum_{i=1}^{n}\left(\frac{z-x_i}{z}\right)^\alpha I(x_i \prec z); \alpha \geq 0 \quad (10)$$

or, infinitesimally:

$$P_\alpha = \int_0^z \left(1-\frac{x}{z}\right)^\alpha f(x)dx; \alpha \geq 0 \quad (11)$$

where y_i is the income of the person i-th, n the population size, z the exogenous poverty line and $I(y_i<z)$ a function that takes value equal to zero for all incomes over the poverty line and 1 for those on or below it. The α parameter is a natural number that allows us to obtain different poverty indices when varying it, thus providing complementary information on the 'shape' poverty has with regards to distribution, i.e. whether the bulk of the poor concentrate just below or far below the poverty line, etc.

Taking α = 0, 1 and 2, we obtain the headcount index (H), the poverty gap (PG) and the poverty gap squared respectively. The headcount determines the proportion of poor people given a known income distribution and a poverty line and is expressed as:

$$H \equiv P_0 = \frac{q}{n} \quad (12)$$

where *q* is the number of persons with an income below *z*.

When $\alpha = 1$ one obtains the poverty gap, which, by including a factor that accounts for the distance of each income to the poverty line, provides an index that shows the *depth* of poverty. Mathematically, the PG is calculated by applying:

$$PG \equiv P_1 = \left(\frac{1}{n}\right)\sum_{i=1}^{n}\left(\frac{z-x_i}{z}\right)I(x_i \prec z) = \frac{1}{n}\sum_{i=1}^{q_i}\left(\frac{z-x_i}{z}\right) \quad (13)$$

Given their widespread use in the literature and graphic capacity to characterize poverty of any income distribution, the operational choice for the PPG index proposed here consists of choosing the redistributional component R of changes in the FGT indices.

Let us first look at whether the R component of changes in the headcount index (R_H) can satisfy properties (i) and (ii). Let us consider a hypothetical income distribution in which the poor are all well below the poverty line. Further consider a situation in which, after a certain period of time, all the poor have increased their income by a certain

amount insufficient to lift any of them out of poverty, whereas the non-poor have experienced no change at all in real terms. In this case, the headcount (H) would not record any change since all the poor have remained so. Despite the fact that this growth is clearly pro-poor in the relative sense, R_H would be zero. We can thus conclude that the redistributional component of changes in the headcount index does not satisfy these two desirable properties and is not directly linked to the difference in growth between the poor and the non-poor. Concretely, this example shows how an income change in which the growth rate of the poor is higher than that of the non-poor does not imply negative values of R_H because the headcount remains unchanged. Indeed, H is not a good index for poverty decomposition because, as Duclos (2008) puts it, the change in a poverty headcount following growth 'hides the variability of the impact of growth among the poor; it also largely depends on the impact of growth on those closest to the poverty line'.

Let us now look at the values of the redistributional component R for changes of the poverty gap. Taking constant prices and a poverty line *z* adapted to inflation, we can rewrite expression (25) in terms of two income distributions given by x_1 and x_2 over a period of time $t = t_2 - t_1$ and with initial and final mean incomes μ_1 and μ_2, respectively:

$$(14) \qquad R_{12} = \frac{1}{2}\left\{\left[P\left(z, \frac{\mu_1}{\mu_2}x_2\right) - P(z, x_1)\right] + \left[P(z, x_2) - P\left(z, \frac{\mu_2}{\mu_1}x_1\right)\right]\right\}$$

The first of the four terms accounts for the value of the poverty measure of the final distribution adjusted to the mean income of the initial one (μ_1). That is, a change in the distribution holding income constant. Inversely, the last term represents the poverty value of the final distribution if there have not been any changes in the 'shape' of the initial income distribution, obtained by shifting the initial distribution upward to meet the mean income of the final one (μ_2). We can then rewrite this expression as:

$$(15) \quad R = \frac{1}{2z}\left[\frac{1}{N_2}\sum_i^{q_2}\left(z - \frac{\mu_1}{\mu_2}x_{2i}\right) - \frac{1}{N_1}\sum_i^{q_1}(z - x_{1i}) + \frac{1}{N_2}\sum_i^{q_2}(z - x_{2i}) - \frac{1}{N_1}\sum_i^{q_1}\left(z - \frac{\mu_2}{\mu_1}x_{1i}\right)\right]$$

where use has been made of the definition of the poverty gap shown in (13). The summatory functions' indices q_1 and q_2 are the number of poor for the initial and final distributions, respectively, while N_1 and N_2 correspond to the total population in these two periods.

