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Changes in poverty and the stability of income distribution in Argentina: evidence from the 1990s via decompositions *

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Abstract

From 1992 to 2001, despite its rapid economic growth during the early 1990s, Argentina experienced a period characterized by increasing income inequality and poverty. An axiomatically modified Datt-Ravallion decomposition, that separates changes in poverty rates into mean and inequality components, will illustrate how each of them has contributed to those changes. Contrary to the claims of much of the recent cross-country literature, income inequality does not appear stable in Argentina. Previous results are extended in two key ways. First, the empirical density function is used to calculate the inequality component, without assuming a particular functional form for the Lorenz curve. Second, both components are recomputed without the vaguely defined Datt-Ravallion residual, which improves interpretability..

Keywords: decomposition of changes in poverty, poverty measures, inequality and growth.
JEL Classification: C16, D63, I30, I31, I32, O54

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1. Introduction

The relationship between growth, inequality and poverty has been, and remains, one of the most controversial topics in development economics. From the 1950s to the early 1970s, the debate emphasized the possible trade offs between growth and income inequality. This derived from the Kuznets' famous "inverted U hypothesis", which posited that inequality rises during the initial phases of development and then declines after some crucial level is reached (Kuznets 1955). In place of the Kuznets' curve, the recent literature points to different empirical regularities. As more time-series data becomes available, it appears that: first, aggregate inequality does not typically change dramatically from year to year.[3] Second, that results from cross-country studies (Dollar and Kraay 2002) are often not applicable to single countries given the existence of measurement errors and country-specific effects (Anand and Kanbur 1993; Ravallion 2001). Finally, that there is a sizeable heterogeneity across countries and time in the gains to the poor from a given rate of growth.

The validity of the first point will be explored via a slightly different method than the regression-based approach used in the recent literature (Huppi and Ravallion 1991; Bruno, Ravallion et al. 1998; Li 1998). The stability of income inequality effects on poverty (as opposed to the stability of income distribution) within a given country will be analysed by using decompositions of changes in poverty rates. The specific question addressed in this paper is the following: how far growth *per se* has (or has not) helped to reduce absolute poverty, given a significant change in inequality. To phrase this question slightly differently, how good was growth *on average* and what was the magnitude of the "trickle down" growth effect?

[3] One study of panel data for 49 countries found that 91.8% of the variance in inequality was due to cross-country variance and only 0.85% was attributable to variance over time (Li, Squire and Zou 1998). When performed on a sub-sample of low and middle-income countries, the figures were 93.1% and 1.4% respectively.

This work will address these questions by focusing on one particular country: Argentina, which by the end of the 1990s was still a relatively rich country (annual per capita income officially calculated at (dollars) US$7418 per person in 2001).[4] Yet, despite its relative wealth, it was a country with a surprisingly high degree of poverty (see Figure 1) seemingly explained by the unequal distribution of incomes (Altimir and Beccaria 2001; Gasparini, Marchionni et al. 2001). According to official figures, the overall poverty rate in 2001 was 35.4% of the individuals, and rates in the poorer Northeast and Northwest regions exceeded 50% (World Bank 2000).[5] The Gini coefficient decreased from a peak of 0.47 in 1989/90 (hyperinflation years), to 0.43 in 1992 after the establishment of the Currency Board in 1991, then reaching a value of 0.52 in 2001, after a three-year recession.

To answer the first question one could investigate the change in the level of poverty arising from a change in economic growth, or due to a change in inequality. For instance, the magnitude of the inequality component may provide a useful measure of the degree of "trickle down" growth.

I will also inspect whether changes in the inequality component (*vis a vis* changes in inequality measured by the Gini index) have been more or less stable during the 1990s and whether those changes have been associated to the way the mean was changing (growth spells vs. recession spells).

