Intertemporal Pro-poorness

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Abstract

A long-lasting debate in the scientific and policy arenas addresses the impact of growth on distribution. A specific branch of the micro-oriented literature, known as 'pro-poor growth', seeks in particular to understand the impact of growth on poverty. Much of that literature supposes that the distributional impact must be measured in an anonymous fashion. The income dynamics and mobility impacts of growth are thus ignored. The paper extends this framework in two important manners. First, the paper uses an 'intertemporal pro-poorness' formulation that accounts for the growth impacts captured separately by anonymity and mobility. Second, the paper's treatment of mobility encompasses both the benefit of"mobility as equalizer" and the variability cost of transient poverty. Several decompositions are proposed to measure the impact of each of these aspects of growth on the pro-poorness of distributional changes. The framework is applied to panel data on 23 European countries drawn from the 'European Union Statistics on Income and Living Conditions' (EU-SILC) survey.

Keywords: pro-poorness, income mobility, growth, poverty dynamics.

JEL codes:

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1 Introduction

A long-lasting interest in economics, both at a micro- and at a macro-economic level, concerns the dynamic relationship between growth and distribution. There is, in particular, a specific branch of the micro-oriented literature, known as 'pro-poor growth', that is gaining renewed and increasing attention among theoretical and empirical analysts. Its main objective is to consider the extent to which poverty changes over time because of growth. A number of different analytical tools have been developed in the pro-poor growth literature to quantify this effect (see, *inter alia*, Ravallion and Chen, 2003, Son, 2004, Duclos, 2009, Essama-Nssah, 2005, Essama-Nssah and Lambert, 2009).

A common feature of these tools is that the identity of the income recipients is irrelevant to the aim of this analysis, that is they satisfy 'anonymity'. Anonymity is a standard property for the measurement of poverty and inequality, requiring that the index be invariant to a permutation of the individual income vector. This is an uncontroversial assumption and is perfectly agreeable if the aim is the understanding of the pure cross-sectional effect of growth. On the other hand, postulating individual anonymity implies that these tools ignore individual income dynamics, that is they ignore the mobility experience that can take place within the overall growth process.

To see this, consider the following two transformation processes A and B undergone by a distribution of income of four individuals:

$$(4,6,9,9) \underset{A}{\rightarrow} (9,9,4,6), \tag{1}$$

$$(4,6,9,9) \underset{B}{\rightarrow} (4,6,9,9), \tag{2}$$

and assume that the poverty line is fixed to 7 in both periods. A common procedure to evaluate the pro-poorness of an income transformation is to compute the Rate of Pro-Poor Growth (RPPG, Ravallion and Chen, 2003),[1] which would be equal to 0 for growth process A as the final marginal distribution of income is strictly identical to the initial marginal distribution. This is true if we restrict our attention to aggregate poverty in each single period of time. However, as soon as we shift our attention to the variation of each individual poverty as consequence of this income dynamic, the RPPG does not appear anymore to be a useful instrument to assess the pro-poorness of this process.[2] Moreover,

[1] The RPPG is equivalent to the variation of the Watts index of poverty between the two periods, divided by the initial headcount ratio as shown by Ravallion and Chen (2003).

[2] For the sake of brevity we focus only on one measure of pro-poor growth. We choose the RPPG because it is the most commonly used indicator, however the main intuition would not

the RPPG would be still equal to 0 if the same initial distribution undergoes the alternative transformation process B. Hence it would evaluate equally two income dynamics otherwise different.

Building on this criticism, recent contributions have argued that welfare relevant judgments of the effect of growth should be based on analysis endorsing a 'non-anonymous' perspective (see notably Grimm, 2007, Jenkins and Van Kerm, 2011, Bourguignon, 2011, **?**, Palmisano and Peragine, forthcoming). Proponents of this new approach stress the link between the overall growth process and the mobility experience that is generated. In so doing, they recognize the role played by mobility in the characterization of the distributional aspect of growth, implying that when one aims at evaluating the pro-poorness of a growth process, one should also account for the role of mobility: a very unexplored land. In fact, while both the measurement of pro-poor growth and the measurement of mobility are quite developed (see Fields and Ok, 1999, Fields, 2008, Jäntti and Jenkins, forthcoming), the analysis of distributional impact of mobility, in particular the analysis of the impact of mobility on poverty, is still on its infancy.

There are two issues that mainly distinguish the analysis of intertemporal pro-poorness we propose here from the standard analysis of pro-poor growth.

First, the assessment of the pro-poorness feature of growth means that we are concerned with how a particular aspect, defining the economic conditions of the poor (poverty/ill-fare or welfare), evolves through the effect of growth. Given that the evaluation of individual (or non-anonymous) growth implies looking at the individual income trajectory over time, it is natural to infer that the evaluation of the impact of growth on poverty implies looking at the individual poverty trajectory over time. Hence, while the pro-poor growth analysis traditionally builds upon the comparison of aggregate cross-sectional poverty between two periods of time, the pro-poor growth analysis cannot prescind from looking at intertemporal (or lifetime) poverty. This, in turns, implies that one needs to depart from the standard unitemporal and focus on a multitemporal perspective.

Second, this analysis involves the choice of the specific meaning of mobility to be used in our measurement model. Consistently, with this interpretation, since Friedman's contribution in 1962 (Friedman 1962), it has been convincingly argued that income mobility has at least two potential effects on social welfare. It generally helps to equalize the distribution of permanent incomes as compared to the distribution of periodic incomes (i.e. cross-sectional incomes), thus increasing social welfare. It also generates variability at the individual level, because of the

change if we were to use other indicators of pro-poor growth (for instance the indexes proposed by Kakwani and Pernia, 2000, **?**).

time variability of individual incomes that mobility induces, thus reducing social welfare if individuals are risk averse.

When is growth pro-poor? The answer is constructed by comparing actual intertemporal ill-fare (or intertemporal poverty) with a benchmark, representing the extent of intertemporal poverty that would arise in the absence of any kind of distributional change. In our case this naturally leads to the use of the poverty experience in the first period as the proper benchmark for our analysis.

As concerned the second issue, we let us being inspired by Bibi, Duclos, and Araar (2014) who have recently put forth some formal insights in that direction. They propose a model to evaluate the welfare implication of mobility, which is able to account for both the cost of inequality across time and across individuals. However, while their model focuses on the inequality and welfare implication of mobility, it is silent on the impact of growth and mobility on poverty (see also Gottschalk and Spolaore, 2002, Creedy and Wilhelm, 2002, Makdissi and Wodon, 2003).

Hence, we propose a pro-poor mobility measurement framework which builds on an explicit ill-fare function able to account for both the costs and the benefits of mobility across time and across individuals. This function turns out to be equivalent to the poverty counterpart of the 'equally distributed equivalent income' (see Atkinson, 1970).

We further explore the multiple pro-poorness features of growth through a set of three additive decompositions of our index. In particular, the first decomposition will be aimed at disentangling the impact of anonymous growth from the non-anonymous (or mobility) one. The second decomposition will be aimed at separating the unitemporal effects of an income transformation process from the multitemporal one. The last decomposition will be aimed at adding to the standard distinction between anonymous and non-anonymous growth, which can be mainly classified as structural mobility, the effect on poverty generated by the exchange component of mobility.

Note that this paper's approach is not only methodologically but, most importantly, conceptually different from previous contributions assessing the impact of growth on poverty proposed by Grimm (2007) and Foster and Rothbaum (2012).[3] A weakness these measures have in common is that they stick to the unitemporal non-anonymous perspective. For instance, Grimm (2007) proposes the Individual Rate of Pro-Poor Growth (IRPPG) which, being equivalent to the average income growth of the initially poor individuals divided by the initial

[3] See also **?** for a partial ordering approach.

headcount ratio, specifically focuses on the initially poor, while it ignores the (negative) income dynamic of those who fall into poverty after growth. Thus, although justifiable on a Rawlsian ground, it provides an incomplete picture of the true impact of growth on poverty.

To see this, consider the example introduced above. The non-anonymous counterpart of the RPPG, the IRPPG, is positive and equal to 0.36 for the first process, while it is equal to 0 for the second process. Hence, differently from the RPPG, the IRPPG does not evaluate the two processes equally. Its positive value reveals the poverty-alleviating impact of the upward mobility experienced by some individuals. By contrast, it does not capture the poverty-generating effect of the downward mobility experienced by some others.[4] This happens because this index is derived within a purely non-anonymous and unitemporal framework. Foster and Rothbaum (2012), instead, use cutoff-based mobility measures to explain variations of poverty over time. However their method only applies to two specific indexes measuring transient poverty.

Thus the contribution of this paper is twofold. The first is that we enhance the 'pro-poor growth' literature by accounting for the impact of an income transformation process on intertemporal poverty and, in so doing, we are also able to disentangle the impact of anonymous growth from impact of mobility (or non-anonymous growth). The second is that we extend the "mobility as equalizer" framework to take into account the impact of mobility on poverty, corrected for the cost of the variability in transient poverty and the cost of inequality in the distribution of intertemporal poverty.

The rest of the paper is organized as follows. Section 2 introduces a framework to analyze the impact of growth on poverty. Section 3 proposes an index of intertemporal pro-poorness. Section 4 presents a set of decompositions of the index proposed. An empirical illustration of this framework is contained in Section 5. Section 6 concludes.

2 General measurement of pro-poorness in an intertemporal setting

Assume that we are interested in the dynamics of a distribution of living standards (incomes, for short) and ill-fare of $n \in \mathfrak{N}$ individuals, with generic

[4]To account for it the same Grimm (2007) proposes a decomposition of the Watts index of poverty. However this is provided only empirically. Furthermore, because this decomposition is based on the comparison of transient poverty before and after growth, intertemporal features are again neglected.

individual $i = 1, ..., n$ over T fixed time periods (annual or monthly for instance) of their life, with each generic period denoted by $t = 1, ..., T$. We assume T to be common to all individuals, *viz*, we are comparing people's lives over comparable time periods.

We assume periodic income $y_{i,t}$ to be drawn from the set of non-negative real numbers $\Re_+$. Let $\boldsymbol{y}_{(i)} := (y_{i,1}, \ldots, y_{i,t}, ..., y_{i,T})$ be the vector of individual i's incomes across T periods and $\boldsymbol{y}_t$ is a cross-sectional vector of incomes at time t. The income profiles $\boldsymbol{y}_i$ is the ith row of the $n \times T$ matrix $\boldsymbol{Y} \in \boldsymbol{\Omega}^n$, where $\boldsymbol{\Omega}^n$ is the set of all $n \times T$ matrices whose entries are non-negative real numbers. Denote by z the poverty line and by $\tilde{y}_{i,t} := \min(y_{i,t}, z)$ the periodic income censored at the poverty line.[5] Over an individual's lifetime, poverty is measured by $p\big(\boldsymbol{y}_{(i)}, z\big)$ with $p\big(\boldsymbol{y}_{(i)}, z\big) \geq 0$ whenever $\exists t \in \{1, \ldots, T\}$ such that $y_{i,t} < z$ and $p\big(\boldsymbol{y}_{(i)}, z\big) = 0$ otherwise.[6] Total intertemporal poverty is measured by the index $P(\boldsymbol{Y}, z)$.

In the traditional context of snapshot poverty analyses, testing the pro-poorness of a growth process implies comparing the observed final poverty level with the one that would have been observed for the same period under some given counterfactual scenario (Duclos, 2009). However, one can think about different alternatives for this counterfactual scenario with decisive implications regarding the outcome of the test for a given growth spell. As a consequence, it is first necessary to specify our benchmark scenario, which we denote by $\hat{\boldsymbol{Y}}$ and which represents an hypothetical structure characterized by the absence of distributional changes.

Our specific concept of pro-poor growth is based on ill-fare comparisons of the actual income structure $\boldsymbol{Y}$ with a benchmark structure $\hat{\boldsymbol{Y}}$ characterized by the absence of distributional changes, and is summarized by the following crucial *intertemporal pro-poorness evaluation function* $IPP\big(P(\hat{\boldsymbol{Y}}, z), P(\boldsymbol{Y}, z)\big)$, where $P(\hat{\boldsymbol{Y}}, z)$ is a measure of the benchmark ill-fare. This function tells us whether ill-fare is higher or lower in the actual income structure as compared to the benchmark and it is assumed to satisfy a set of very basic and standard properties.[7] They are, $\forall \boldsymbol{Y}, \boldsymbol{Y}', \hat{\boldsymbol{Y}}, \hat{\boldsymbol{Y}}' \in \boldsymbol{\Omega}^n$:

- *Pro-poor*: $P(\hat{\boldsymbol{Y}}, z) > P(\boldsymbol{Y}, z) \Rightarrow IPP\big(P(\hat{\boldsymbol{Y}}, z)), P(\boldsymbol{Y}, z)\big) > 0$;

[5] Hence we are considering poverty lines that are fixed over time, this is consistent with the absolute approach to the measurement of poverty. However, note that, by considering distributions of income normalized at the poverty line, our framework can be consistent with poverty lines changing over time.

[6] As indicated later in the text, these restriction means that a union approach is consequently used in the present paper for the definition of the poverty domain.

[7] These properties are already existing in the literature but they have been applied on a different domain. For instance, Fields (2010) uses them to propose a mobility index as an equalizer of income over time.