By reorganizing the equally indexed summations and factorizing, equation (15) can be written as:

$$(16) \qquad R_{PG} = \frac{1}{2z}\left[\frac{1}{N_2}\sum_i^{q_2}\left(2z - \left(1 + \frac{\mu_1}{\mu_2}\right)x_{2i}\right) - \frac{1}{N_1}\sum_i^{q_1}\left(2z - \left(1 + \frac{\mu_2}{\mu_1}\right)x_{1i}\right)\right]$$

I want to establish a link between the PPG index based on the redistributional component R and the relative PPG criterion defined by the poor growing faster than society's average growth. As said earlier, the main problem in doing this is the inability to establish the group of poor. This can only be done for a marginal time period in

which neither the total population nor the number of poor change. It is shown below that only in this case can the link be established. The index does, however, fulfil the desired intuitive axioms enumerated above for the more general case where changes in population and the number of poor occur.

If the population and the number of poor remain unchanged, $N_1 = N_2 = N$ and $q_1 = q_2 = q$ and the growth in the mean of the poor can be defined as:

$$(17) \qquad g_p \equiv \frac{\sum_i^q x_{2i}}{\sum_i^q x_{1i}} - 1$$

Expression (16) can then be written as:

$$(18) \qquad R_{PG} = \frac{1}{2zN}\left[\sum_i^q \left(\left(1+\frac{\mu_2}{\mu_1}\right)x_{1i} - \left(1+\frac{\mu_1}{\mu_2}\right)x_{2i}\right)\right]$$

Making use of the definition of average growth g over the given period, the mean incomes ratios can be expressed as follows:

$$(19) \qquad \frac{\mu_2}{\mu_1} = 1+g$$

$$(20) \qquad \frac{\mu_1}{\mu_2} = \frac{1}{1+g}$$

Substituting (19) and (20) in expression (18) we obtain:

$$(21) \qquad R_{PG} = \frac{1}{2zN}\left[\sum_i^q \left((2+g)x_{1i} - \left(1+\frac{1}{1+g}\right)x_{2i}\right)\right]$$

Making use of (17), expression (21) can then be written as:

$$(22) \qquad R_{PG} = \frac{1}{2zN}\left[\sum_i^q \left((2+g)x_{1i} - \left(1+\frac{1}{1+g}\right)(1+g_p)x_{1i}\right)\right]$$

Which, by factorizing and rearranging the terms, can be finally expressed as follows:

$$(23) \qquad R_{PG} = \frac{1}{2zN}(g-g_p)\left(1+\frac{1}{1+g}\right)\sum_i^q x_{1i}$$

As can be observed, the sign of R_{PG} will be given by the difference in growth between the poor and the society as a whole. Whenever the growth in the mean of the poor is

higher (lower) than that of the whole society, the redistributional component of changes in the poverty gap is negative (positive), and the new PPG index proposed here $\Phi = -R_{PG}$ is positive (negative), showing growth has been *pro-poor pro-nonpoor*. If all incomes grow at the same rate, R_{PG} equals zero and growth has been pro-poor neutral.