One of the motivations is an empirical one. During the early 1990s Argentina had one of the lowest Gini coefficients of Latin America. Despite this, (total household) income inequality

[4] Indeed, GDP per capita slumped from that value to US$2671 per capita in 2002, after the crisis.
[5] Poverty rates estimations for Brazil were 30%, for Mexico 15% and for Chile: 15% (World Bank 2000).

during the 1980s and, in particular, 1990s has risen more than in other Latin-American countries (Li 1998; Szekely 2003). [6,7] Moreover, Li, Squire and Zou found that only in seven countries (Australia, Chile, China, France, Italy, New Zealand and Poland) there was a statistically large and quantitatively important time trend in relation to the mean absolute rate of change (0.6% a year) of their 49-country sample. As an example, the results for Chile for the period 1968/1994 indicated an annual change of 1% in their estimated country-specific term in the regression. When performing the same regression to the Argentine data, this figure turns out to be 2.2% of the 1992-2001 estimated country-specific term in the regression (see table 4 in Li, Squire and Zou for details). Therefore, one would expect this case study to cast doubt on cross-country regression-based results.

Besides the empirical motivation, there is a methodological-policy concern as well. In order to understand the effectiveness with which growth and inequality changes has translated into poverty reduction through time; it may be useful to quantify its contribution in a simple and generalized way. The magnitude of the growth and inequality components may identify directly the effect of a particular phenomenon, which in turn may help to figure out the impact of a particular development policy.

There is an extensive literature in Argentina on the determinants of inequality and poverty during the 1990s (FIEL 1999). However, so far none of them has explicitly explored and disentangled the impact of growth and inequality on poverty. In particular, there is no current literature (to the author's knowledge) that uses a precise, simple yet also general

[6] Li, Squire and Zou found that the highest Ginis in Latin America for the 1990-1997 period were: Brazil: 0.578, Mexico: 0.546, Honduras: 0.545 , Panama : 0.52, Chile : 0.518 and Colombia: 0.515. The lowest one were Dominican Rep.: 0.469, Costa Rica: 0.46 and Venezuela: 0.44, which lie at the bottom of their (unfortunately not exhaustive) list of Latin-American countries (Argentina was not in their sample). By taking the Argentine Gini coefficient of the total household income (without adjustment for underreporting, which is the same concept of income than the one considered by Li, Squire and Zou) in the 1990-1997 period for the 16 urban municipalities would yield a Gini of 0,44 close to Venezuela, the lowest Gini in their Latin-American list.

[7] Szekely shows this by estimating a regression for each country separately, being the dependent variable the Gini coefficient, and the independent variable, a year trend (t=1, 2, ..n).

specification of changes in the distribution of incomes. Nor has any literature yet compared different decompositions empirically.

These methods will be illustrated with micro data for the GBA (Greater Buenos Aires) area from the Permanent Household Survey EPH (Encuesta Permanente de Hogares) from 1992 to 2001 (October-spells).[8] The EPH is a household survey conducted by INDEC (National Institute of Statistics and Census) which collects information on labour incomes, profits, interests, rents and pensions at the household level.

The paper is structured as follows. Section 2 gives an outline of the work and an overview of welfare changes in Argentina by using traditional methods of dominance. Section 3 applies a different type of Datt-Ravallion decomposition to the Argentine data. Finally, Section 4 concludes.

[8] The same exercise will be repeated for the whole country (29 urban areas) when data becomes available.

2. Plan and brief overview of welfare changes during the 1990s: Trends and traditional dominance analysis

2.1 Plan

I will begin by examining stochastic dominance over this period in order to obtain results that are consistent with different poverty lines. Subsequently, a decomposition of changes in poverty into growth and distributional effects, by slightly changing the Datt-Ravallion method will be expounded, with the precise objective of looking at which component had contributed the most to increases (decreases) in poverty rates. The decomposition will provide a measure of the (infinitesimal) change in the poverty function with respect to inequality or growth, independently taken (*ceteris paribus*).[9] This method is in contrast to the recent attempts in the literature to measure separately the impact of changes in mean income and income inequality on poverty via regressions (Huppi and Ravallion 1991) and to earlier decompostions. [10]

Using data from Brazil and India, Datt and Ravallion found the growth component to explain the largest part of observed changes in poverty. Applying the same methodology to African, Latin-American, East and Southeast Asian countries, Demery et al (1995) came to the conclusion that first, poverty changes are largely determined by economic growth and second, that changes in inequality are of secondary importance to changes in poverty in the great majority of cases (Demery, Sen et al. 1995).