- *Anti-poor*: $P(\hat{\boldsymbol{Y}}, z) < P(\boldsymbol{Y}, z) \Rightarrow IPP\big(P(\hat{\boldsymbol{Y}}, z), P(\boldsymbol{Y}, z)\big) < 0$;
- *More Pro-poor*:
  - Assuming $\boldsymbol{Y}$ and $\boldsymbol{Y}' \in \boldsymbol{Y}$ are two alternative actual structures, $P(\boldsymbol{Y}, z) < P(\boldsymbol{Y}', z) \leq P(\hat{\boldsymbol{Y}}, z) \Rightarrow IPP(P(\hat{\boldsymbol{Y}}, z), P(\boldsymbol{Y}, z)) > IPP(P(\hat{\boldsymbol{Y}}, z), P(\boldsymbol{Y}', z))$;
  - Assuming $\hat{\boldsymbol{Y}}$ and $\hat{\boldsymbol{Y}}' \in \hat{\boldsymbol{Y}}$ are two alternative benchmark structures, $P(\hat{\boldsymbol{Y}}, z) > P(\hat{\boldsymbol{Y}}', z) \geq P(\boldsymbol{Y}, z) \Rightarrow IPP(P(\hat{\boldsymbol{Y}}, z), P(\boldsymbol{Y}, z)) > IPP(P(\hat{\boldsymbol{Y}}', z), P(\boldsymbol{Y}, z))$;
- *More Anti-poor*:
  - Let $\boldsymbol{Y}$ and $\boldsymbol{Y}' \in \boldsymbol{Y}$ be two alternative actual structures and $\hat{\boldsymbol{Y}} \in \boldsymbol{\Omega}^n$ the benchmark structure: $P(\boldsymbol{Y}, z) > P(\boldsymbol{Y}', z) \geq P(\hat{\boldsymbol{Y}}, z) \Rightarrow IPP\big(P(\hat{\boldsymbol{Y}}, z), P(\boldsymbol{Y}, z)\big) < IPP\big(P(\hat{\boldsymbol{Y}}, z), P(\boldsymbol{Y}', z)\big)$;
  - Let $\hat{\boldsymbol{Y}}$ and $\hat{\boldsymbol{Y}}' \in \hat{\boldsymbol{Y}}$ be two alternative benchmark structures and $\boldsymbol{Y} \in \boldsymbol{\Omega}^n$ the actual structure: $P(\hat{\boldsymbol{Y}}, z) < P(\hat{\boldsymbol{Y}}', z) \leq P(\boldsymbol{Y}, z) \Rightarrow IPP\big(P(\hat{\boldsymbol{Y}}, z), P(\boldsymbol{Y}, z)\big) < IPP\big(P(\hat{\boldsymbol{Y}}', z), P(\boldsymbol{Y}, z)\big)$;

That is, we require that a measure of pro-poor growth be decreasing in the ill-fare of the actual income structure, increasing in the ill-fare of the benchmark structure and equal to zero if there is no difference between poverty in the actual and benchmark situation. A broad class of measures would be consistent with these requirements. In order to define our measure we need to further specify the relationship between the two arguments of the intertemporal pro-poorness function, the benchmark structure and the poverty measure to be used. The first two points will be discussed in the next paragraphs, the third being lengthily addressed in section 3.

As for the first issue, we propose the difference between intertemporal poverty according to the benchmark structure and intertemporal poverty according to the actual income structure, that is:[8]

$$IPP := P(\hat{\boldsymbol{Y}}, z) - P(\boldsymbol{Y}, z). \tag{4}$$

It can easily be checked that (**??**) fulfils the basic structure that we impose for our intertemporal pro-poorness evaluation function. As expected this index

[8]Though we focus on the absolute index IPP in the present paper, it is worth noting that researchers may prefer its relative counterpart IPP^r, that is:

$$IPP^r := 1 - \frac{P(\boldsymbol{Y}, z)}{P(\hat{\boldsymbol{Y}}, z)}. \tag{3}$$

is equal to 0 when growth is not characterized by pro-poorness features, that is it does not have any effect on intertemporal poverty with respect to the benchmark situation. It is positive if it alleviates intertemporal poverty; it is, instead, negative if it acts by increasing intertemporal poverty.

As far as the second issue is concerned, we argue that the absence of any distributional change implies the preservation of the *status quo* of the population. Therefore, the benchmark used in this paper is based on a hypothetical income structure $\boldsymbol{Y}_1 \in \boldsymbol{\Omega}^n$ in which every period's income distribution is the same as the first period's.[9] Consequently, the benchmark scenario assumes each individual income profile to be perfectly flat. A comparison between poverty in the actual income structure and poverty in the benchmark case measures the extent of the intertemporal impact of growth on poverty because the benchmark is obtained as a sequence of incomes that results in the case of distributional immutability, given the first period distribution.[10] Our choice can be motivated by the possibility to further disentangle the effects of pure neutral growth from redistribution.

In fact, if we require in our framework that intertemporal poverty in the absence of distributional changes be equivalent to the poverty experienced in the initial period, that is, $P(\hat{\boldsymbol{Y}}, z) = P(\boldsymbol{Y}_1, z) = P(\boldsymbol{y}_1, z)$, an additional interpretation of this index is that it captures the extent of poverty variation, when the accounting horizon is extended, with respect to the poverty experienced in the first period.[11] It deserves to be stressed that the assumption is customary in the literature related to intertemporal poverty measurement so that this last interpretation of the index IPP can be used with the index suggested in the next section as well as with the majority of existing intertemporal indices P.

[9] This is consistent with the approach proposed by Chakravarty, Dutta, and Weymark (1985) and Fields (2010).

[10] See on this (Chakravarty et al., 1985, page 4). However, the benchmark in Chakravarty et al. (1985) is based on the hypothesis of relative immobility, *i.e.* the share of each individual in total income is assumed to remain stable during the whole period, while our benchmark scenario draw on absolute immobility, *i.e.* each individual's income remains stable during the whole period. So, while the concept of mobility in Chakravarty et al. (1985) is close to the relative view of growth pro-poorness later supported by Kakwani and Pernia (2000), our view relates to the one suggested in Ravallion and Chen (2003). As shown in section 4

[11] This property is called normalization in Hoy and Zheng (2011). A weaker assumption is the one-period equivalence axiom in Bossert, Chakravarty, and d'Ambrosio (2012) that states that, in degenerate cases where $T = 1$, intertemporal poverty should coincide with snapshot poverty.

3 A family of intertemporal pro-poorness indices

3.1 Individual ill-fare

Let the normalized poverty gap be given by $g_{i,t} := \frac{z-\tilde{y}_{i,t}}{z}$.[12] Then, let $\boldsymbol{g}_{(i)} := (g_{i,1}, \ldots, g_{i,t}, ..., g_{i,T})$ be the corresponding vector of normalized poverty gaps for individual i across T periods and $\boldsymbol{G}$ the corresponding $n \times T$ matrix of normalized poverty gaps for the whole population where $\boldsymbol{g}(i)$ is the ith row of $\boldsymbol{G}$. Finally, the periodic marginal distribution of relative income shortfall at time t is given by the vector $\boldsymbol{g}_t := (g_{1,t}, \ldots, g_{n,t})$. The relative gap $g_{i,t}$ is a standard measure of individual poverty in the literature for both snapshot and intertemporal poverty measurement. It is, for instance, at the base of the well-known class of the FGT (Foster, Greer, and Thorbecke, 1984) additively decomposable poverty indices as well as of its intertemporal generalizations like Foster (2009), Canto, Gradìn, and del Rio (2012) or Busetta and Mendola (2012), not to mention specific members of the family of indices introduced by Hoy and Zheng (2011), Bossert et al. (2012) and Dutta, Roope, and Zank (2013). Using normalized gaps and assuming that transient poverty induces social costs, the poverty level of each individual i, over the T periods, and thus over the vector $\boldsymbol{g}_{(i)}$, can be measured by:

$$p_\beta\left(\boldsymbol{y}_{(i)}, z\right) := \sum_{t=1}^{T} \omega_t g_{i,t}^{\beta} \qquad \text{with } \beta \geq 1, \tag{5}$$

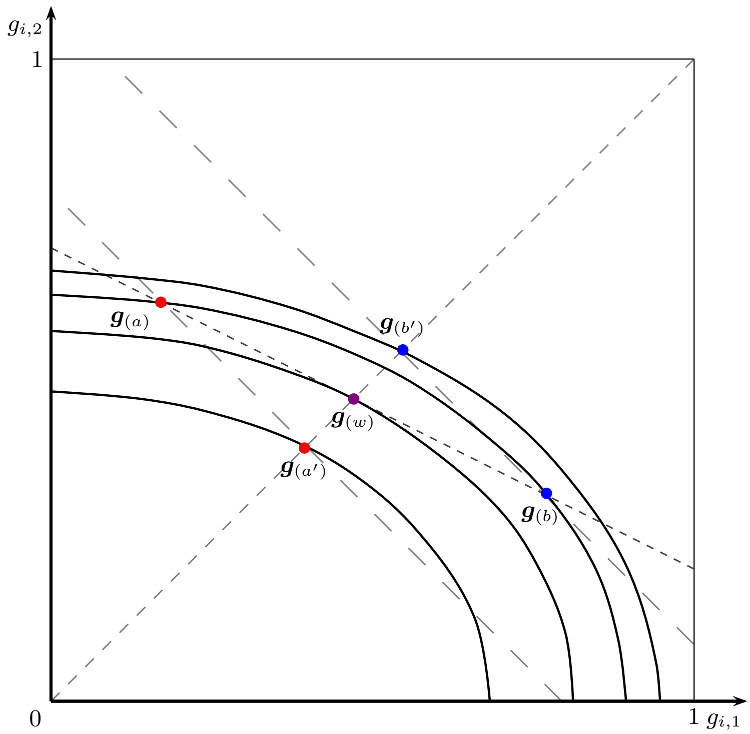
where ω_t is a weighting function that captures the sensitivity of an individual with respect to the specific period in which the deprivation is experienced and that satisfies $\sum_{t=1}^{T} \omega_t = 1$. If $\omega_t > \omega_{t+1}$ more importance is given to the poverty experienced earlier in life, for instance in her childhood; if $\omega_t < \omega_{t+1}$ more importance is given to the poverty experienced later in life.[13] Parameter β, which captures the intensity of periodic poverty, can be interpreted as a measure of aversion to inequality and variability in the normalized poverty gaps, hence as a measure of aversion to transient poverty. Higher levels of β give higher

[12] Using relative gaps is a standard practice for poverty measurement that guarantee that poverty orderings are not affected by change in income measurement units. However, it deserves to be noted that this choice is not neutral from a normative point of view (Zheng, 2007). For instance, poverty gaps can alternatively be measured using absolute gaps $g^a_{i,t} := z - \tilde{y}_{i,t}$ that are the basis of absolute poverty indices (Chakravarty, 1983).

[13] Note that this specification makes our framework consistent with a new branch of the literature that emphasizes the early aspects of the pattern of lifetime poverty. In fact, (5) can be considered a specific version of the lifetime individual poverty measure introduced by Hoy and Zheng (2011). See also **?**.

weight to a loss of income when income is already low than when it is large. For $\beta = 1$, (5) corresponds to the simple weighted average of the individual i's poverty gaps across time, but it is not sensitive to transfers that equalize poverty gaps from one period to the other. For $\beta > 1$, instead, a sequence of income increments and decrements that keep the weighted mean unchanged but reduces the intertemporal variability of poverty gaps, decreases $p_\beta\left(\boldsymbol{y}_{(i)}, z\right)$, thus making the index 'transitory poverty' or 'variability' sensitivity. It can, then, be inferred that income variability induced by mobility generates poverty that is transitory, thus inequality across the periodic ill-fare status of each individual. Finally, the measure adopts a "union" view for poverty identification since individuals are regarded as poor whenever they are deprived at least one time during the whole period.

Figure 1: Intertemporal progressive transfer and individual poverty level changes.



Note: The iso-poverty contours corresponds to the case $\beta = 2$, $\omega_1 = \frac{1}{3}$, and $\omega_2 = \frac{2}{3}$.

It is important to stress that in the case $\exists t \in \{1, \ldots, T\}$ such that $\omega_t \neq \frac{1}{T}$, intertemporal progressive transfers do not necessarily result in a decrease of $p_\beta\left(\boldsymbol{y}_{(i)}, z\right)$ since the transfer is likely to raise the weighted average individual income shortfall. Figure 1 illustrates the issue in the two-period case with two income gap profiles $\boldsymbol{g}_{(a)}$ and $\boldsymbol{g}_{(b)}$ that show the same weighted mean income shortfall represented by $\boldsymbol{g}_{(w)}$. It is important to have in mind that since we are using income shortfalls, moving towards the origin is associated with an increase in well-being and the non-poverty domain corresponds to the origin. In the case of individual a, a progressive intertemporal transfer from the second to the first period that cancels out intertemporal variability (profile $\boldsymbol{g}_{(a')}$) results in a decrease of individual poverty since weights are chosen to reflect loss-aversion. However, considering the income shortfall profile $\boldsymbol{g}_{(b)}$, it can be seen that the effect of the progressive transfer can be decomposed in two opposite effects that result in a worsening of poverty. Indeed, canceling out the effect of variability, *i.e.* moving from profile $\boldsymbol{g}_{(b)}$ to profile $\boldsymbol{g}_{(w)}$, decreases poverty, but the pure effect of the change in the weighted average income shortfall, *i.e.* moving from profile $\boldsymbol{g}_{(w)}$ to $\boldsymbol{g}_{(b')}$, contributes to the increase of b's poverty level as the worsening in the second-period income shortfall is not fully compensated from a well-being point of view by the alleviation of the first-period income shortfall that is given a lower weight by the social evaluator. It can easily be checked that intertemporal progressive transfers never make individuals worse off in the specific case $\omega_t = \frac{1}{T}$ $\forall t \in \{1, \ldots, T\}$.

In order to obtain a useful measure of poverty which explicitly accounts for time variability, we use the poverty counterpart of the 'equally distributed equivalent income' in Atkinson (1970) for the measurement of social welfare and inequality. In our context, the equally distributed equivalent (EDE) poverty gap for individual i, $\pi_\beta\left(\boldsymbol{g}_{(i)}\right)$, is given by:

$$\pi_\beta\left(\boldsymbol{g}_{(i)}\right) := p_\beta^{-1}\left(p_\beta\left(\boldsymbol{y}_{(i)}, z\right)\right) = \left(\sum_{t=1}^{T} \omega_t g_{i,t}^{\beta}\right)^{\frac{1}{\beta}}. \tag{6}$$

The EDE gap $\pi_\beta\left(\boldsymbol{g}_{(i)}\right)$ is the value of ill-fare that, if experienced by individual i at each period of his lifetime, would yield him the same average poverty over time as that generated by the distribution of his periodic poverty. For $\beta = 1$, $\pi_\beta\left(\boldsymbol{g}_{(i)}\right)$ equals the simple weighted average of the individual poverty gaps over time, that is $\pi_1\left(\boldsymbol{g}_{(i)}\right) = \sum_{t=1}^{T} \omega_t g_{i,t}$. For $\beta \geq 1$, $\pi_\beta\left(\boldsymbol{g}_{(i)}\right)$ is never lower than $\pi_1\left(\boldsymbol{g}_{(i)}\right)$ because of the individual's aversion to transient poverty, for a given sensitivity to early/late poverty. Their difference can be interpreted as the cost of transient poverty for individual i:

$$c_\beta(\boldsymbol{g}_{(i)}) := \pi_\beta\left(\boldsymbol{g}_{(i)}\right) - \pi_1\left(\boldsymbol{g}_{(i)}\right). \tag{7}$$

Consequently an individual intertemporal ill-fare status can be expressed as:

$$\pi_\beta\left(\boldsymbol{g}_{(i)}\right) = c_\beta(\boldsymbol{g}_{(i)}) + \pi_1\left(\boldsymbol{g}_{(i)}\right) \tag{8}$$

That is, for a given individual, intertemporal poverty can be decomposed into the costs of transient poverty and her weighted average deprivation over time, respectively represented by $c_\beta(\boldsymbol{g}_{(i)})$ and $\pi_1\left(\boldsymbol{g}_{(i)}\right)$. Furthermore, it says that the individual i would be willing to increase by a maximum value $c_\beta(\boldsymbol{g}_{(i)})$ her (weighted) average income shortfall to remove variability in her ill-fare status. Note that $c_\beta(\boldsymbol{g}_{(i)}) = 0$ if income relative to the poverty line does not vary over time. Hence, $\pi_\beta\left(\boldsymbol{g}_{(i)}\right)$ represents a measure of individuals' intertemporal ill-fare, corrected for the part of transitory poverty generated by mobility, that is, the individual intertemporal poverty increased by the cost of mobility. In the absence of distributional transformations individual intertemporal poverty will be equivalent to $\pi_\beta\left(\boldsymbol{g}_{(i)}\right) = \pi_1\left(\boldsymbol{g}_{(i)}\right)$.