To show this, let us consider the following population of five persons with initial incomes 1 to 5 and poverty line z = 3.5. We then study several possible distributional shifts and the associated values of mean income (μ), growth in the mean (g), growth in the mean of the initial poor (g_p), changes in the poverty gap (ΔPG) and their redistributional (R_{PG}) and growth (G_{PG}) components.[2]

Table 1

Person	Initial	I	II	III	IV	V	VI	VII	VIII	IX
A	1	3	3	2	5	1	2	0	1.2	1.05
B	2	2	2	2	2	2	2	2	2.4	2.1
C	3	3	3	2	3	3	3	3	3.6	3.15
D	4	4	3.5	4	4	3	3	3	4.8	4.2
E	5	5	3.5	5	1	6	5	7	6	5.25
μ	3	3.4	3	3	3	3	3	3	3.6	3.15
g_p		0.33333	0.33333	0	0.66667	0	0.16667	-0.1666	0.2	0.05
g		0.13333	0	0	0	0	0	0	0.2	0.05
$g-g_p$		-0.2	-0.3333	0	-0.6667	0	-0.1667	0.16667	0	0
R_{PG}		-0.0645	-0.1143	0	0	0.0286	-0.0286	0.0857	-0.0114	0.00007
G_{PG}		-0.0497	0	0	0	0	0	0	-0.0514	-0.0172
ΔPG		-0.1143	-0.1143	0	0	0.0286	-0.0286	0.08571	-0.0629	-0.0171

2 See Appendix 3 for an example with a much larger population.

Shift	Description
I	Pro-poor growth in which the PG is reduced through G and R ($R_{PG}<0$)
II	Pro-poor redistributional shift ($R_{PG}<0$)
III	Redistributional shifts among the poor are neutral if the PG remains unchanged ($R_{PG}=0$)
IV	Under anonymity, the exchange of incomes between two individuals is not captured by R_{PG} ($R_{PG}=0$)
V	Pro-nonpoor redistributional shift that causes one individual to fall below the poverty line ($R_{PG}>0$)
VI	Pro-poor redistributional shift that increases the headcount but decreases the poverty gap ($R_{PG} < 0$)
VII	Pro-nonpoor redistributional shift ($R_{PG}>0$)
VIII, IX	Pro-poor neutral growth that increases everyone's income by the same proportion; R_{PG} is close to 0 and it can be seen in IX that it rapidly tends to zero as we enlarge the population and/or decrease the rate of growth ($R_{PG}=0$)[3]

As can be seen in Table 1, the sign of R_{PG} generally coincides with that of the difference between the average growth and the growth in the mean of the initial poor ($g-g_p$). In Columns IV and V, however, this does not seem to hold true. Income shift IV represents, under anonymity, no change at all and thus R_{PG} equals zero. Nonetheless, $g-g_p$ is negative because the growth of the poor has been calculated violating anonymity as it has been taken into account that A's income jumped from one to five while ignoring that E fell from five to one. R_{PG} thus provides a better description since we want anonymity to hold. In case V, g_p has again been calculated as the income growth experienced by the initial poor and does not account for one individual initially non-poor who has fallen into poverty.

In conclusion, the redistributional component of changes in the poverty gap is strictly linked to the relative PPG approach earlier discussed when there is no change in the population or in the number of poor. For the general case, it avoids having to define or choose a changing group of poor and allows maintaining anonymity. R_{PG} is thus a measure with which we can evaluate, measure and interpret the redistributional changes that had an impact on the PG over a given period. Its value indicates the percentage poverty gap change due exclusively to redistributional shifts in the income distribution. Moreover, it satisfies all the desirable axioms proposed by Duclos (2008), including Kakwani and Son's (2006) requisite that it be a monotonic function of poverty reduction.

3 It is shown in Appendix 3 that R_{PG} also equals zero when larger populations experience an equal percentage growth for each individual.

Thus, the proposed PPG index is:

(24) $$\Phi = -R_{PG}$$

If $\Phi > 0$, growth has been pro-poor, and pro-nonpoor when $\Phi < 0$. When it equals zero, the poverty gap did not experience any change due to redistributional shifts, implying that neither the poor nor the non-poor disproportionally benefited from growth.