[9] This is exactly the definition of a partial derivative.
[10] They analyzed poverty changes with a measure of income inequality and mean GDP (or GDP growth rate) as explanatory variables.

This paper will show that for Argentina this does not seem to hold, neither across groups nor by sub-periods under the period under study [11]. It is still contentious whether this 20% increase in inequality (as measured by the Gini index) was due to a domestic Argentine phenomenon or a global economic trend that affected Argentina after 1990, when her major move away from a high-inflation economy with heavy state intervention and protection to a more open, private-sector oriented economy, took place.[12]

It will be verified that the inequality component dominates the growth component for the whole period. Accordingly, it may be worth analyzing first, the circumstances under which each component arises as the crucial one and, second, the type of decomposition which might be the more accurate in order to isolate the impacts of growth/inequality on poverty.

Bourguignon, Ferreira et al found two chief limitations to this method. First, the analysis relies on summary measures of the distribution rather than the full distribution. Second, the decomposition of changes in poverty measures often leaves an unexplained residual of a non-trivial magnitude. Here, an attempt will be made to work out both problems. The first problem will be tackled somehow by using the cumulative empirical distribution instead of a parameterized distribution function (i.e. instead of using a lognormal or Singh Maddala that "bound" the number of parameters of the function). [13, 14] Since the parameterization of a Lorenz curve will no longer be required to calculate the inequality component, this will make the decomposition much simpler to implement.

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[11] It holds for the 2001/2002 period, which is a completely unusual year (financial crisis).

[12] In fact, inequality rose in almost every OECD country during the last two decades, being the case of UK the most dramatic one, where the Gini coefficient increased by 10 percentage points between 1970 and 1995 .

[13] Of course, this will not completely solve the problem, since a summary measure of growth (the mean) is still used here.

[14] Later, by looking at micro-simulation techniques, which permit us to follow the evolution of the distribution of income with considerable detail over time, this point will be fully solved .

The second point will be approached by applying to the Argentine data an axiomatic technique through which the Datt-Ravallion residual is not required to maintain the decomposition as in Shorrocks (1999)and (Kolenikov and Shorrocks 2005).

2.2 Poverty and Inequality Trends

While many social indicators improved during the 1990s (for example, infant mortality dropped from 25 deaths per 1000 births in 1991 to approximately 18 deaths per 1000 births in 1998 (World Bank 2000), poverty levels have remained stubbornly high despite the rapid economic growth experienced in the 1991/1998 period. Figure 1 shows the evolution over time (1988 to 2003) of the official estimates of poverty rates for the GBA. Since 1990, there has been a substantial drop in poverty, with the overall headcount ratio for all urban areas dropping from 33.7% of all individuals during the hyperinflation in October 1990 to 16.1% in May 1994 (the lowest poverty rate during the 1990s).

However from 1994 on, poverty rates started to increase steadily, mainly influenced by the impact of the financial Mexican crisis in 1995 (which produced a decline in GDP and a sharp rise in unemployment) and the Brazilian Devaluation in 1999 (Argentina's largest trading partner). By the end of 2001, the failure to honour the foreign debt and the devaluation of the peso, the national currency, have added to the poor performance of welfare indicators during the last decade. In October 2002, 54.3% of the population was living in poverty (Table 1). This situation was clearly compounded by rising income inequality (Tables 3 and 4, Figures 3 and 4). The rate of extreme poverty fell from 6.6% in October 1990 to 3.5% in October 1994, then increasing thereafter to reach 25.2% of all individuals in May 2003 (Table 2). Besides the appreciation of the exchange rate and the collapse in 2001, it appears that the “new regime” was characterized by both lower employment–growth elasticity and larger wage differentials by skill.

The movements in poverty and extreme poverty mirrored a dramatic fall in household income (Table 7), and a clear deterioration of labour market conditions (Table 6). In October 2002, unemployment peaked to 17.8% and, in addition, 20% of the economically active population became underemployed or worked part-time due to the lack of good full-time jobs.