The discussion above shows that mobility may have an individual cost: it can contribute to create transitory poverty experience, and thus it can worsen the ill-fare of individuals in a society. How much the individual is willing to increase her average poverty in order to compensate transitory poverty will clearly depend on the specific value given to the parameter β.

3.2 Social ill-fare

We then use again the FGT additively decomposable procedure to aggregate individuals' $\pi_\beta\left(\boldsymbol{g}_{(i)}\right)$ in order to obtain a measure of intertemporal social ill-fare corrected for the cost of transient poverty, as follows:[14,15]

$$P_{\alpha,\beta}\left(\boldsymbol{Y}, z\right) := \frac{1}{n}\sum_{i=1}^{n}\left(\pi_\beta\left(\boldsymbol{g}_{(i)}\right)\right)^\alpha, \tag{9}$$

where $\alpha \geq 1$ is a parameter of poverty aversion across individuals. In order to obtain an aggregate measure of intertemporal poverty sensitive to the equaliza-

[14] The measure corresponds to the index P_α^θ proposed by Bourguignon and Chakravarty (2003) in the context of multidimensional poverty measurement.

[15] Our poverty measurement framework is similar to the framework outlined in Duclos, Araar, and Giles (2010) to decompose total poverty into transient and chronic poverty. The main difference is represented by the concern toward aversion to poverty variability over time and aversion to poverty inequality between individuals. In fact, while in Duclos et al. (2010) the same parameter is used to measure both kinds of aversion, that is $\alpha = \beta$, in this paper two different parameters will be used. Moreover, Duclos et al. (2010) assume $\omega_t = \frac{1}{T}$ $\forall t \in \{1, \ldots, T\}$. See also Clark, Hemming, and Ulph (1981), Chakravarty (1983), Canto et al. (2012), Hoy, Thompson, and Zheng (2012).

tion effect of mobility, we use again the EDE methodology, obtaining the EDE in the population, $\Pi_{\alpha,\beta}(\boldsymbol{G})$, representing our measure of social intertemporal poverty:

$$\Pi_{\alpha,\beta}(\boldsymbol{G}) := \left(\frac{1}{n}\sum_{i=1}^{n}\left(\pi_{\beta}\left(\boldsymbol{g}_{(i)}\right)\right)^{\alpha}\right)^{\frac{1}{\alpha}}. \tag{10}$$

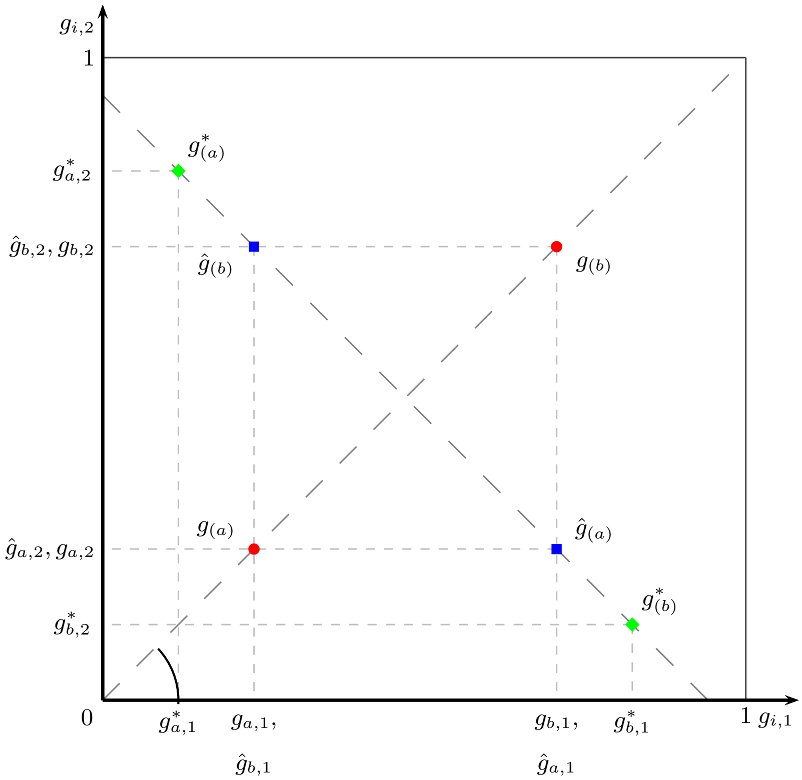
Although the indices $P_{\alpha,\beta}$ and $\Pi_{\alpha,\beta}$ are ordinally equivalent and so can be used indifferently for comparing any pair of distributions, we prefer the last index since it has a simple and appealing interpretation.[16] Indeed, the index $\Pi_{\alpha,\beta}(\boldsymbol{G})$ is the level of intertemporal ill-fare which, if assigned equally to all individuals and across all time periods, would produce the same poverty level as that generated by the intertemporal distribution $\boldsymbol{G}$. It thus can be seen as an intertemporal generalization of the class of ethical poverty indices introduced by Chakravarty (1983) for snapshot monetary poverty. The index aggregate across individuals' intertemporal poverty, $\pi_{\beta}(\boldsymbol{g}_{(i)})$, therefore by construction it incorporates early/late poverty sensitivity. For $\omega_1 \neq \omega_2$, the size of impact of periodic poverty on aggregate intertemporal poverty will depend on the specific period in which that poverty is experienced.

In order to better understand the trade-off between inequality reduction and income variability and their implications for pro-poor evaluation, consider Figure 2, which shows the poverty gap of two individuals, $i = a, b$, over a two-period lifetime horizon, $t = 1, 2$, in three different polar scenarios. For the sake of clarity, we assume without loss of generality that $\omega_1 = \omega_2$. In a first scenario, the two individuals experience the same poverty each period, that is, $g_{a,1} = g_{a,2} = \pi_{\beta}(\boldsymbol{g}_{(a)})$ and $g_{b,1} = g_{b,2} = \pi_{\beta}(\boldsymbol{g}_{(b)})$. In this situation there is no variability, however also inequality of poverty between individuals remains unchanged. Thus $\Pi_{\alpha,\beta}(\boldsymbol{G}) = \Pi_{\alpha}(\boldsymbol{g}_1)$. In a second scenario the opposite happens, that is, $\hat{g}_{a,1} = \hat{g}_{b,2}$ and $\hat{g}_{b,1} = \hat{g}_{a,2}$; thus, $\pi_{\beta}\left(\hat{\boldsymbol{g}}_{(a)}\right) = \pi_{\beta}\left(\hat{\boldsymbol{g}}_{(b)}\right)$ and $\Pi_{\alpha,\beta}\left(\hat{\boldsymbol{G}}\right) = \Pi_{1,\beta}\left(\hat{\boldsymbol{G}}\right)$. In this situation individuals experience time variability, but their intertemporal poverty is equalized.

Given that $\hat{\boldsymbol{g}}_{(a)} + \hat{\boldsymbol{g}}_{(b)} = \boldsymbol{g}_{(a)} + \boldsymbol{g}_{(b)}$, the ranking of these two income transformation processes, using the intertemporal pro-poorness index, will depend on the social preference towards time income variability and intertemporal poverty inequality between individuals. Note that the distribution of period incomes is the same under the two processes. Hence, when the social evaluator shows the same degree of aversion towards variability and inequality (*i.e.* $\alpha = \beta$) we

[16] For the sake of presentation it is also more interesting for graphical representations as the value can meaningfully be read on the same axes as income shortfalls.

Figure 2: Inter-individual inequality vs intertemporal variability.



would judge the two distributions as equivalent. In a more general setting, their ranking will depend on the values given to α and β. Indifference towards time variability, $\beta = 1$, will allow to judge $\hat{\boldsymbol{G}}$ better than $\boldsymbol{G}$. Indifference towards intertemporal inequality will allow to judge $\boldsymbol{G}$ as better than $\hat{\boldsymbol{G}}$. When $\alpha = \beta$, the two processes will have the same degree of pro-poorness (no pro-poorness), which will be null in this specific case. This happens because in the first scenario there are neither costs nor benefits generated by mobility, whereas in the second scenario the benefits of intertemporal poverty equalization are canceled out by the costs of variability: moving from $\boldsymbol{G}$ to $\hat{\boldsymbol{G}}$, therefore redistributing from the less poor to the poorer, reduces inequality but introduces variability. If, however, $\alpha > \beta$, $\boldsymbol{G}$ will be more pro-poor than $\hat{\boldsymbol{G}}$; the other way round, if $\alpha < \beta$, $\hat{\boldsymbol{G}}$ will be more pro-poor than $\boldsymbol{G}$.

Last, consider a third scenario $g^*_{a,1} = g^*_{b,2}$ and $g^*_{b,1} = g^*_{a,2}$. As in the second scenario, $\Pi_{\alpha,\beta}\left(\boldsymbol{G}^*\right) = \Pi_{1,\beta}\left(\boldsymbol{G}^*\right)$, but it can easily be understood that the growth process $\boldsymbol{G}^*$ shows more intertemporal poverty than $\hat{\boldsymbol{G}}$ since the former exhibits more time variability than the later. However, one cannot say a priori whether $\hat{\boldsymbol{G}}$ is more pro-poor than $\boldsymbol{G}^*$ as the counterfactual situations differ. As it will be seen later, the ranking given by the IPP will depend on the respective values of α and β in that particular case. Considering the comparison with $\boldsymbol{G}$, in those case in which α is higher than β, it is worth emphasizing that $\boldsymbol{G}^*$ could be judged as more pro-poor than $\boldsymbol{G}$, while the opposite conclusion would hold for $\alpha < \beta$.

For $\alpha > 1$, $\Pi_{\alpha,\beta}(\boldsymbol{G})$ is higher than the simple average across the individuals′ intertemporal poverty corrected for the cost of transient poverty, that is, $\Pi_{1,\beta}(\boldsymbol{G}) = \frac{1}{n}\sum_{i=1}^{n}\pi_\beta\left(\boldsymbol{g}_{(i)}\right)$. Hence the difference:

$$c_{\alpha,\beta}(\boldsymbol{G}) := \Pi_{\alpha,\beta}(\boldsymbol{G}) - \Pi_{1,\beta}(\boldsymbol{G}) \tag{11}$$

represents the cost of inequality of intertemporal poverty across individuals. This cost (11) is also different from:

$$\frac{1}{n}\sum_{i=1}^{n} c_\beta(\boldsymbol{g}_{(i)}) = \Pi_{1,\beta}(\boldsymbol{G}) - \Pi_{1,1}(\boldsymbol{G}), \tag{12}$$

which is the average cost of transient poverty in a population. Putting (12) into (11) and solving for $\Pi_{\alpha,\beta}(\boldsymbol{G})$ we obtain:

$$\Pi_{\alpha,\beta}(\boldsymbol{G}) = \frac{1}{n}\sum_{i=1}^{n} c_\beta(\boldsymbol{g}_{(i)}) + c_{\alpha,\beta}(\boldsymbol{G}) + \Pi_{1,1}(\boldsymbol{G}). \tag{13}$$

Equation (13) expresses total intertemporal poverty as the sum of three components: the cost of transient poverty, the cost of inequality in intertemporal poverty and the average of individual intertemporal poverty gaps in the population.

In the absence of distributional transformation, the benchmark distribution $\boldsymbol{Y}_1$ yields the benchmark deprivation matrix $\boldsymbol{G}_1$. As noted for individual ill-fare, the parameter β then becomes irrelevant for the social evaluation of poverty and the cross-sectional vector $\boldsymbol{g}_1$ can be substituted for the whole benchmark matrix $\boldsymbol{G}_1$. More precisely, we have $\Pi_{\alpha,\beta}(\boldsymbol{G}_1) = \Pi_{\alpha,\beta}(\boldsymbol{g}_1) = \Pi_{\alpha,1}(\boldsymbol{g}_1) =: \Pi_\alpha(\boldsymbol{g}_1)$ and our benchmark intertemporal poverty measure becomes:

$$\Pi_\alpha(\boldsymbol{g}_1) = \left(\frac{1}{n}\sum_{i=1}^{n} g_{i,1}^{\alpha}\right)^{\frac{1}{\alpha}}, \tag{14}$$

which is equivalent to initial cross-sectional poverty. More specifically, equation (14) returns the EDE gap corresponding to the FGT index P_α associated with the initial distribution of income. In this benchmark situation, the cost of inequality between individuals is equal to the cost of inequality experienced in the initial period, that is:

$$c_\alpha(\boldsymbol{g}_1) := \left(\frac{1}{n}\sum_{i=1}^{n} g_{i,1}^{\alpha}\right)^{\frac{1}{\alpha}} - \frac{1}{n}\sum_{i=1}^{n} g_{i,1} \tag{15}$$

$$= \left(P_\alpha(\boldsymbol{g}_1)\right)^{\frac{1}{\alpha}} - P_1(\boldsymbol{g}_1), \tag{16}$$

that simply corresponds to the EDE gap associated with the initial value of the FGT index P_α minus the initial value of the poverty gap ratio P_1. As long as there is some degree of inequality between the poor, it can easily be shown that $c_\alpha(\boldsymbol{g}_1) > 0$.

Using (15), the benchmark level of poverty can thus be expressed as:

$$\Pi_\alpha(\boldsymbol{g}_1) = c_\alpha(\boldsymbol{g}_1) + \Pi_1(\boldsymbol{g}_1). \tag{17}$$

That is, intertemporal poverty in the benchmark situation is defined by the cost of inequality in the distribution of the individual poverty gaps experienced in the first period and the aggregate poverty gap in the first period.

Specific cases for the index $\Pi_{\alpha,\beta}(\boldsymbol{G})$ are also worth considering as they will be useful for the decompositions suggested in section 4. Note for instance that $\Pi_{\alpha,1}(\boldsymbol{G})$ accounts for the cost of inequality across individuals but not for the cost of transient poverty.