The choice is of particular interest for the case of many developing countries with limited or nil per capita growth, where poverty reduction efforts should not only depend on growth but also target income redistribution, particularly in highly unequal societies. The PPG index proposed here takes into account the redistribution effect on poverty whereas the growth effect can be accounted for through the growth in mean income. Following earlier literature, a new rate of pro-poor growth combining both contributing factors to poverty reduction can be constructed as:

(25) $$\gamma^{*} = \gamma + \Phi = \gamma - R_{PG}$$

This new PPG rate equals the growth rate of the mean income (γ) plus the PPG index proposed above (Φ), which is nothing but the redistributional component of changes in the poverty gap. Note that while γ accounts for the growth in the mean income of the whole society, R_{PG} focuses on the effects of income redistribution on the poor. Arguably, one could also choose growth in the poor's mean income instead of the γ but it seems more useful to have a rate that captures growth for the whole society, modifying its value on the grounds of how income redistribution has affected the poor in terms of the poverty gap. When redistribution changes in income contribute to decreasing (increasing) the mean distance of the poor to the poverty line, then the PPG rate will show a greater (smaller) value than the actual growth rate in the mean income. Thus, any poverty reduction strategy should pursue the maximization of this new rate of pro-poor growth.

Alternatively, the PPG rate could also be defined including a factor related to society's inequality aversion instead of simply adding R_{PG}:

(26) $$\gamma^{*} = \gamma + \nu\Phi = \gamma - \nu R_{PG}$$

Given the *per se* arbitrary character of choosing a ν, using $\nu = 1$ seems a natural choice and implies that every percentage point change in the poverty gap will produce a percentage point change in the PPG rate. Arguably, one could choose differently depending on the relative value one wants to place on the redistributional character of growth.

5 Pro-poor performance: a tool for evaluation and monitoring

If poverty reduction targets are to be met, it would be useful to resort to a PPG monitoring methodology that could help set targets and evaluate progress, particularly in cases in which lack of or slow growth alone is not likely to facilitate the achievement of such targets within the expected period. Thus, the need for poverty targets that rely

both on economic growth and redistribution so that poor progress on the former can be compensated for by fostering the latter.

5.1 Time-adjusted PPG index

In order to be able to compare the degree of pro-poorness of different periods or countries, we can define the time-adjusted PPG index (Φ_t) as the index for a given period divided by the length of this period in years. Note that this temporal normalization assumes, as McCulloch and Baulch (1999) point out, that the reduction in poverty is uniform during the given period. This does not pose any problem as long as it is used to analyse relatively short periods of time as some of the macroeconomic variables required for the study of any given period, such as GDP, are also annual.

(27) $$\Phi_t = \frac{\Phi}{t}$$

5.2 Time-adjusted PPG evaluation

The PPG evaluation of the period under study can be based on the redistribution achieved in terms of poverty gap reduction compared to the one that would have been needed to completely eliminate the existing PG or to achieve a certain goal (PG_g). Two simple indicators can be used for this evaluation, with the first one being:

(28) $$\xi_E = \frac{\Phi}{\Phi^{EPG}}$$ Poverty gap elimination pro-poor performance

where Φ_t^{EPG} is the annual Φ necessary to lift all poor above the poverty line for the same experienced growth effect. The second one calculates how good the redistributional changes have been in terms of progressing to a given target poverty gap value:

(29) $$\xi_T = \frac{\Phi}{\Phi^{TPG}}$$ Poverty gap target-based pro-poor performance

with Φ_t^{TPG} being the equivalent to Φ_t^{EPG} but for a set poverty gap target different from zero.

As can be seen, the first indicator (28) is a particular case of the second one (29) when the target poverty gap value is zero. Using expressions (4) and (24) the more general Φ_t^{TPG} can be calculated as follows:

(30) $$\Phi_t^{TPG} = PG_i + G_{PG} - PG_g$$

where PG_i is the initial poverty gap, G_{PG} the growth effect contributor to poverty gap changes and PG_g the value of poverty gap set as goal for the given period.