There was a sharp increase in inequality between the 1980s and the 1990s. However, from 1990 to 1992 the distribution became more egalitarian, due to the equalizing effect of the removal of the inflationary tax which tends to affect the poor most (Canavese, Sosa Escudero et al. 1999).[15] Nevertheless, inequality began to increase again in 1993, jumping again sizably in 1995, after the Mexican crisis. It must be noted that there are two stable sub-periods (1991/94 and 1995/98) with a big jump in 1995. Finally, in 2002 the highest Gini value since reliable data is available (0.53) was reached.[16] The myriad of reasons which may have caused these changes will be looked at in another piece of work (see "Research Proposal").

2.3 Stochastic dominance and the three 'I's of poverty curves (Incidence, Inequality and Intensity of poverty)

Given a particular poverty measure P(.) and a particular poverty line, z, P(.) is able to determine which distribution has more poverty than the other. Unlike inequality measurement in which dominance theory has a long tradition, dominance analysis in poverty measurement is still a relatively new field (Atkinson 1987; Foster and Shorrocks 1988; Jenkins and Lambert 1998).

[15] Inflation fell from a peak of over 1300 percent in 1990, to less than one percent during 1996/98, jumping again to 41% in 2002. Real economic growth, on the other hand, increased from an average rate of –1.1% during the 1980s, to 5.8% during the 1991/98 period, then dropping to -10.9% in 2002, after the crisis.

[16] The INDEC releases household data since 1974, but periodically only from 1980/82 on.

Using *poverty* dominance analysis, it is possible to say that all members of the class of a general additive poverty measures (including P_α measures) would rank one income distribution as having more poverty than another, given z. Also, given the controversy which usually goes with setting z, dominance criteria encompassing many z would be very desirable because a given poverty measure belonging to the class of general additive poverty measures would rank one income distribution as having more poverty than another, for a range of z.

Figure 2 shows how the Cumulative Density Function for the distribution of household adult-equivalent incomes for 2001 (also called the poverty incidence curve) is everywhere at least as high as the distribution of adult-equivalent incomes for 1998. However, the 1998 curve crosses the 1992 distribution at approximately $500 (1998 pesos), which is slightly above the 75th percentile of the distribution. This implies that 2001 first order dominates 1998, for every z between 0 (zero) and the maximal income, and for all members of the class of general additive poverty measures. However, we do not know if 1998 in turn first order dominates 1992.

As another piece of evidence, second order *welfare* dominance will be investigated as well (Shorrocks 1983). Figure 3 shows by means of the Generalized Lorenz Curve (GLC) for the distribution of household adult-equivalent incomes, that the GLC for 1992 is everywhere at least as high as the distribution of adult-equivalent incomes for 1998 and the 1998 curve is everywhere at least as high as the 2001 distribution.[17] This implies that 1992 second-order dominates 1998, and 1998 in turn second-order dominates 2001. This will hold if and only

[17] Generalized Lorenz Curve=Lorenz curve of *x* times the mean of *x* (where x is a given distribution of incomes).

if welfare in 1992 was higher than welfare in 1998 and welfare in 1998 was higher than welfare in 2001 (Fields 2001).[18]

To endorse these results Jenkins and Lambert provide a new device, the three 'I' s of poverty curve, which play a similar role to the Generalized Lorenz Curves. They describe income distribution and implement tests of whether one distribution dominates another. Those curves have been plotted as well. Figure 5 shows the curves with the poverty line set at $160 (1998 pesos, per adult-equivalent, per month) which illustrates the same trend depicted with the cumulative density functions and GLC.

[18] We were able to draw these conclusions because we know that the GLC did not cross in our sample.

3. Decompositions for poverty levels changes

Recent theoretical advances have brought the interplay between growth, poverty and inequality back into a prominent position in development theories. Benabou (1996) provides an excellent survey of early contributions in this rapidly growing literature. However, in concerning the existing methods for quantifying this relationship, the literature is still rather new and scarce despite recently attracting increased attention (Datt and Ravallion 1991; Kakwani and and Subbarao 1992; Kakwani 1993; Shorrocks 1999; Kolenikov and Shorrocks 2005).