When $\beta = \alpha$, the longitudinal nature of data is lost as we only consider the marginal distributions of income shortfall at each period. Let then the EDE of the multi-period cross-sectional individual ill-fare be defined by:

$$\Pi_\alpha(\boldsymbol{G}) := \Pi_{\alpha,\alpha}(\boldsymbol{G}) = \left(\frac{1}{n}\sum_{i=1}^{n}\sum_{t=1}^{T}\omega_t g_{i,t}^{\alpha}\right)^{\frac{1}{\alpha}}. \tag{18}$$

The index $\Pi_\alpha(\boldsymbol{G})$ can be interpreted as intertemporal ill-fare imposing time anonymity on social evaluation. Imposing time anonymity implies that we are indifferent with respect to the dependence of transient poverty from one period to the other. The intertemporal allocation of cross-sectional poverty across individuals is not a matter of concern to this social ill-fare function: switching the income of two poor individuals at a given period t will consequently leave the social evaluation of intertemporal poverty unchanged, whatever the income levels in these two individuals in the other periods.[17] $\Pi_\alpha(\boldsymbol{G})$ can also be interpreted as the intertemporal poverty that would result if there were only growth but no mobility, since $\Pi_\alpha(\boldsymbol{G})$ does not account for the two effects of mobility on poverty. In fact, $\Pi_\alpha(\boldsymbol{G})$ is not corrected for the cost of mobility generated by the time income variability, which acts by increasing transitory poverty; it is neither corrected for the benefit of mobility generated by the potential equalization of income when the accounting horizon is extended, which reduces intertemporal poverty and inequality in the distribution of intertemporal poverty. Finally, it deserves to be noted that $\Pi_\alpha(\boldsymbol{G})$ does not treat income shortfalls during the whole period as if perfect pooling could be performed since in general $\exists t \in \{1, \ldots, T\}$ such that $\omega_T \neq \frac{1}{T}$. Indeed, intertemporal permutation of income shortfalls are likely to change the marginal periodic distribution of income, hence changing the level of intertemporal poverty as deprivations may not be given the same weight from one period to another.

3.3 The iso-elastic family of intertemporal pro-poorness indices

Using the poverty index introduced in the previous sections, the measure of intertemporal pro-poorness that follows from (**??**) can be expressed as follows:

$$IPP_{\alpha,\beta} = \Pi_\alpha(\boldsymbol{g}_1) - \Pi_{\alpha,\beta}(\boldsymbol{G}). \tag{20}$$

The index is equal to 0 when growth is not characterized by pro-poorness features, that is it does not have any effect on intertemporal poverty with respect to first period deprivation. It is positive (negative) if the growth process has resulted in an alleviation (worsening) of intertemporal poverty. IPP will also be equal to 0 in the hypothetical, but still possible, situation of a population that never experiences poverty over the time horizon considered. In the extreme case in which there is no poverty in the first period, but some poverty is, instead, generated, after growth, $IPP_{\alpha,\beta}$ will be equivalent to $-\Pi_{\alpha,\beta}(\boldsymbol{G}) < 0$. In the opposite case in which there is deprivation only in the starting period, it can easily be shown that the value of $IPP_{\alpha,\beta}$ will be equal to $(1-\omega_1)\Pi_\alpha(\boldsymbol{g}_1) > 0$.

It is worth noting that, since $\Pi_\alpha(\boldsymbol{g}_1)$ can be regarded as a snapshot estimate of poverty for the first period, $IPP_{\alpha,\beta}$ measures the evolution of poverty over

[17] This can more easily be seen if we express $\Pi_\alpha(\boldsymbol{G})$ in the following manner:

$$\Pi_\alpha(\boldsymbol{G}) = \left(\sum_{t=1}^{T} \omega_t \frac{1}{n} \sum_{i=1}^{n} g_{i,t}^{\alpha}\right)^{\frac{1}{\alpha}} = \left(\sum_{t=1}^{T} \omega_t P_\alpha(\boldsymbol{g}_t)\right)^{\frac{1}{\alpha}}. \tag{19}$$

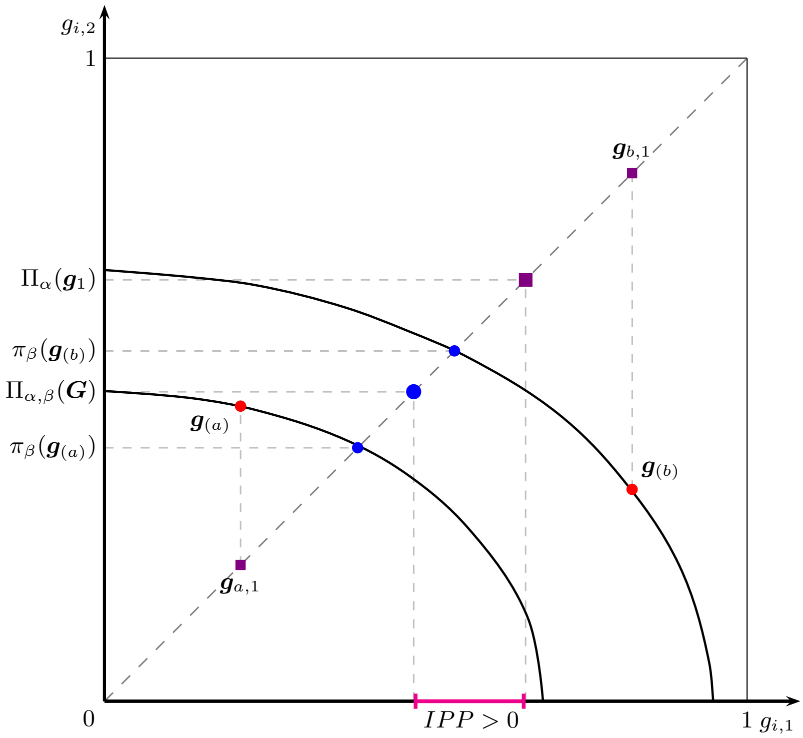
the complete time interval as compared to poverty in the first period. Moreover, $IPP_{\alpha,\beta}$ incorporates the cost of transitory poverty and the benefits of a reduction of inequality between the individual intertemporal poverty.[18] This implies, that in addition to growth, mobility may exert an additional impact on poverty. This impact will depend on the trade-off between the increase in the costs of time income variability generated by mobility, which increases transient poverty, and the increase in the benefit of long term equalization generated by mobility, which reduces intertemporal poverty. Hence, our index of intertemporal pro-poorness allows for aversion behavior of individuals towards time variability, generating additional individual transient poverty, and inequality between individuals, increasing aggregate intertemporal poverty.

It can easily be seen that the index $IPP_{\alpha,\beta}$ complies with properties that are usually regarded as desirable for social evaluation indices like population invariance, anonymity, scale invariance, continuity, and subgroup consistency. As for monotonicity, instead, a few observations are in order here. $IPP_{\alpha,\beta}$ is increasing in the initial level of aggregate poverty and decreasing in the level of aggregate intertemporal poverty. Considering $t \geq 2$, an increase in the individual periodic illfare result in an increase of $IPP_{\alpha,\beta}$. The effects of changes in first-period relative income gaps are however not so clear as the counterfactual distribution is affected. Indeed, an increase in a person's first-period income has, in fact, a positive impact on both the benchmark and the comparing total intertemporal poverty, hence resulting in an ambiguous effect with respect to $IPP_{\alpha,\beta}$.

For the sake of illustration, we consider the examples (1) and (2) in the introduction that both assume zero economic growth. For the first process, the sign of $IPP_{\alpha,\beta}$ will depend on the value assigned to the parameter of aversion to transient poverty and aversion to intertemporal poverty, whatever the choice of the weighting scheme. Let consider the case where each period gets the same weight (*i.e.* $\omega_1 = \omega_2$). When more relevance is given to variability aversion (assume $\beta = 3$ and $\alpha = 2$), the index will be negative (*e.g.* $IPP_{2,3} = -0.027$), implying that this process has been detrimental for poverty, in particular because of the more transient poverty generated. When more relevance is given to aversion to intertemporal poverty (assume $\alpha = 3$ and $\beta = 2$), the index will be positive (*e.g.* $IPP_{3,2} = 0.029$), in particular because of the effect of long term equalization. Clearly for the second process, $IPP_{\alpha,\beta} = 0$ since there is perfect immobility.

[18] Note that the value of $IPP_{\alpha,\beta}$, using poverty in the first period as the proper benchmark, is not the opposite of the value of $IPP_{\alpha,\beta}$, when poverty in the final period is used as benchmark. This is fine since the natural benchmark is the initial period.

Figure 3: The intertemporal pro-poorness of a two-period growth/mobility process.



Note: The iso-poverty contours corresponds to the case $\beta = 2$, $\omega_1 = \frac{1}{3}$, and $\omega_2 = \frac{2}{3}$. For social aggregation α is set equal to 3.

Figure 3 illustrates the computation of IPP in a two-person two-period case with loss aversion ($\omega_2 > \omega_1$) and primacy of aversion to inequality over aversion to variability ($\alpha > \beta$). The observed joint distribution of income shortfalls is depicted by the two red dots $\boldsymbol{g}_{(a)}$ and $\boldsymbol{g}_{(b)}$. One can observe that the poorest individual has benefited from a dramatic improvement of his situation during the whole period, but that the less poor person is characterized by a downward trend. Assuming the poverty line is the same at both periods, we can also see that average income has increased between the two dates. The computation of the associated value of $\Pi_{\alpha,\beta}$ first involves the estimation of $\pi_\beta(\boldsymbol{g}_{(a)})$ and $\pi_\beta(\boldsymbol{g}_{(b)})$ that can easily be found by projecting on one axis the points where the iso-poverty curves for each ill-fare profile cross the diagonal of perfect immobility (blue dots). Then aggregation across the population yields the representative income shortfall profile (large blue dot) that gives the value $\Pi_{\alpha,\beta}(\boldsymbol{G})$ by projection on one of the axes. For the benchmark situation, we first generate the benchmark profiles (violet squares) by vertical projection of the observed profiles on the diagonal of perfect immobility. Then aggregation makes it possible to find the corresponding social evaluation $\Pi_\alpha(\boldsymbol{g}_1)$ for this benchmark scenario (large violet dot). In the present case, the difference between $\Pi_\alpha(\boldsymbol{g}_1)$ and $\Pi_{\alpha,\beta}(\boldsymbol{G})$ is positive, indicating that the whole growth process has been pro-poor from an intertemporal point of view. It can be seen that this result is mainly due to positive economic growth that benefited to the initially poorest person.

4 Decompositions

We now proceed to decompose the index provided in (20). For expositional simplicity, we take $T = 2$.[19] Hence, in what follows the generic poverty measure $\Pi_{\alpha,\beta}(\boldsymbol{G})$, for any $\alpha \geq 1$ and $\beta \geq 1$, will be denoted by $\Pi_{\alpha,\beta}(\boldsymbol{g}_1, \boldsymbol{g}_2)$ and the benchmark poverty, $\Pi_\alpha(\boldsymbol{g}_1)$, by $\Pi_\alpha(\boldsymbol{g}_1, \boldsymbol{g}_1)$.

A first decomposition entails the distinction between the anonymous component of the growth process and its mobility component. This is given by the following expression:

$$IPP_{\alpha,\beta} = \underbrace{\Pi_\alpha(\boldsymbol{g}_1) - \Pi_\alpha(\boldsymbol{g}_1, \boldsymbol{g}_2)}_{AG} + \underbrace{\Pi_\alpha(\boldsymbol{g}_1, \boldsymbol{g}_2) - \Pi_{\alpha,\beta}(\boldsymbol{g}_1, \boldsymbol{g}_2)}_{M} \tag{21}$$

Recall that $\Pi_\alpha(\boldsymbol{g}_1, \boldsymbol{g}_2)$ is the intertemporal poverty obtained accounting only for anonymous income growth, but not for the benefits and costs of mobility. Since $\beta = \alpha$ in $\Pi_\alpha(\boldsymbol{g}_1, \boldsymbol{g}_2)$, the measure is not sensitive to the way second-period incomes are ordered for a given ordering of first period incomes across the population. As $\Pi_\alpha(\boldsymbol{g}_1, \boldsymbol{g}_1)$, the benchmark intertemporal poverty, is equivalent to the poverty in the initial period, it can be immediately inferred that AG captures the effect on poverty of the anonymous growth component, while the residual term M captures the effects of mobility.

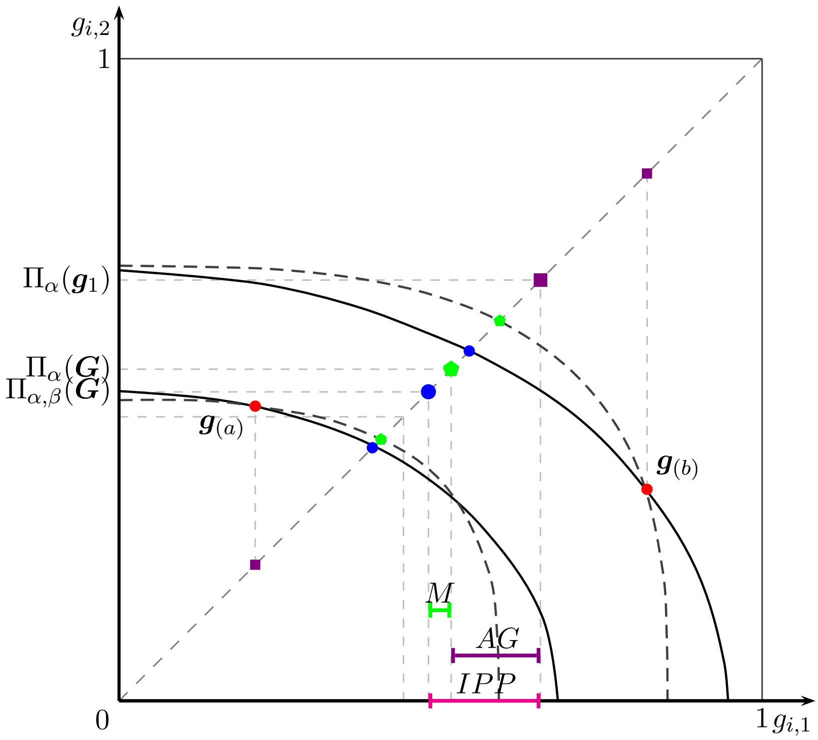
The sign of $IPP_{\alpha,\beta}$ will depend on the interaction between these two components. Considering again the example given by (1), we obtain $AG = 0$ and $M = 0.029$ with $\alpha = 3$ and $\beta = 2$. As expected, the anonymous growth impact is then nil so that the whole change in intertemporal poverty can be attributed to a pro-poor mobility effect.