5.3 Target-based future performance trend

It may be of interest to estimate to what extent growth has to be pro-poor in order to achieve a poverty gap reduction goal. For that we need to predict how GDP and population will evolve over a certain future period. Let us consider that either we have an estimation of the GDP growth rate for the whole period or it can be obtained from the compound annual growth estimates (n years):

$$g = g_1(1+g_2)...(1+g_n) = g_1\prod_{i=2}^{n}(1+g_i) \tag{31}$$

Assuming that the growth in the mean income ($\boldsymbol{\gamma}$) is proportional to the ratio GDP to population, we can express γ in terms of the GDP growth rate (**g**) and the relative increase of population over the period (g_{pop}) as:

$$\gamma = \frac{1+g}{1+g_{pop}} - 1 \tag{32}$$

Increasing every individual income by γ, we shift the income distribution to the future in a distributionally neutral manner. Alternatively, and as it is done in the case study that follows, one can also project the growth of the mean income extrapolating it from the trend shown in the last period available.

We can then decompose changes in the poverty gap between the most recent income survey and the distribution obtained by expanding everyone's income by the expected rate of mean income growth up to the chosen future year. This way we can calculate the growth component of the poverty gap reduction (G_{PG}) if incomes increase in a distributionally neutral manner following the mean income growth pattern of the last few years. Having G_{PG} and imposing a final goal value for the poverty gap, we obtain the redistributional component (R_{PG}) needed to achieve the chosen goal within the given period. The target-based PPG index calculated from this R_{PG} (Φ_t^{TPG}) estimates the redistributional change in the poverty gap needed to reach a chosen target value for the PG given certain expectations of economic and populational growth. This, in turn, can be used to evaluate and monitor the trend that the PPG index, and thus redistributional changes, follow in subsequent years in relation to the one that would have led to achieving the target. Note that Φ_t^{TPG} can only be used as a trend because the actual rate of growth is only known *a posteriori* and the evaluation is based on future estimates of growth.

Therefore, the proposed indicator to assess progress in terms of attaining a pro-poor growth that will help achieve a chosen final poverty gap target is given by:

$$\eta = \frac{\Phi_t}{\Phi_t^{TPG}} \tag{33}$$

This poverty gap target-based pro-poor performance trend is defined by the ratio of the annual PPG index observed in a certain period to the annual PPG index necessary to achieve a set PG target in a chosen period provided we have an expectation for

economic and population growth, or, alternatively, for the evolution of the mean income.

The indices presented above help to evaluate progress toward some targets in terms of poverty gap values. The limitation is, however, that poverty targets such as those in the MDGs tend to focus on the headcount index instead. This notwithstanding, working with the PG decomposition enables us to categorize growth as pro-poor in a way which is linked to the relative approach defined by a growth that involves higher rates of growth for the poor than for the non-poor.

6 Case study: Honduras

This section uses Honduras' household surveys[4] income data and the moderate and extreme poverty lines (z) for rural and urban population provided by ECLAC (2002) and adjusted to inflation. National official poverty lines calculated by the INE are not employed since they do not follow inflation and occasional changes in the way they are measured imply that any decomposition of poverty is likely to also capture changes in the poverty lines themselves.

Table 2 shows Honduras' headcount and poverty gap percentage values for selected years between 1992 and 2007:

Table 2

(%) Year	Moderate poverty		Extreme poverty	
	Headcount	Poverty gap	Headcount	Poverty gap
1992	77.24	43.66	52.10	23.14
1994	78.06	46.66	56.56	27.46
1998	74.64	44.14	50.87	25.90
2001	73.90	44.24	51.43	26.84
2004	73.69	45.26	52.59	28.30
2007	71.77	42.99	49.43	26.35

Source: Author's own calculations.

4 The 'Encuesta Permanente de Hogares de Propósitos Múltiples' is carried out twice a year by Hondura's 'Instituto Nacional de Estadística' (INE).