Unfortunately, the various existing inequality measures are not particularly useful if we want to investigate whether shifts in income distribution helped or hurt the poor during a period of overall economic contraction (expansion). It is certainly not possible to conclude that a reduction in inequality will reduce poverty.[19] Moreover, even when a specific reduction (increase) in inequality does imply a reduction (increase) in poverty, the change in the inequality measure can be quite uninformative because it does not quantify the impact. Therefore, one of the objectives here will be to confront the convenience of traditional inequality measures versus the decomposition approach.

In addition, even if an inequality index had kept the same value between two points in time, there could have been mild forces operating in different directions that compensated each other in the aggregate, in distributional terms.

Some of the earlier decompositions procedures were proven to violate some intuitively natural axioms. Here, by applying the axiomatic approach proposed by Kakwani (1997), an

[19] Using any measure which satisfies the Pigou-Dalton criterion

adding up decomposition procedure will be derived and applied, introducing the idea of average growth and inequality effects, the sum of which is equal to the total change in poverty. [20, 21]

Moreover, it will be a symmetric decomposition; in particular, the contributions will not depend on the order in which factors are considered. As stated in Datt and Ravallion (1991 p.277-278) ..."if the mean income or the Lorenz curve remains unchanged over the decomposition period, then the residual (R) vanishes. The residual exists whenever the poverty measure is not additively decomposable (i.e whenever (9) is not respected or what is the same, whenever the change in poverty measure is not linear on the components) between μ and L, i.e. whenever the marginal effects on the poverty rate of changes in the mean (Lorenz curve) depend on the precise Lorenz curve (mean). Separability of the poverty measure between the mean and Lorenz parameters is also required for the decomposition to be independent of the choice of the reference".

The methodology explained below will then serve to impose some requirements in the poverty change function which in turn will become an additively decomposable function between any *m* components (such as the growth and the decomposition component here). (Here a footnote about Shorrocks) The only assumption required will be that the poverty function is homogeneous of degree one.

[20] Datt and Ravallion rejected this solution as being arbitrary (Datt and Ravallion 1991, p.278 third footnote). Far from being arbitrary, the analysis suggests that this is exactly the outcome that results from applying a systematic decomposition procedure to the growth-inequality issue.

[21] This axiomatic procedure gives similar results as the SOS (Shapley-Owen-Shorrocks) decomposition procedure discussed in Shorrocks (1999). His proposed solution considers the marginal effect on poverty of eliminating each of *m* contributory factors in sequence, and then assigns to each factor the average of its marginal contribution in all possible elimination sequences. This procedure yields an exact additive decomposition of P into *m* contributions (see Section 3.1.2 for a full explanation of this procedure) without any requirement of linearity of the change in poverty function..

From a methodological perspective, it seems interesting to assess different decompositions because they may give us some hints about a proper and consistent way of defining a *growth (inequality) component* and about the nature of those components.

3.1 Modified Datt-Ravallion method

3.1.1 The (empirical) cumulative density function approach.

The most commonly used measures of poverty are completely defined by a cumulative distribution function and a poverty line. Let y denote household adult-equivalent income and $F_t(y)$ denote the cumulative distribution function over the whole population which represents the proportion of persons with an income less than or equal to y at time t. The mean household adult-equivalent income, μ_t, will be used to measure the *growth component* and let z denote the poverty line (which will be the same for all individuals and will be deflated at 1998 *pesos* for all years).

It will now be illustrated how the cumulative density function and the mean of a given distribution can be used to measure the *inequality component*. Bearing in mind that the Lorenz curve is a mean-normalized integral of the inverse of a distribution function and if $L'(p)$ denotes the slope of the Lorenz curve, and y is the income level which cuts off the bottom *p* percent, we can write (Kakwani 1980):

$$L(p) = \frac{1}{\mu}\int_0^p F^{-1}(y)\,dy \qquad (1)$$

And by deriving (1) we obtain:

$$y = F^{-1}(p) = \mu L'(p) \qquad (2)$$

where L(p) is the equation of the Lorenz curve, giving the fraction of total income that the *pth* fraction of the population possess (for a population ordered in ascending order of income).