It is important to underline that the evaluation of the second component M will strongly depend on the relevance that the social planner will give to the costs and the benefits of mobility and on the interaction between the two. Observe, in fact, that M will be positive when aversion towards individual poverty is

[19] See the appendix for a generalization to larger values of T.

stronger than aversion to individual temporal variability, $\alpha > \beta$; whereas it will be negative when the costs of variability are higher than the benefits deriving from equalization, that is $\alpha < \beta$. It is worth emphasizing that the sign of the effect is not determined by the weighing scheme (ω_1, ω_2). If $\beta = \alpha$ that is, when the social planner gives equal relevance to the costs and benefits of mobility in terms of their impact on intertemporal poverty, then $M = 0$. In this case the positive and negative effects of mobility on poverty compensate each other and the overall impact of mobility on poverty will be null. Furthermore, when $\beta = 1$, that is, when individuals are risk neutral, the evaluation of pro-poorness will not take into account the costs of time variability generated by mobility and thus $M > 0$. If $\alpha = 1$, that is when the social planner is inequality neutral, the evaluation of pro-poorness will not take into account the benefits of long term income equalization generated by mobility, thus $M < 0$. In this case mobility is bad since it only acts by increasing intertemporal poverty.

Figure 4: Decomposing the intertemporal pro-poorness of a two-period growth/mobility process: first decomposition.



Note: The iso-poverty contours corresponds to the case $\beta = 2$, $\omega_1 = \frac{1}{3}$, and $\omega_2 = \frac{2}{3}$. For social aggregation α is set equal to 3.

Figure 4 illustrates this decomposition considering the intertemporal pro-poorness of the scenario presented in Figure 3. In this case, the difference between the benchmark (large violet square) and the anonymous intertemporal poverty (large green pentagon) is positive, indicating that the AG component positively contributes to the intertemporal pro-poorness of the growth process. The effects of mobility corresponds to the difference between the anonymous evaluation of intertemporal poverty (large green pentagon) and the observed level of intertemporal poverty (large blue dot). In the present case, mobility exerts a less important, but still positive effect when compared with the anonymous growth effect.

Taking a different perspective, we may wish to introduce concerns regarding the distinction between the standard unitemporal perspective to the evaluation of pro-poor growth and this paper's intertemporal perspective. For this purpose, it is worth noting that in this two-period scenario, equation (13) becomes:

$$\Pi_{\alpha,\beta}\left(\boldsymbol{g}_1,\boldsymbol{g}_2\right)=\omega_1 P_1(\boldsymbol{g}_1)+\omega_2 P_1(\boldsymbol{g}_2)+\frac{1}{n}\sum_{i=1}^{n}c_\beta(\boldsymbol{g}_{(i)})+c_{\alpha,\beta}\left(\boldsymbol{g}_1,\boldsymbol{g}_2\right). \tag{22}$$

Rewriting $\Pi_{\alpha,\beta}$ in terms of (17) and (22), we get the following second decomposition:

$$\begin{aligned} IPP_{\alpha,\beta} = {} & \underbrace{\omega_2\left[P_1\left(\boldsymbol{g}_1\right)-P_1\left(\boldsymbol{g}_2\right)\right]}_{\Delta P^c}+\underbrace{\omega_2\left[c_\alpha\left(\boldsymbol{g}_1\right)-c_\alpha\left(\boldsymbol{g}_2\right)\right]}_{\Delta c^c} \\ & +\underbrace{\left[\omega_1 c_\alpha(\boldsymbol{g}_1)+\omega_2 c_\alpha(\boldsymbol{g}_2)\right]-c_{\alpha,\beta}(\boldsymbol{g})}_{M^{mc}}-\underbrace{\frac{1}{n}\sum_{i=1}^{n}c_\beta(\boldsymbol{g}_{(i)})}_{CV} \end{aligned} \tag{23}$$

The first component, ΔP^c, is basically the difference between the initial value of the poverty gap ratio $P_1\left(\boldsymbol{g}_1\right)$ and its final value $P_1\left(\boldsymbol{g}_2\right)$. Clearly, ΔP^c can take both negative or positive values: it is positive (negative) when aggregate poverty in the second period is lower (higher) than aggregate poverty in the first period and there is anonymity with respect to time and to individuals. The second component Δc^c is the difference between the cost of inequality of poverty in the initial period, $c_\alpha\left(\boldsymbol{g}_1\right)$, and the same cost in the final period, $c_\alpha\left(\boldsymbol{g}_2\right)$. Δc^c can be both positive or negative, depending whether inequality of cross-sectional poverty reduces or increases between the two periods. Thus, leaving aside the factor ω_2, together ΔP^c and Δc^c capture the usual unitemporal anonymous pro-poor growth effect in the spirit of Ravallion and Chen (2003).[20]

[20] It is worth stressing the difference between AG and the sum $\Delta P^c+\Delta c^c$. The two elements

The third component M^{mc} is the difference between the total costs in terms of poverty of unitemporal inequalities of deprivations and the cost of multitemporal inequality, which in turns can be interpreted as the ability of mobility to modify inequality when we take an intertemporal perspective. M^{mc} can be positive or negative, depending on the extent to which mobility equalizes intertemporal inequality as compared to cross-sectional inequality. Note that this component can take negative value because it is also corrected for the costs of variability. The fourth component CV captures the cost of transient poverty generated by mobility. CV is always positive since, in presence of risk averse individuals, time income variability always represents a cost that reduces the pro-poorness of an income transformation process. Taken together the two components M^{mc} and CV capture the trading-off effects on poverty between the benefits and costs of mobility. In fact $M^{mc} - CV$ is actually the difference between the ability of mobility to reduce the inequality of poverty between individuals and the variability that it generates. Thus, they encompass the new multitemporal pro-poorness effect. Note that if there is neutrality with respect to inequality between individuals' intertemporal poverty, i.e. $\alpha = 1$, $\Delta c^c = 0$ and $M^{mc} = 0$; whereas, if there is neutrality to time variability, i.e. $\beta = 1$, $CV = 0$. Finally, in the limiting case $\alpha = \beta = 1$, $\Delta c^c = M^{mc}_{\alpha,\beta} = CV = 0$, thus $IPP_{\alpha,\beta} = \Delta P^c$.

To see how it works consider again the first process of our example. The first two components, ΔP^c and Δc^c, are equal to 0 since the (anonymous) temporal distribution of income is the same in both periods. For $\alpha = 3, \beta = 2$, $M^{mc} = 0.089$ is positive meaning that the process is acting by reducing poverty, through a reduction of its inequality costs in the itertemporal perspective with respect to cross-sectional inequality. In fact note that in each period of time inequality is unchanged, but as soon as we enlarge the time-horizon individuals' poverty are less unequal. Last $CV = 0.059$, implying that mobility is also negatively affecting poverty, this is because this process is also acting by generating new poverty (the two individuals that were rich in the initial period are becoming poor in the second period).

The last decomposition we wish to introduce entails a further feature of mobility, namely reranking. In addition to the distinctions anonymous/non-

can respectively be expressed as:

$$AG = \left(P_\alpha(\boldsymbol{g_1})\right)^{\frac{1}{\alpha}} - \left(\omega_1 P_\alpha(\boldsymbol{g_1}) - \omega_2 P_\alpha(\boldsymbol{g_2})\right)^{\frac{1}{\alpha}}, \tag{24}$$

$$\Delta P^c + \Delta c^c = \omega_2 \left(\left(P_\alpha(\boldsymbol{g_1})\right)^{\frac{1}{\alpha}} + \left(P_\alpha(\boldsymbol{g_2})\right)^{\frac{1}{\alpha}}\right). \tag{25}$$

In the specific case $\alpha = 1$ we have effectively $AG = \Delta P^c + \Delta c^c$, but in the general case $\alpha > 1$, we will observe $AG \leq \Delta P^c + \Delta c^c$.

anonymous and costs/benefits of mobility, this decomposition aims at incorporating in our analysis the impact that mobility exerts on poverty through the reanking it generates. In order to do this, we denote by $\boldsymbol{g}_1^I$ the distribution of poverty gaps in the first period that has the mean gap of the first period, the same inequality as the second period but rearranged in the same order as in the first period.[21] We then denote by $\boldsymbol{g}_1^{IR}$ the distribution of poverty gaps in the second period but scaled to have the mean poverty gap of the first period.[22] Note that the counterfactual distributions $\mathbf{g}_1^I$ and $\mathbf{g}_1^{IR}$ are constructed by considering the inequality and ranking of the distribution of the poverty gaps and not the distribution of income. Although this procedure can be questionable, we think this to be in line with our approach that is sensitive to inequality of poverty across time (through β) and to inequality of intertemporal poverty across individuals (through α). By observing that $\Pi_\alpha(\boldsymbol{g}_1) = \Pi_{\alpha,\beta}(\boldsymbol{g}_1, \boldsymbol{g}_1)$ The decomposition is then obtained as follows:[23]

$$
\begin{aligned}
IPP_{\alpha,\beta} = & \underbrace{\left[\Pi_{\alpha,\beta}(\boldsymbol{g}_1, \boldsymbol{g}_1) - \Pi_{\alpha,\beta}\left(\boldsymbol{g}_1, \boldsymbol{g}_1^I\right)\right]}_{I} + \underbrace{\left[\Pi_{\alpha,\beta}\left(\boldsymbol{g}_1, \boldsymbol{g}_1^I\right) - \Pi_{\alpha,\beta}\left(\boldsymbol{g}_1, \boldsymbol{g}_1^{IR}\right)\right]}_{R} \\
& + \underbrace{\left[\Pi_{\alpha,\beta}\left(\boldsymbol{g}_1, \boldsymbol{g}_1^{IR}\right) - \Pi_{\alpha,\beta}(\boldsymbol{g}_1, \boldsymbol{g}_2)\right]}_{PG}. \qquad (26)
\end{aligned}
$$

From the expression above it can be observed that our index of intertemporal pro-poorness can actually synthesize the effect on poverty of three components. The first component I captures the intertemporal effects of changes in cross-section inequality of poverty ($\boldsymbol{g}_1$ and $\boldsymbol{g}_1^I$ have the same mean and same ranking). It is, in fact, positive (negative) if there is a decrease (increase) in inequality between the two periods. Note that, for $\beta \neq 1$, each of this component is corrected for the cost of intertemporal variability. More specifically, I captures the effect of the evolution of overall inequality: inequality across time and inequality across individuals. In fact, an increase in inequality will always result in I being negative, no matter the combination of the values of the parameters. Hence $I < 0$ also when $\alpha = 1$; this happens because, in spite of neutrality with respect to inter-individual inequalities, the income profile presents variability (the reversal

[21] In the case of our example, given the distribution of poverty gap in the initial period and final period $\boldsymbol{g}_1 = (0.43, 0.14, 0, 0)$ and $\boldsymbol{g}_2 = (0, 0, 0.43, 0.14)$, $\boldsymbol{g}_1^I$ will be given by $(g_{3,2}, g_{4,2}, g_{1,2}, g_{2,2}) \times \frac{\mu(\boldsymbol{g_1})}{\mu(\boldsymbol{g_2})}$, where $\mu(\boldsymbol{g}_t)$ is the the average poverty gap in period t.

[22] In the case of our example $\boldsymbol{g}_1^{IR} = (g_{1,2}, g_{2,2}, g_{3,2}, g_{4,2}) \times \frac{\mu(\boldsymbol{g_1})}{\mu(\boldsymbol{g_2})}$.

[23] See **?** for a similar decomposition of the CDW's (Chakravarty, Dutta, Weymark 1985) ethical index of mobility.

argument holds for a reduction in inequality). It follows that for $\alpha = \beta = 1$, given the neutrality to intertemporal variability and poverty, I will be null.

The second component, R, captures the poverty effect of reranking ($\boldsymbol{g}_1^{IR}$ and $\boldsymbol{g}_1^{I}$ have the same mean and same cross-sectional inequality, but differ in the ranking of individuals). $R = 0$ if there is no-reranking. When instead there is some reshuffling of the individuals in the population, given time variability correction, its sign will depend on the parameters. For $\alpha < \beta$, $R < 0$ because reranking provokes time variability. Therefore if, for individuals, the costs of mobility, in terms of ill-fare increase due to variability, are higher than the benefits due to reranking, R will act by reducing intertemporal pro-poorness. The opposite happens for $\alpha > \beta$, in which case reranking (corrected for time variability) will increase intertermporal pro-poorness, $R > 0$. It follows that $\alpha = \beta = 1$ implies $R = 0$.

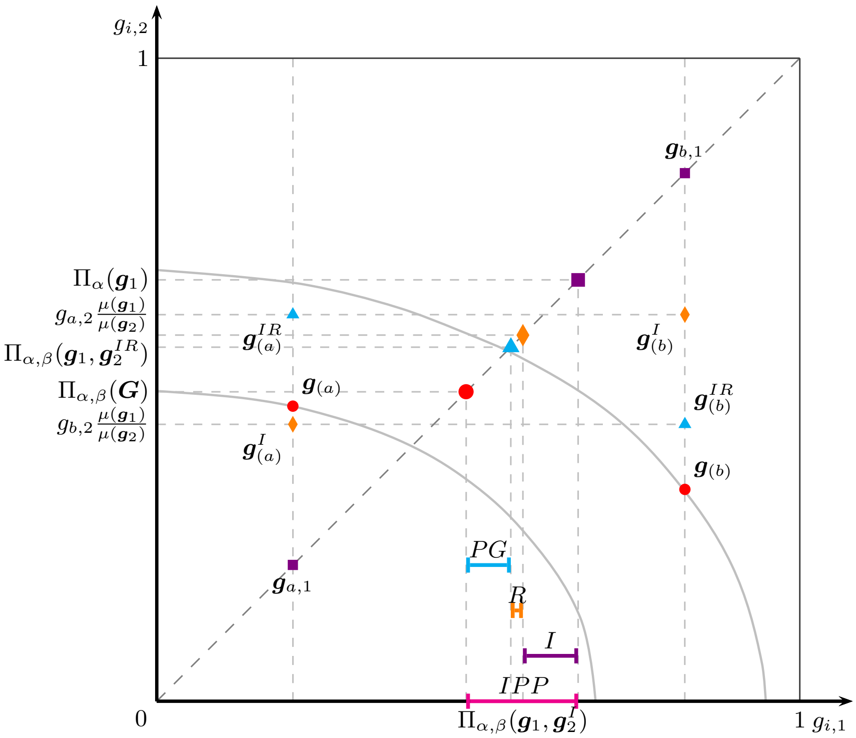
The third component PG captures a pure growth effect on poverty ($\boldsymbol{g}_2$ is $\boldsymbol{g}_1^{IR}$ scaled to mean of $\boldsymbol{g}_2$). It will be positive (negative) if there is a reduction in individuals' intertemporal ill-fare due to pure growth. Differently from the previous components, the sign of PG will not depend on the values of the parameters, however the higher is β with respect to α the higher is the (negative or positive) extent of the impact. When $\alpha = \beta = 1$, $IPP_{\alpha,\beta} = PG$, that is, pro-poorness is only determined by the pure growth in individuals' income.[24]

In our example $I = 0$ given that inequality is unchanged in both period, as already came out previously; $R = -0.03$ for $\alpha = 2, \beta = 3$, since in this process there is a reshuffling of individuals in the distributions, the first two poor individuals are now the two richest, but this also provokes time variability whose costs are higher than the benefits from reranking; the other way round for $\alpha = 3, \beta = 2$ in which case $R = 0.12$. $PG = 0$ given that the average gap is unchanged.