Table 3

(%) Period	Moderate poverty			Extreme poverty		
	R_{PG}	G_{PG}	Δ(PG)	R_{PG}	G_{PG}	Δ(PG)
1992–94	1.49	1.51	3.00	3.04	1.29	4.33
1994–98	0.65	-3.17	-2.52	1.26	-2.83	-1.57
1998–2001	-0.54	0.64	0.10	0.47	0.47	0.94
2001–04	2.61	-1.59	1.02	2.78	-1.32	1.46
2004–07	1.41	-3.67	-2.26	1.06	-3.01	-1.95

Source: Author's own calculations.

The results of decomposing total changes in the poverty gap Δ(PG) for the periods determined by these years provide us with the redistributional component from which we obtain the pro-poor index Φ defined earlier. The decomposition results are presented in Table 3:

Table 4 compares the difference between the mean income growth of the poor minus that of the whole population (poor-society growth difference) to the pro-poor growth index. As mentioned earlier, the poor are not the same group for the initial and final year within a period. Thus, I take the poor to be those below poverty line in the first period, i.e. the initial year headcount index (H_i), and the group composed of the H_i percent poorer population in the final year. If, say, in the initial year 60 per cent of the population are poor, we take their mean income growth to be the increase experienced compared to the 60 per cent poorer population in the second survey, regardless of what the proportion of poor is in the latter.

Table 4

(%) Period	Moderate poverty			Extreme poverty		
	Poor society growth difference	Pro-poor growth index Φ	Ratio	Poor's mean income growth	Pro-poor growth index Φ	Ratio
1992–94	-4.39	-1.49	2.95	-9.88	-3.04	3.25
1994–98	-2.19	-0.65	3.37	-4.32	-1.26	3.42
1998–2001	1.82	0.54	3.40	-1.90	-0.47	4.00
2001–04	-9.04	-2.61	3.47	-11.37	-2.78	4.09
2004–07	-5.54	-1.41	3.94	-4.92	-1.06	4.65

Source: Author's own calculations.

As can be observed from Table 4, the difference between the growth in the mean income of the poor and that of the whole society is strongly correlated to the pro-poor index proposed herein, as shown by the similar values obtained for the ratio. This confirms the suitability of using the redistributional changes in the poverty gap as an indicator of how the poor have fared in terms of mean income as compared to the non-poor or the society as a whole.

Thus, we can categorize the different periods in terms of their pro-poorness as follows (Tables 5 and 6):

Table 5

Moderate poverty

Period	G_{PG}	PPG index Φ	Type of growth
1992–94	1.51	-1.49	Anti-poor reduction in mean income
1994–98	-3.17	-0.65	Pro-nonpoor growth
1998–2001	0.64	0.54	Anti-nonpoor reduction in mean income
2001–04	-1.59	-2.61	Pro-nonpoor growth
2004–07	-3.67	-1.41	Pro-nonpoor growth

Table 6

Extreme poverty

Period	G_{PG}	PPG index Φ	Type of growth
1992–94	1.29	-3.04	Anti-poor reduction in mean income
1994–98	-2.83	-1.26	Pro-nonpoor growth
1998–2001	0.47	-0.47	Anti-poor reduction in mean income
2001–04	-1.32	-2.78	Pro-nonpoor growth
2004–07	-3.01	-1.06	Pro-nonpoor growth

Table 7

Moderate poverty (%)				
Period	PPG index Φ	$\Phi_t = \Phi/t$	ξ_E (PG elimination)	ξ_T (halving 1992's PG)
1992–94	-1.49	-0.58	-3.30	-6.38
1994–98	-0.65	-0.19	-1.50	-3.23
1998–2001	0.54	0.17	1.20	2.36
2001–04	-2.61	-0.87	-6.11	-12.69
2004–07	-1.41	-0.47	-3.38	-7.42

Source: Author's own calculations.

Table 8

Extreme poverty (%)				
Period	PPG index Φ	$\Phi_t = \Phi/t$	ξ_E (PG elimination)	ξ_T (halving 1992's PG)
1992–94	-3.04	-1.18	-12.45	-23.65
1994–98	-1.26	-0.37	-5.13	-11.59
1998–2001	-0.47	-0.15	-1.80	-3.54
2001–04	-2.78	-0.93	-10.90	-22.99
2004–07	-1.06	-0.35	-4.18	-9.49

Source: Author's own calculations.