Figure 6 shows the cumulative distribution function which may be used to estimate the poverty rate associated with any poverty line and illustrates a situation in which, given a fixed poverty line, growth raises all incomes by the same factor, leading to a simple rightward shift of the initial year distribution function from F_t to F_t*. For instance, F_t* is a construction which takes F_t as the reference and multiplies every income by $\lambda = \frac{\mu_{t+n}}{\mu_t}$, where μ_t and μ_{t+n} are the average incomes of periods t and t+n, respectively. By construction, F_t* and F_{t+n} have the same mean.

If one focuses, for instance, on the headcount ratio, then this shift reduces the headcount ratio from H_t to H_t*. [22] If economic growth is instead accompanied by inequality-reducing redistribution, the eventual distribution F_{t+n} will exhibit less spread than F_t, producing a further reduction in the poverty rate from H_t* to $H_{t+n,}$ the poverty rate at the final time period. The total sub-changes in the poverty rate is then [23]:

$$H_t^* - H_t = H(F_t^*, z) - H(F_t, z) \qquad (3)$$

[22] Thus H_t* is the estimated poverty rate that *would* have been observed in the final period if the inequality *had* remained at the initial level, t.
23 In the next section will be given a definition of growth component and ineq component. Then, it can be seen that here the growth com is given by equation (3), while the inequality component i=G and (4) = inequality component

and

$$H_{t+n} - H^*_t = H(F_{t+n}, z) - H(F_t^*, z) \qquad (4)$$

Since F_{t+n} and F_t* have the same mean, μ_{t+n}, by construction, from applying differences to (1) we can therefore write:

$$\mu_{t+n}\left[L_{t+n}(p) - L^*_t\ (p)\right] = \int_0^p \left[F_{t+n}^{-1}(y) - F\ {}^*_t{}^{-1}\ (y)\right]dy \qquad (5)$$

This shows that Lorenz changes are captured by cumulative density functions changes when the mean is fixed (Atkinson 1970; Shorrocks 1983). The *inequality component* is then defined as the change in poverty if the Lorenz curve were to change but mean income remained unchanged. Unlike Kakwani and Subbarao's method, the method proposed here satisfies this last prerequisite. [24] I have not got rid of the residual component by lumping it in with the redistribution component as them. However, the issue to solve now is the reference year and the accuracy of the definition of I

[24] In their paper : I=ΔP-G where G= P (μ t+n, Lt)-P(μt, , Lt). This would be the same as the definition here if and only if the Lorenz were not going to change (i.e Lt= Lt+n)Later they calculated I on their own (I= P (μ t, Lt+n)-P(μt, , Lt)., but then G +I was different from ΔP what impulse Datt and Ravallion to introduce the idea of a residual.

3.1.2 The Datt-Ravallion decomposition revisited

Datt and Ravallion treat the subject as follows. The poverty measure P at date (or region/country) t is written as:

$$P_t(z, F_t) \qquad (6)$$

As explained in the previous section, the methodology proposed here does not need a vector of parameters fully describing the Lorenz curve to calculate the change in inequality. In fact the residual that may eventually appear is also a part of the *inequality component* that failed to be explained by the special form of the Lorenz curve chosen (NEED TO TEST THIS!!) or because of he reference data chosen . This is explained by the fact that inequality in a distribution can change in infinite ways (reference date) .