This decomposition is sketched in Figure 5 on the base of the scenario already introduced before. In this situation, the inequality component is positively affecting pro-poorness as indicated by the difference between the benchmark (large violet square) and the ill-fare of the counterfactual profile $(\mathbf{g}_1, \mathbf{g}_1^I)$ (large orange

[24] This decomposition, although exact, is path-dependent. This means that the value of each of its components (four) would be different in presence of different 'paths' for the decomposition. For instance, one might have wanted to capture first the growth effect, then the reranking effect and the inequality. It is wide acknowledged that such different paths yield different results for the decomposition, and that no path is in any sense more correct than another (see, e.g. **?**). A possible solution to this problem would be possible by applying the Shapley-Shorrocks decomposition, which consists of taking the Shapley-value of each effect across all possible paths of the decomposition (see Shorrocks, 2013). In this specific case we would have 24 (4!) possible paths.

Figure 5: Decomposing the intertemporal pro-poorness of a two-period growth/mobility process: third decomposition.



Note: The iso-poverty contours corresponds to the case $\beta = 2$, $\omega_1 = \frac{1}{3}$, and $\omega_2 = \frac{2}{3}$. For social aggregation α is set equal to 3.

diamond-shape dot). The difference between the latter and the ill-fare of the counterfactual scenario $(\mathbf{g}_1, \mathbf{g}_1^{IR})$ (large sky blue triangle) also indicates that reranking plays a positive role in determining the extent of pro-poorness, although by a lower extent than inequality. Finally, the impact of pure growth on pro-poorness is obtained by the difference between the ill-fare of the counterfactual scenario $(\mathbf{g}_1, \mathbf{g}_1^{IR})$ (large sky blue triangle) and actual intertemporal poverty (large red dot). It is again positive implying that pure growth is improving the degree of pro-poorness.

5 Empirical illustration

5.1 Data

In this Section we provide an empirical application of the approach proposed in the paper, using the panel component of the Eurostat 'European Union Statistics on Income and Living Conditions' (EU-SILC). The EU-SILC, started in 2005, is a representative survey of the resident population within each European country, interviewed every year. For the present paper we consider the 2006 and 2009 waves. While the EU-SILC is increasingly used for distributional analysis in general, it is much less used for income mobility analysis in particular, mostly because it tracks individuals for a maximum of four years. However, this does not hamper the applicability of our work, which keeps its meaningfulness even when a restricted time-horizon is considered (differently from frameworks of intergenerational mobility).

Hence, in addition to show how our framework can be applied on real data, the aim of this section is to investigate the pro-poorness of the distributional transformation that took place between 2006 and 2009 in 23 European countries, from an intertemporal perspective. In so doing, we are able to uncover some aspects of pro-poorness not captured when using traditional pro-poor growth measures. The relevance of this empirical illustration is further emphasized by the observation that the time interval we consider includes the year in which the economic crisis started in Europe, allowing to believe that these countries might have performed very differently in terms of pro-poorness, given the different social security systems and economic structure in place in each country.[25]

The unit of observation is the household; the household members are defined as the persons usually resident whether they are related or not to the other household members. The measure of living standard is household disposable income, which includes all household members earnings, transfers, pensions, and capital incomes, net of taxes on wealth, incomes and social insurance contribution. Incomes are expressed in Euros at PPP exchange rates and in constant prices of 2005 and then adjusted for differences in household size using the OECD equivalence scale. The countries considered are: Austria (AT), Belgium (BE), Bulgaria (BG), Cyprus (CY), Czech Republic (CZ), Estonia (EE), Spain (ES), Finland (FI), France (FR), Hungary (HU), Iceland (IS), Italy (IT), Latvia (LV), Lithuania (LT),Malta (MT), Netherlands (NL), Norway (NO), Poland (PL), Portugal (PT), Slovenia (SI), Sweden (SE), and United Kingdom (UK).

We perform the illustration using a relative approach to poverty, with country-specific poverty lines fixed at 60% of the median income in 2006. Relative gaps for the year 2008 are thus estimated using the same poverty line for each country.

[25] See **?** for robust comparisons of intertemporal poverty between these countries.

5.2 Results

In this Section we evaluate the pro-poorness of the income transformation process that took place between 2006 and 2009 for the European countries listed above. Remember from (20) that the assessment of pro-poorness depends on the choice of the weighting scheme as well as the value to be given to the parameters expressing aversions to transient poverty and to inequality of intertemporal poverty. Here, we choose to weigh equally illfare at both periods. Regarding α and β, we select, among the possible, a set of values which are commonly used in the literature, these are 1, 2 and 3. The numerical values of our measure of intertemporal pro-poorness, for all possible combinations of α and β and for all the countries considered, are reported in Table 1 in the appendix, a graphical representation is available in Figure 6.

Figure 6: The $IPP_{\alpha,\beta}$ for 23 European countries, 2006–09.

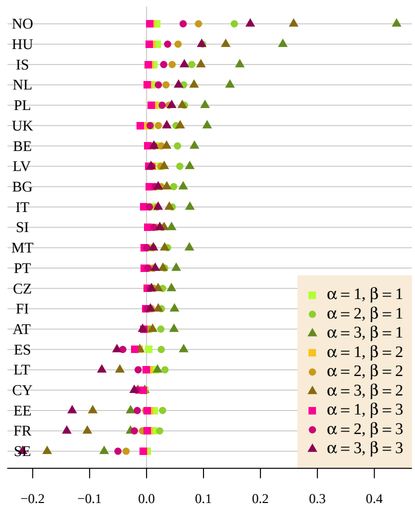


Table 1 and Figure 6 establish our point that the distribution of intertemporal pro-poorness among countries is quite dispersed. It also depends on the normative relevance given to variability and inter-individual inequality. The value of the index for each combination of the parameters is quite variable among the countries, witnessing that they have performed quite differently in the same time-interval. In particular, it could be argued that, in an intertemporal pro-poorness perspective, the very early phase of the crisis has impacted on each country-specific population with different degrees of gravity. For thirteen out of twenty-three countries, encompassing all the southern countries, the index is negative at least for one combination of α and β. Among them Cyprus and Denmark show the worst performance (the index is always negative), followed by Spain and Sweden. Indeed, for $\alpha = \beta = 1$ Cyprus and Denmark are the only two countries with negative intertemporal pro-poorness. The remaining ten countries for which the index is always positive are mostly represented by continental and eastern countries, among them there are five of the new members (PL, CZ, HU, LV, SI). For them the 2006-2009 can be judged as an intertemporal poverty reducing process, although the IPP value varies considerably with the values of the parameters; an exception is Norway that performs always better than the other countries.

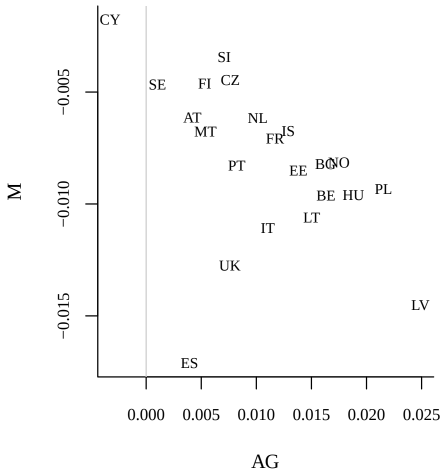
We deepen our analysis by computing the three types of decompositions introduced before, each of them emphasizing a distinct aspect of the distributional process under investigation. The numerical values of the first decomposition are reported in Table 2 in the appendix. This decomposition entails the distinction between anonymous and non-anonymous intertemporal pro-poorness. A more synthetic representation of the results is reported in Figure 7.

From Table 2 it can be immediately grasped that distinguishing between anonymous and non-anonymous growth does matter. Note, in fact, that there is always a considerable amount of variability, which, in the case of transient poverty aversion and inequality neutrality, reduces the degree of pro-poorness of the 2006-2009 growth process. Hence if one would stick to a pure anonymous evaluation he would end up with an overestimation of this growth episode for all the countries considered. It appears that the negative impact of variability on pro-poorness is strong enough to revert the sign of the of anonymous growth on intertemporal pro-poorness. For instance, consider the case of $\alpha = 1$, AG, which only depends on this parameter, is negative for only two out of twenty-three countries. The associated IPP, computed accounting for time variability, will be negative for nine out of twenty-three countries when $\beta = 2$. Of course, given $\alpha = 1$, the higher the value of β the higher will be the number of cases in which this inversion will be generated.

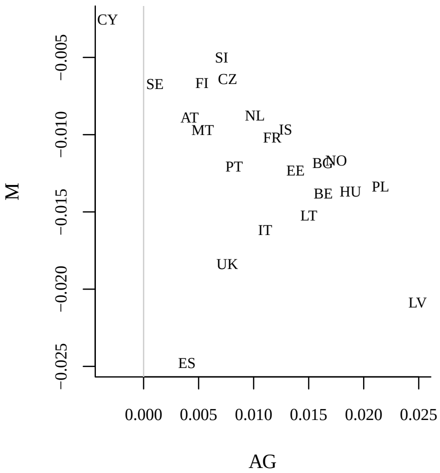
In a specular way, the inequality reducing aspect of mobility is also sizable and not accounting for it, in a society in which instead inequality aversion prevails, would bring about an underestimation of the pro-poorness of the 2006-2009 growth process, although this aspect seems to affect pro-poorness less strongly than time variability does. Note, in fact, that for $\alpha = 2$ and $\beta = 1$, $AG < 0$ for six out of twenty-three countries and the associated $IPP < 0$ for three out of twenty-three countries. Hence while accounting for variability changes the final

Figure 7: First decomposition: anonymous growth vs mobility within European countries, 2006–09.

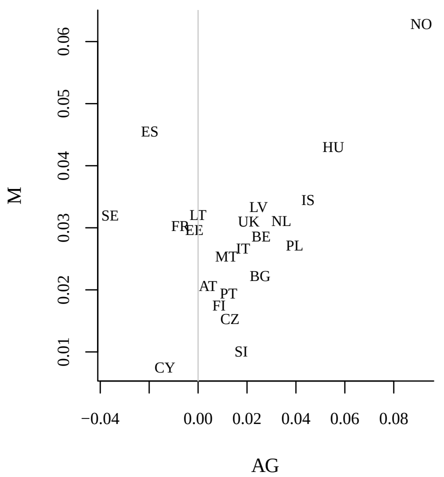
(a) $\alpha = 1, \beta = 2$.



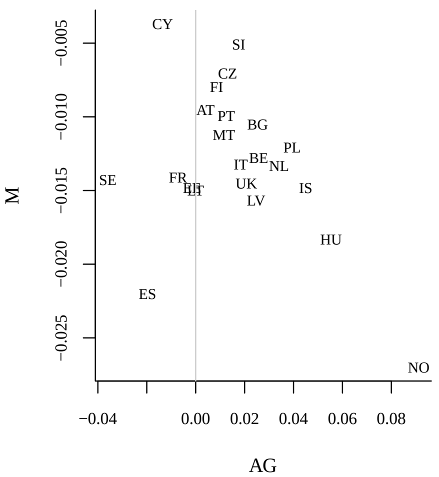
(b) $\alpha = 1, \beta = 3$.



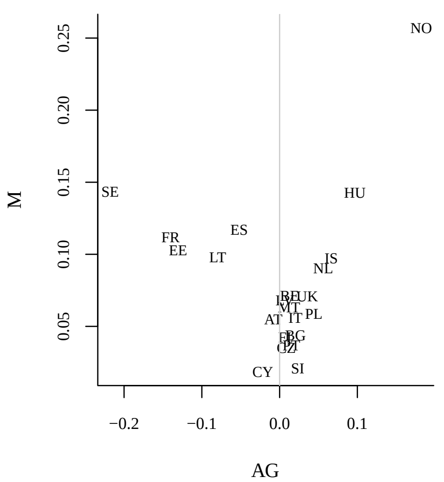
(c) $\alpha = 2, \beta = 1$.



(d) $\alpha = 2, \beta = 3$.



(e) $\alpha = 3, \beta = 1$.



(f) $\alpha = 3, \beta = 2$.

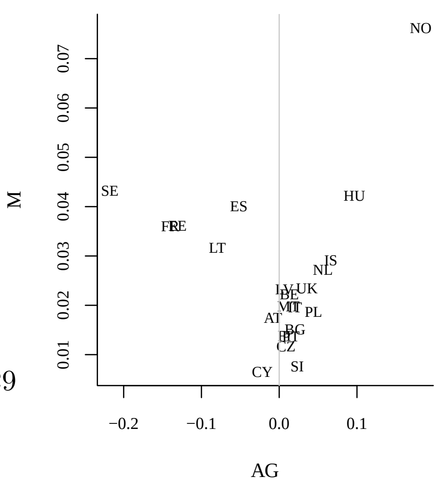
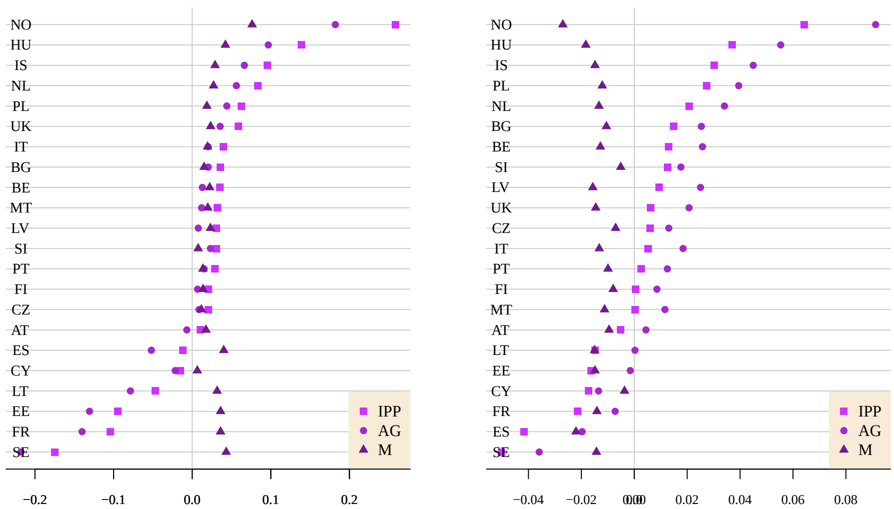


Figure 8: First decomposition: anonymous growth vs mobility within European countries, 2006–09.