As regards the time-adjusted PPG Index, evaluation and future performance, the results are shown in Tables 7 and 8.

Table 8 shows that extreme poverty has experienced regressive distributional changes of between 1.8 per cent and 12.4 per cent of the redistribution that would have been needed in order to completely eliminate the poverty gap. In the case of the moderate poor (Table 7), these have only experienced all but one single period of progressive redistributional changes when the annual redistributional component was a mere 1.2 per cent of what would have been needed to lift all poor out of poverty. Since the poverty gap has remained quite stable over the period studied, the PPG evaluation in relation to the goal of halving the PG shows results that approximately double those obtained for the total elimination of the PG. This is the result of the growth component remaining small. Halving the poverty gap would take approximately half the redistributional effort it would take to completely eliminate it.

Finally, the target-based future performance trend is calculated by evaluating the annual redistribution (in terms of poverty gap decomposition contributions) that has taken place in the period 2004–07. This is compared to the one that would have been needed to halve 1992s poverty gap by 2015 if the mean income was to increase following 2001–04s trend:

Table 9

Target-based future performance trend (2015 goal) (η;%)		
Period evaluated	Moderate poverty	Extreme poverty
2004–07	-27.55	-30.22

The results show that the redistribution that took place in the period 2004–07 was both against the moderate and extreme poor and had values of around 30 per cent of those needed to attain the chosen goals of halving 1992's moderate and extreme poverty gaps.

7 Conclusions

The paper has shown a comprehensive review of the concepts and operationalization of PPG found in the literature. Going beyond the methodologies that determine whether growth is pro-poor but not to what extent it is so, it addresses existing PPG indices' shortcomings and proposes a new index and rate of pro-poor growth.

This index is based on the redistributional components of changes in the poverty gap and can be understood as the percentage reduction in the latter measure due to shifts in the distribution of income. Using the relative approach, it provides a measure of the intensity of pro-poorness, something no other previous index does. Moreover, it has been shown that the index is strongly related to whether the poor grow faster than the rest of society or than the non-poor. These properties make it a powerful tool for analysis and, as shown in Section 5, also for monitoring and goal setting, while allowing an intuitively meaningful interpretation potentially useful for policymakers.

The PPG analysis developed here for the case of Honduras shows that in all but one of the spells considered between 1992 and 2007 for moderate and extreme poverty growth was either pro-nonpoor or there was an anti-poor reduction in mean income. That means, in most spells redistributional shifts benefited the non-poor or disproportionally harmed the poor. The policy implication is that if poverty is to be tackled in an effective manner, this consistent trend should be redressed.

Appendix 1: Pro-poor axioms proposed by Duclos (2008)

Given the initial and final income vectors $x_i=(x_{i1},...,x_{in})$ and $x_j=(x_{j1},...,x_{jn})$, respectively, we consider a relative pro-poor change in which the poor experience a relative change in living standards that can be denoted by 1+g. Let us define a pro-poor evaluation function $W(x_i,x_j,g;z)$ as the change in an evaluation function, typically a poverty index, where z is the poverty line:

$$W(xi, x_j, g; z) \equiv P^*(x_j, 1+g; z) - P(x_i; z)$$

The change from income x_i to x_j is pro-poor if $W(x_i,x_j,g;z) \leq 0$

Axiom 1 *Focus on the poor:* Let $x_i' = (\min(x_{i1},z),...,\min(x_{in},z))$. Then $W(x_i,x_j,g;z) = W(x_i',x_j,g;z)$. This assures that the assessment is focused on the poor and their evolution and not on those above the poverty line.

Axiom 2 *Population invariance*: Adding to the initial or final population a replication of itself leaves W unchanged. It allows for changes in the size of population.

Axiom 3 *Population symmetry or anonymity*: Let M be a permutation matrix of dimensions n x n and $x_i' = M\ x_i$. Then $W(x_i,x_j,g;z) = W(x_i',x_j,g;z)$. That is, our measure of pro-poorness remains unaffected if the incomes of any two persons of a given distribution are permuted since we are not concerned on persons but on income levels.