We now define the *growth* and *inequality components*:

Definition 1: The *growth component* of a change in the poverty measure is defined as the change in poverty due to a change in the mean income while holding the Lorenz curve L_t constant at some reference level L_r:

$$G(t, t+n; r) = P(z, \mu_{t+n}, L_r) - P(z, \mu_t, L_r)$$

Definition 2: The *inequality component* is the change in poverty due to a change in the Lorenz curve L_t while keeping the mean income constant at the reference level μ_r: $I(t, t+n; r) = P(z, \mu_r, L_{t+n}) - P(z, \mu_r, L_t)$

Therefore, a change in poverty between t and t+n may change due to a change in the mean income, μ_t, or due to a change in the Lorenz curve, L_t, and can be decomposed as follows[25]:

$$\Delta P_{t,t+n} = P_{t+n} - P_t = \mathrm{P}(G_{t,t+n}(.), I_{t,t+n}(.), R_{t,t+n}(.)) \tag{7}$$

where this function may also be written:

$$\Delta P_{t,t+n} = P_{t+n} - P_t = \underbrace{G(t,t+n,r)}_{\text{Growth component}} + \underbrace{I(t,t+n,r)}_{\text{Inequality component}} + \underbrace{R(t,t+n,r)}_{\text{Residual}} \tag{8}$$

In (8) the first two arguments in the parentheses refer to the initial and terminal dates of decomposition and the last argument makes explicit the reference date, r, with respect to which the observed change in poverty is decomposed.

The functional form of (7) will be determined by the following three Axioms (Kakwani 1997).

Axiom 1: If $I_{t,t+n} = 0$, then $\Delta P_{t,t+n} = G_{t,t+n}$ and if $G_{t,t+n} = 0$, then $\Delta P_{t,t+n} = I_{t,t+n}$

This axiom is intuitive, implying that when the growth (inequality) effect is zero, then the change in poverty must be entirely due to changes in income inequality (mean income).

[25] It would also be possible to explain the decomposition in an alternative way, using an elasticity- based presentation of this approach. For instance, the elasticity of the headcount ratio with respect to the *growth component*, G, would be G*(μ / H) , where μ is the mean income and H is the headcount ratio.

Axiom 2: If $G_{t,t+n} \leq 0$ and $I_{t,t+n} \leq 0$, then $\Delta P_{t,t+n} \leq 0$ and if $G_{t,t+n} \geq 0$ and $I_{t,t+n} \geq 0$, then $\Delta P_{t,t+n} \geq 0$.

This axiom implies that if both growth and inequality effects are less (greater) than or equal to zero, then the total poverty effect must also be less (greater) than or equal to zero.

Axiom 2 will always be satisfied if $\frac{\partial P}{\partial G_{t,t+n}} \geq 0$ and $\frac{\partial P}{\partial I_{t,t+n}} \geq 0$

Axiom 3 (symmetry axiom): $G_{t,\, t+n} = -G_{t+n,\, t}$ and $I_{t,\, t+n} = -I_{t+n,\, t}$

Axiom 3 implies that both growth and inequality effect must be symmetric with respect to base and terminal years. The violation of this axiom gives rise to the problem of nominating the base and/or terminal date as the reference and that can only be made on an ad hoc basis

Kakwani and Subbarao (1990, 1991), for example, violate this axiom, which prompted Datt and Ravallion to propose the decomposition given in (8). They have actually found that the residual can be quite large.[26] Further, since there are only two factors ("pure growth" and "inequality"), what meaning can be attached to such a high value of the residual is not clear.

We know that $\Delta P_{t,t+n} = -\Delta P_{t+n,t}$ which implies that $\mathrm{P}(G_{t,t+n}, I_{t,t+n}) = -\mathrm{P}(-G_{t+n,t}, -I_{t+n,t})$ By using Axiom 3 becomes $\mathrm{P}(G_{t,t+n}, I_{t,t+n}) = -\mathrm{P}(-G_{t,t+n}, -I_{t,t+n})$. This equation will always hold if P is a homogeneous function of degree one. Then using Euler's theorem, we obtain that . Then using Euler's theorem we obtain: $\mathrm{P}(G_{t,t+n}, I_{t,t+n}) = \frac{\partial \mathrm{P}}{\partial G_{t,t+n}} G_{t,t+n} + \frac{\partial \mathrm{P}}{\partial I_{t,t+n}} I_{t,t+n}$

[26] In general the residual does not vanish. However, the residual itself does have an interpretation. To see this, observe that for r = t, the residual in (8) can be written: R(t, t+n; r) = G(t, t+n; t+n)- G(t, t+n; t) R(t, t+n; r)=I(t, t+n; t+n) –I(t, t+n; t).