(a) $\alpha = 3, \beta = 2$. (b) $\alpha = 2, \beta = 3$.



judgment of seven countries, accounting for inequality in intertemporal poverty changes the final evaluation only in three countries. This can be better seen form the plots in Figure 7. When we assume inequality neutrality and we only impose time variability aversion the two components of pro-poorness, namely AG and M are inversely correlated. By contrast, when we recognize inequality aversion, for every value of β the two components result to be mostly uncorrelated.

Figure 8 is also informative on this.[26] Here, countries are ordered from top to bottom by decreasing value of the $IPP_{\alpha,\beta}$ and estimates are read off the abscissa of the plot. For each country, the final value of intertemporal po-poorness is marked on the horizontal line by a square, the anonymous growth component by a dot and the mobility component by a triangle. The panel on the left reports estimations of the first decomposition for $\alpha = 3, \beta = 2$. From the figure we observe that the benefits of mobility, namely intertemporal equalization, is only very moderately affecting intertemporal pro-poorness. IPP and AG show a very similar shape, that is, they are distributed similarly across countries, while we do not observe any systematic relationship between M and IPP: there is no support here for a claim that higher equalization affects substantially the degree of pro-poorness among European countries for the 2006-2009 growth episode.

[26] We do not include Denmark in this and following Figures because it behaves as an outlier.

It is only for the three most pro-poor countries - Norway, Hungary and Island- that the mobility component appears to be influential on IPP and correlated to AG. On the contrary, for the bottom ranked countries - LT, EE, FR, SE - the benefits of mobility are not enough to compensate the negative impact of anonymous growth.

The panel on the right reports the estimates of the first decomposition for $\alpha = 2, \beta = 3$ and again is supportive of the relative stronger effect of the costs of mobility over its benefits. Losses of pro-poorness due to variability, when time volatility aversion is stronger than inequality aversion, are higher than the gains of pro-poorness due to equalization, when inequality aversion is stronger than volatility aversion. As before, the costs of mobility are more pronounced for the most pro-poor countries.

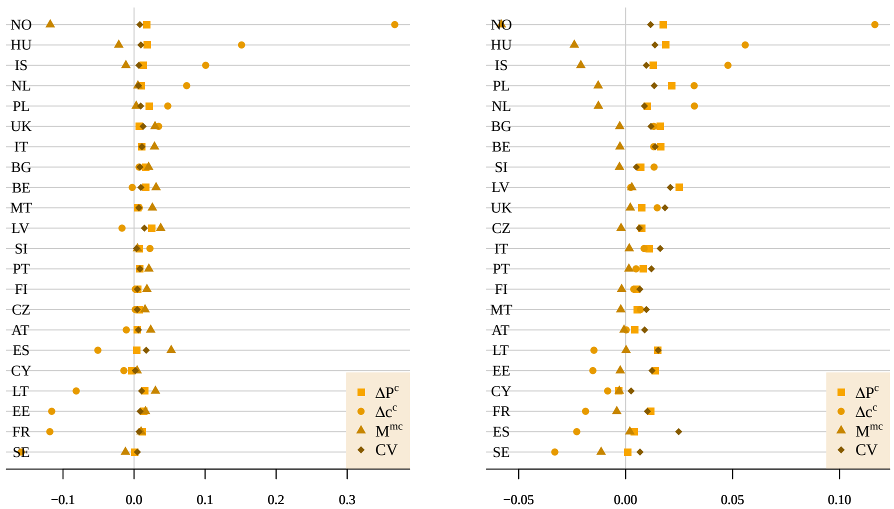
Last notice that while the ranking of countries according to $IPP_{\alpha,\beta}$ is more or less stable when we change the values of the parameters, an almost complete reranking is generated when we use AG and M to compare them. This is supportive of the relevance of disentangling the different aspects that interact to determine a distributional change. In this particular case, Figure 8 panel (b) tells us that the transitory poverty experience generated by mobility, through variability, is strongly affecting the intertemporal poverty of individuals, although in aggregate this is compensated by anonymous growth.

We now turn to illustrate the second decomposition, whose results are reported in Table 3. A first surprising information is that, within the unitemporal component, variation in cross-sectional average poverty gap and variation in the cost of cross-sectional inequality have a different trend for eight countries. In particular, when $\alpha = 3$, the former are increasing over time for only two countries, while the latter are increasing for ten countries. This conflicting trend is still existing, although in a lower number of cases, when less relevance is given to inequality aversion, that is the case of $\alpha = 2$. As for the difference between unitemporal and multitemporal costs, the third component, the results on the 23 European countries confirm somehow the stronger effect of time variability over inequality aversion. Observe, that the value of the third component is in fact almost always negative when $\beta > \alpha$ and it remains negative for a number of countries also when $\alpha > \beta$.

Moreover, this result is also supporting the view that enlarging the analysis to an intertemporal perspective does suggest a different, thus complementary, picture of the pro-poorness features of growth. The values taken by M^{mc} for the countries considered in this sample witness that there is a clear difference

Figure 9: Second decomposition: Unitemporal vs multitemporal effect within European countries, 2006–09.

(a) $\alpha = 3, \beta = 2$. (b) $\alpha = 2, \beta = 3$.



between the amount of unitemporal and multitemporal costs. Last, the fourth component, capturing the cost of variability, as expected is positive and most importantly different from 0, indicating that, no matter the value of β, as long as it is different form 1, there will always be some sizable variability which will act by reducing the degree of pro-poorness.

Figure 9 is quite instructive on this. Countries are ordered as in the previous figure. For each country, the firs component of this decomposition (ΔP^c) is marked on the horizontal line by a square, the second (Δc^c) by a dot, the third (M^{mc}) by a triangle, the fourth (CV) by a rhombus.

The panel on the left reproduces the decomposition for $\alpha = 3$ and $\beta = 2$. The contribution of the variation in the cross sectional costs of inequality is remarkable, while the effect of the other components appears quite weak. The three top ranked countries are the only exception to this. For them the multitemporal cost effect is considerable and is actually acting by reducing intertemporal pro-poorness. For the rest of the countries (with the exception of SE), instead, this component has a positive but little effect. The costs of variability are clearly always positive. The variation in cross sectional poverty is also positive (with the exception of CY).

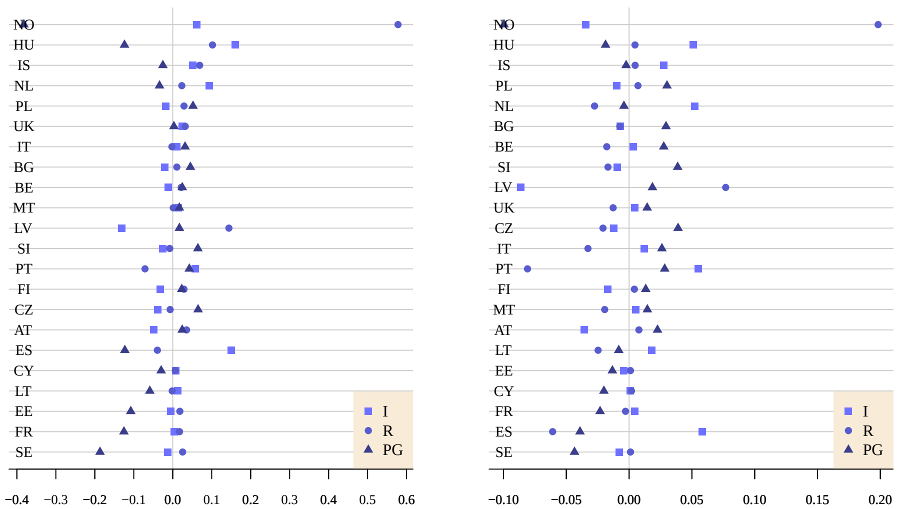
The right-hand panel reports the decomposition for $\alpha = 2$ and $\beta = 3$. We observe again that IPP is mostly determined by the variation in the cross-sectional costs of inequality; this result is somehow expected given that this component only depends on α. For the same reason also the variation in cross sectional poverty is almost always positive, in particular for the more pro-poor countries. In addition, the extent of its effect is more consistent than in the previous scenario. As for the multitemporal costs component, its impact is negative and quite strong for the bottom and especially for the top ranked countries. For the latter the effect of this component is diverting from the effect of all the others, hence reducing consistently the final degree of pro-poorness. How to explain the increasing negativity of the multitemporal costs in the second scenario? Recall that this component is the difference between the cross-sectional and intertemporal costs of inequality, therefore the higher is the relevance attached to inequality (higher α), the higher will be the benefit coming from intertemporal equalization (corrected for the cost of variability), the lower will be the multitemporal costs. At the same time, for every α different from one, the higher is the relevance attached to variability (higher β) the higher will be the multitemporal costs of inequality, as it incorporate this variability features.

The last stage of our empirical illustration consists of evaluating intertemporal pro-poorness according to the third decomposition. Results for the estimation of each component are reported in Table 4. The numerical value of its components and their sign reveal that each of them affects pro-poorness in a different and unrelated way. This can be easily grasped from Figure 10, as usual we provide an illustration of the decomposition for two different combinations of the value of the parameters. Countries are ordered as in the previous figure. For each country, the first component (I) is marked on the horizontal line by a square, the second (R) by a dot, the third (PG) by a triangle.

Consider the left-hand panel in which $\alpha = 3$ and $\beta = 2$. Given that countries are ranked according to their respective IPP, Figure 10 establishes that for the top ranked countries much of their pro-poorness is determined by variation in inequality and reranking (the first two components of the decomposition), whereas pure growth seems to affect pro-poorness in an opposite direction. Also note that for these countries (NO, HU, IS, NL) pure growth appears to be harmful for pro-poorness. However its negative impact, as seen before, is more than compensated by the impact of the first two components. A different story characterizes the bottom ranked countries: I and R have almost no effect on IPP, which only depends on pure (negative) growth. For the rest of the countries IPP is always positive while its underlying components act in very different way.

Figure 10: Third decomposition: Inequality vs Reranking vs Growth within European countries, 2006–09.

(a) $\alpha = 3, \beta = 2.$ (b) $\alpha = 2, \beta = 3.$



Pure growth effects is almost always positive, inequality effect is negative (with the exception of PT and ES), while reranking is positive for some countries and negative for others. However, in general these three effects compensate each other. Last, the ranking of countries changes dramatically if we chose one instead of the other component to compare countries on the base of their growth performance.

A remark is in order here. Note that for the more pro-poor countries, the impact of PG diverts from the impact of AG in the first decomposition. This is due to the fact that AG is not purged from the effect of inequality (and reranking) while PG is. The panel on the right considers $\alpha = 2$ and $\beta = 3$. Changing the values of the parameters does not change the distribution of PG among countries: its impact is still negative for highest and lowest ranked countries while positive for middle ranked countries. By contrast, the inequality and reranking effects vary substantially. In this case pro-poorness is not determined by one or the other specific component, its final value is rather determined by their interactions, with the exception of Norway for which pro-poorness seems to be mostly driven by reranking. Furthermore, differently from the previous case, for most of the countries inequality and reranking effect diverts each other.

A final overall observation is that the top and bottom parts of the between country distribution of our index of pro-poorness are the most affected by an increase in aversion towards time income variability.

6 Conclusion

When is growth pro-poor? In this paper we have proposed an answer to this question, by arguing that a more comprehensive assessment of pro-poorness can be obtained by shifting the analysis from a pure cross-sectional perspective to a longitudinal one. Such an approach makes it possible to account for each individual ill-fare dynamic over time. Sticking to the cross-sectional perspective, in fact, implies that the mobility experience that takes place during a growth process is ignored. This is the main shortfall of most of the tools developed by the pro-poor growth literature.

To this end, we have introduced a family of aggregate indices of intertemporal pro-poorness. These indices measure the impact of a distributional transformation process on the intertemporal poverty of a given society, which is expressed as an equally-distributed-equivalent aggregation of the lifetime poverty experience of each individual in that society. The measure of intertemporal poverty, at the base of the indices of pro-poorness proposed here, captures transient poverty and interindividual intertemporal poverty aversion. As a result intertemporal pro-poorness, in the way it has been conceived in this work, in addition to growth, is able to account for the costs and benefits of mobility: the former reducing pro-poorness because of variability that increases transient poverty; the latter increasing pro-poorness thanks to long-term equalization that reduces inequality between individuals' intertemporal poverty.

We have then proposed a set of decompositions of our family of indices in order to infer the role of the different features of a distributional transformation in alleviating or worsening individual and social ill-fare. These features are usually hidden by the existing frameworks of pro-poorness, since they are shaped within a unitemporal and anonymous context.

Finally, we have provided an empirical illustration of our measurement framework for 23 European Countries over the period 2006-2009. This analysis has shown that accounting for mobility matters and that the family of indices we have introduced here can be used to complement existing tools for the evaluation of the pro-poorness features of growth.

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Appendix

Generalization to t periods

As discussed in the main text, the decompositions provided in this paper may be generalized to consider a time horizon of $T \geq 2$ periods.