Axiom 4 *Monotonicity*: Let $\alpha > 0$ be a positive constant and let $x_j' = (x_{j1},...,x_{jk}+\alpha,...,x_{jn})$. Then $W(x_i,x_j,g;z) \geq W(x_i,x_j',g;z)$. Related to the Pareto principle, if the income of at least one person increases over the period, W should not increase but, in most cases, fall.

Axiom 5 *Normalization*: $W(x_i,x_j,0;z) = 0$ if there is no distributional change, implying a neutral pro-poor judgement.

Appendix 2: Operational shortcomings of the Kakwani and Pernia's PPG index

Apart from its proneness to diverge to infinity discussed in the text, one can see from the expression (8) that the values of Φ in case of an 'anti-rich per capita recession' fall into two non-contiguous intervals: $(-\infty, 0)$ and $(1, \infty)$. Actually, the first interval is not accounted for in Kakwani and Pernia (2000), where $\Phi < 1$ is considered to be entirely pro-nonpoor. To see this, let us consider a decrease in the mean income, then $G > 0$. If R is positive, i.e. there is an anti-poor change in the distribution, the values of Φ belong to the interval (0, 1) since regardless of the value of R the denominator will always be greater than the numerator. In the case of an anti-rich change with $R < 0$, we obtain values falling in the two intervals mentioned above, $(-\infty, 0)$ and $(1, \infty)$, depending on whether $|R|$ is greater or smaller than $|G|$, respectively.

As regards the PEGR, apart from incorporating Φ and thus the associated limitations described above, it presents an additional disadvantage. Theoretically, the PEGR should 'correct' upward and downward the value of growth in the mean income depending on whether distributional changes in income have had a positive or negative effect on poverty changes, respectively. In the case of mean income growth this works smoothly; it does not, however, when $G > 0$. If the mean income suffers a reduction over the period studied, we have seen that the values of Φ can fall into three intervals, namely: (i) anti-poor recession with $\Phi \in (0, 1)$; (ii) anti-nonpoor recession with $|R| < |G|$ and $\Phi \in (1, \infty)$; and (iii) anti-nonpoor recession with $|R| > |G|$ and $\Phi \in (1, \infty)$. When constructing the PEGR the first two possibilities produce results which do not match the interpretation intended in the definition of this rate.

For the first case, if one multiplies values of Φ greater than 0 and smaller than 1 by the growth rate in the mean income—which is negative for the case of the 'per capita recession' under consideration—we obtain a negative PEGR that is actually smaller in absolute value than the actual rate of growth. In fact, considering that it is a pro-nonpoor recession where the poor are disproportionately harmed, the PEGR should be larger in absolute value than the actual one with both being negative. In terms of interpretation this is clearly wrong. Similarly, if we look at the second case, a pro-poor recession where the distributional component is smaller in absolute value than the growth component, we find that the resulting PEGR is negative and greater in absolute value than the growth rate of the mean income. That is, the PEGR results for these two cases are interchanged.

Appendix 3

Example of the link between relative higher growth for the poor and the redistributional component of changes in the poverty gap for a population of 10,000 individuals. It can be seen that the sign of R_{PG}, and thus of the PPG index Φ, are consistent with that of the growth difference between the poor and the non-poor.

Z = 6000€ Initial distribution	Final distribution income increases	Growth comparison	Value of R_{PG}	Type of growth
- 6000 persons with an income of 2000€ and,	Poor: +300 Nonpoor: +2000	$g_{poor} < g_{nonpoor}$	0.01	Pro-nonpoor
- 4000 persons with 9000€	Poor: +600 Nonpoor: +2000	$g_{poor} > g_{nonpoor}$	-0.01	Pro-poor
	Everyone: +1000 increase	$g_{poor} > g_{nonpoor}$	-0.14	Pro-poor
	Everyone: 10% increase	$g_{poor} = g_{nonpoor}$	0	Neutral

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