If this is the case, then the first decomposition will be easily obtained by adding and subtracting in (20) the EDE of the periodic individual ill-fare, as defined in (19), as follows:

$$\underbrace{\Pi_{\alpha}\left(\boldsymbol{g}_{1}\right)-\Pi_{\alpha}\left(\boldsymbol{g}\right)}_{AG}+\underbrace{\Pi_{\alpha}\left(\boldsymbol{g}\right)-\Pi_{\alpha,\beta}\left(\boldsymbol{g}\right)}_{M} \tag{27}$$

In order to generalize the second decomposition, observe that (13) can be rewritten as:

$$\Pi_{\alpha,\beta}(\boldsymbol{g})=\omega_1 P_1(\boldsymbol{g}_1)+\omega_2 P_2(\boldsymbol{g}_2)+...+\omega_T P_T(\boldsymbol{g}_T)+c_{\alpha,\beta}(\boldsymbol{g})+\frac{1}{n}\sum_{i=1}^{n} c_{\beta}((g)) \tag{28}$$

Then, $IPP_{\alpha,\beta}$ can be decomposed as follows:

$$\underbrace{\omega_2\left[P_1\left(\boldsymbol{g}_1\right)-P_1\left(\boldsymbol{g}_2\right)\right]+\omega_3\left[P_1\left(\boldsymbol{g}_1\right)-P_1\left(\boldsymbol{g}_3\right)\right]+...+\omega_T\left[P_1\left(\boldsymbol{g}_1\right)-P_1\left(\boldsymbol{g}_T\right)\right]}_{\Delta P^c}+c_{\alpha,\beta}(\boldsymbol{g})+\frac{1}{n}\sum_{i=1}^{n} c_{\beta}(\boldsymbol{g}_{(i)}) \tag{29}$$

$$+\underbrace{\omega_2\left[c_{\alpha}\left(\boldsymbol{g}_1\right)-c_{\alpha}\left(\boldsymbol{g}_2\right)\right]+\omega_3\left[c_{\alpha}\left(\boldsymbol{g}_1\right)-c_{\alpha}\left(\boldsymbol{g}_3\right)\right]+...+\omega_T\left[c_{\alpha}\left(\boldsymbol{g}_1\right)-c_{\alpha}\left(\boldsymbol{g}_T\right)\right]}_{\Delta c^c} \tag{30}$$

$$+\underbrace{\left[\omega_1 c_{\alpha}(\boldsymbol{g}_1)+\omega_2 c_{\alpha}(\boldsymbol{g}_2)+\omega_3 c_{\alpha}(\boldsymbol{g}_3)+...+\omega_T c_{\alpha}(\boldsymbol{g}_T)\right]-c_{\alpha,\beta}(\boldsymbol{g})}_{M^{mc}}-\underbrace{\frac{1}{n}\sum_{i=1}^{n} c_{\beta}(\boldsymbol{g}_{(i)})}_{CV} \tag{31}$$

Last, when $T \geq 2$, the third decomposition is obtained as follows:

$$\underbrace{\left[\Pi_{\alpha,\beta}\left(\boldsymbol{g}_1\right)-\Pi_{\alpha,\beta}\left(\boldsymbol{g}_1^{I}\right)\right]}_{I}+\underbrace{\left[\Pi_{\alpha,\beta}\left(\boldsymbol{g}_1^{I}\right)-\Pi_{\alpha,\beta}\left(\boldsymbol{g}_1^{IR}\right)\right]}_{R}+ \tag{32}$$

$$+ \underbrace{\left[\Pi_{\alpha,\beta}\left(\boldsymbol{g}_1^{IR}\right) - \Pi_{\alpha,\beta}\left(\boldsymbol{g}\right)\right]}_{PG} \tag{33}$$

Here, $\boldsymbol{g}^I = (\boldsymbol{g}_1, ..., \boldsymbol{g}_t^I, ..., \boldsymbol{g}_T^I)$, where $\boldsymbol{g}_t^I$ denotes the counterfactual distribution of poverty gaps at time t obtained by preserving the same average poverty gaps and rank of the first period distribution. Similarly, $\boldsymbol{g}^{IR} = (\boldsymbol{g}_1, ..., \boldsymbol{g}_t^{IR}, ..., \boldsymbol{g}_T^{IR})$, where $\boldsymbol{g}_t^{IR}$ denotes the counterfactual time-specific distribution of poverty gaps obtained by preserving the same average poverty gap of the first period distribution.

Tables and Figures

Table 1: Pro-poor mobility index for European Countries, 2006–09.

	(α, β)								
Country	(1,1)	(2,1)	(3,1)	(1,2)	(2,2)	(3,2)	(1,3)	(2,3)	(3,3)
AT	0.0043	0.0251	0.0481	-0.0019	0.0044	0.0106	-0.0046	-0.0051	-0.0069
BE	0.0163	0.0544	0.0841	0.0067	0.0258	0.0352	0.0025	0.0130	0.0129
BG	0.0163	0.0476	0.0643	0.0081	0.0254	0.0356	0.0044	0.0148	0.0204
CY	-0.0033	-0.0060	-0.0031	-0.0050	-0.0135	-0.0151	-0.0058	-0.0172	-0.0216
CZ	0.0076	0.0283	0.0437	0.0032	0.0131	0.0203	0.0012	0.0060	0.0087
DK	-0.0335	-0.4456	-1.0565	-0.0498	-0.5809	-1.3658	-0.0588	-0.6663	-1.5630
EE	0.0138	0.0281	-0.0280	0.0053	-0.0015	-0.0945	0.0015	-0.0163	-0.1306
ES	0.0039	0.0258	0.0652	-0.0132	-0.0197	-0.0119	-0.0209	-0.0417	-0.0520
FI	0.0053	0.0261	0.0490	0.0007	0.0086	0.0206	-0.0013	0.0006	0.0068
FR	0.0117	0.0231	-0.0281	0.0046	-0.0072	-0.1040	0.0015	-0.0213	-0.1401
HU	0.0188	0.0984	0.2393	0.0092	0.0553	0.1390	0.0051	0.0370	0.0968
IS	0.0129	0.0794	0.1637	0.0062	0.0450	0.0954	0.0032	0.0301	0.0664
IT	0.0110	0.0451	0.0761	-0.0000	0.0185	0.0399	-0.0051	0.0052	0.0203
LT	0.0151	0.0323	0.0192	0.0045	0.0003	-0.0469	-0.0001	-0.0147	-0.0786
LV	0.0250	0.0584	0.0757	0.0104	0.0250	0.0310	0.0041	0.0094	0.0078
MT	0.0054	0.0369	0.0752	-0.0014	0.0116	0.0318	-0.0043	0.0004	0.0120
NL	0.0101	0.0652	0.1465	0.0040	0.0341	0.0834	0.0013	0.0208	0.0562
NO	0.0175	0.1541	0.4391	0.0093	0.0912	0.2583	0.0058	0.0642	0.1821
PL	0.0215	0.0666	0.1026	0.0122	0.0395	0.0627	0.0082	0.0274	0.0441
PT	0.0082	0.0319	0.0521	-0.0001	0.0125	0.0288	-0.0038	0.0026	0.0152
SE	0.0010	-0.0040	-0.0745	-0.0036	-0.0359	-0.1746	-0.0057	-0.0502	-0.2178
SI	0.0071	0.0277	0.0439	0.0037	0.0176	0.0308	0.0021	0.0125	0.0232
UK	0.0076	0.0517	0.1064	-0.0051	0.0207	0.0590	-0.0108	0.0062	0.0355

Table 2: First decomposition for European Countries, 2006–09 ($\alpha \neq \beta$).

Country	($\alpha=1,\beta=2$)		($\alpha=1,\beta=3$)		($\alpha=2,\beta=1$)		($\alpha=2,\beta=3$)		($\alpha=3,\beta=1$)		($\alpha=3,\beta=1$)	
	AG	M	AG	M	AG	M	AG	M	AG	M	AG	M
AT	0.0043	-0.0061	0.0043	-0.0089	0.0044	0.021	0.0044	-0.0095	-0.0069	0.055	-0.0069	0.018
BE	0.016	-0.0096	0.016	-0.014	0.026	0.029	0.026	-0.013	0.013	0.071	0.013	0.022
BG	0.016	-0.0082	0.016	-0.012	0.025	0.022	0.025	-0.011	0.02	0.044	0.02	0.015
CY	-0.0033	-0.0018	-0.0033	-0.0026	-0.014	0.0075	-0.014	-0.0037	-0.022	0.018	-0.022	0.0065
CZ	0.0076	-0.0045	0.0076	-0.0064	0.013	0.015	0.013	-0.007	0.0087	0.035	0.0087	0.012
DK	-0.034	-0.016	-0.034	-0.025	-0.58	0.14	-0.58	-0.085	-1.6	0.51	-1.6	0.2
EE	0.014	-0.0085	0.014	-0.012	-0.0015	0.03	-0.0015	-0.015	-0.13	0.1	-0.13	0.036
ES	0.0039	-0.017	0.0039	-0.025	-0.02	0.045	-0.02	-0.022	-0.052	0.12	-0.052	0.04
FI	0.0053	-0.0046	0.0053	-0.0066	0.0086	0.018	0.0086	-0.008	0.0068	0.042	0.0068	0.014
FR	0.012	-0.0071	0.012	-0.01	-0.0072	0.03	-0.0072	-0.014	-0.14	0.11	-0.14	0.036
HU	0.019	-0.0096	0.019	-0.014	0.055	0.043	0.055	-0.018	0.097	0.14	0.097	0.042
IS	0.013	-0.0067	0.013	-0.0097	0.045	0.034	0.045	-0.015	0.066	0.097	0.066	0.029
IT	0.011	-0.011	0.011	-0.016	0.018	0.027	0.018	-0.013	0.02	0.056	0.02	0.02
LT	0.015	-0.011	0.015	-0.015	0.00028	0.032	0.00028	-0.015	-0.079	0.098	-0.079	0.032
LV	0.025	-0.015	0.025	-0.021	0.025	0.033	0.025	-0.016	0.0078	0.068	0.0078	0.023
MT	0.0054	-0.0068	0.0054	-0.0097	0.012	0.025	0.012	-0.011	0.012	0.063	0.012	0.02
NL	0.01	-0.0062	0.01	-0.0088	0.034	0.031	0.034	-0.013	0.056	0.09	0.056	0.027
NO	0.017	-0.0082	0.017	-0.012	0.091	0.063	0.091	-0.027	0.18	0.26	0.18	0.076
PL	0.022	-0.0093	0.022	-0.013	0.039	0.027	0.039	-0.012	0.044	0.059	0.044	0.019
PT	0.0082	-0.0083	0.0082	-0.012	0.013	0.019	0.013	-0.0099	0.015	0.037	0.015	0.014
SE	0.001	-0.0047	0.001	-0.0067	-0.036	0.032	-0.036	-0.014	-0.22	0.14	-0.22	0.043
SI	0.0071	-0.0034	0.0071	-0.005	0.018	0.01	0.018	-0.0051	0.023	0.021	0.023	0.0076
UK	0.0076	-0.013	0.0076	-0.018	0.021	0.031	0.021	-0.015	0.036	0.071	0.036	0.023

Table 3: Second decomposition for European Countries, 2006–09.

Country	($\alpha = 3, \beta = 3$)				($\alpha = 2, \beta = 3$)			
	ΔP^c	Δc^c	M^{mc}	CV	ΔP^c	Δc^c	M^{mc}	CV
AT	0.0043	-0.011	0.023	0.0061	0.0043	0.00026	-0.00075	0.0089
BE	0.016	-0.0025	0.031	0.0096	0.016	0.013	-0.0027	0.014
BG	0.016	0.007	0.02	0.0082	0.016	0.013	-0.0028	0.012
CY	-0.0033	-0.014	0.0043	0.0018	-0.0033	-0.0084	-0.003	0.0026
CZ	0.0076	0.0017	0.015	0.0045	0.0076	0.0069	-0.0021	0.0064
DK	-0.034	-1	-0.29	0.016	-0.034	-0.42	-0.19	0.025
EE	0.014	-0.12	0.016	0.0085	0.014	-0.015	-0.0025	0.012
ES	0.0039	-0.051	0.052	0.017	0.0039	-0.023	0.002	0.025
FI	0.0053	0.0018	0.018	0.0046	0.0053	0.0038	-0.0019	0.0066
FR	0.012	-0.12	0.0099	0.0071	0.012	-0.019	-0.0041	0.01
HU	0.019	0.15	-0.022	0.0096	0.019	0.056	-0.024	0.014
IS	0.013	0.1	-0.012	0.0067	0.013	0.048	-0.021	0.0097
IT	0.011	0.011	0.029	0.011	0.011	0.0086	0.0017	0.016
LT	0.015	-0.081	0.03	0.011	0.015	-0.015	0.00022	0.015
LV	0.025	-0.017	0.037	0.015	0.025	0.0024	0.0029	0.021
MT	0.0054	0.0074	0.026	0.0068	0.0054	0.0069	-0.0023	0.0097
NL	0.01	0.074	0.0054	0.0062	0.01	0.032	-0.013	0.0088
NO	0.017	0.37	-0.12	0.0082	0.017	0.12	-0.058	0.012
PL	0.022	0.047	0.003	0.0093	0.022	0.032	-0.013	0.013
PT	0.0082	0.0081	0.021	0.0083	0.0082	0.0049	0.0015	0.012
SE	0.001	-0.16	-0.012	0.0047	0.001	-0.033	-0.011	0.0067
SI	0.0071	0.022	0.0048	0.0034	0.0071	0.013	-0.0029	0.005
UK	0.0076	0.035	0.03	0.013	0.0076	0.015	0.0022	0.018

Table 4: Third decomposition for European Countries, 2006–09.

Country	($\alpha = 3, \beta = 2$)			($\alpha = 2, \beta = 3$)		
	noname	R	PG	*noname*	R	PG
AT	-0.049	0.035	0.024	-0.036	0.0078	0.023
BE	-0.011	0.022	0.024	0.0032	-0.018	0.028
BG	-0.02	0.011	0.045	-0.0072	-0.0074	0.029
CY	0.0078	0.0068	-0.03	0.00098	0.0019	-0.02
CZ	-0.038	-0.0066	0.065	-0.012	-0.021	0.039
DK	0.18	0.24	-1.8	0.054	0.11	-0.83
EE	-0.0051	0.018	-0.11	-0.0041	0.0011	-0.013
ES	0.15	-0.039	-0.12	0.058	-0.061	-0.039
FI	-0.031	0.029	0.023	-0.017	0.0042	0.013
FR	0.0038	0.017	-0.13	0.0046	-0.0029	-0.023
HU	0.16	0.1	-0.12	0.051	0.0047	-0.019
IS	0.052	0.069	-0.025	0.028	0.0048	-0.0024
IT	0.01	-0.0021	0.032	0.012	-0.033	0.026
LT	0.013	-0.0014	-0.059	0.018	-0.025	-0.0082
LV	-0.13	0.14	0.017	-0.086	0.077	0.019
MT	0.014	0.0013	0.017	0.0052	-0.019	0.015
NL	0.094	0.023	-0.034	0.052	-0.028	-0.0041
NO	0.062	0.58	-0.38	-0.034	0.2	-0.1
PL	-0.018	0.029	0.052	-0.0099	0.0071	0.03
PT	0.057	-0.071	0.043	0.055	-0.081	0.028
SE	-0.013	0.025	-0.19	-0.0079	0.0011	-0.043
SI	-0.026	-0.0077	0.065	-0.0093	-0.017	0.039
UK	0.024	0.032	0.003	0.0045	-0.013	0.014