Using Axiom 1 (and if I=0), and by simple substitution gives us $G_{t,t+n} = \frac{\partial \Delta P}{\partial G_{t,t+n}} G_{t,t+n}$

(similarly if $G_{t,t+n} = 0$). From these results, the following separability condition arises:

$$\frac{\partial \Delta P}{\partial G_{t,t+n}} = \frac{\partial \Delta P}{\partial I_{t,t+n}} = 1 \qquad (9)$$

It therefore follows that $P(G_{t,t+n}, I_{t,t+n})$ must be of the following form:

$$\Delta P(G_{t,t+n}, I_{t,t+n}) = G_{t,t+n} + I_{t,t+n} \tag{10}$$

Now a new definition of $G_{t,t+n}$ and $I_{t,t+n}$ is needed, so that Axiom 3 and equation (10) are always satisfied. Let $\overline{G}_{t,t+n}$ be the average growth between G (t, t+n; t) and G (t, t+n; t + n) which is:

$$\overline{G}_{t,t+n} = \frac{1}{2}[G(t, t+n; t) + G(t, t+n; t+n)] \tag{11}$$

and $\overline{I}_{t,t+n}$ be the average inequality component between I (t, t +n; t+n) and I (t, t+n; t)

$$\overline{I}_{t,t+n} = \frac{1}{2}[I(t, t+n; t) + I(t, t+n; t+n)] \tag{12}$$

As a result, there is no residual term if this average is applied and then the symmetry axiom is always satisfied ($\overline{G}_{t,t+n} = -\overline{G}_{t+n,t}$ and $\overline{I}_{t,t+n} = -\overline{I}_{t+n,t}$). [27]As expected, both components will sum up to the overall change in poverty rate.

$$\Delta \mathrm{P}_{t,t+n} = \overline{G}_{t,t+n} + \overline{I}_{t,t+n} \tag{13}$$

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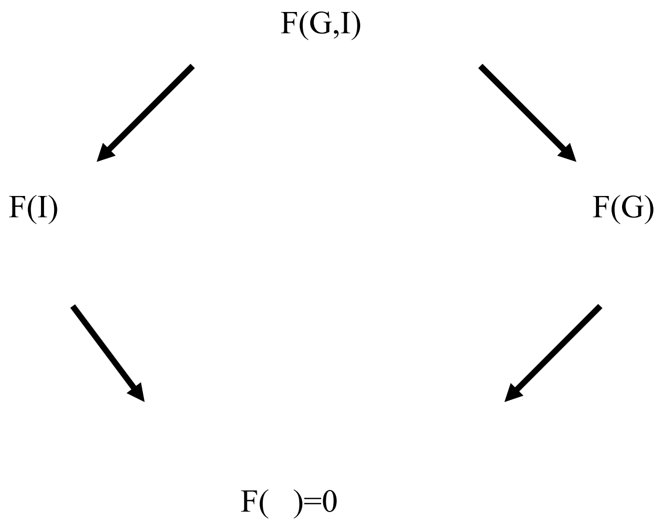
27 I t is true that by using this averaging procedure , I may be assigning the residual "equally " to both components. (to be tested with the data)

Both components have intuitively appealing interpretations. The *growth component* indicates the rise in poverty due to a shift in mean income, averaged with respect to the Lorenz curves prevailing in the base and final years. While the *inequality component* represents the average impact of the change in the distribution of relative incomes, with the average taken with respect to the mean income levels in the two periods.

The axiomatic (averaging) method just applied, turns out to give exactly the same result (when we have two components) as the one presented in Shorrocks (1999) and Shorrocks and Kolenikov (2005) based on the Shapley value. Figure A illustrates the basic structure of the Shapley decomposition which is particularly simple given that there are just two factors, G and I, and hence only two possible elimination sequences.

Figure A: Shapley decomposition for the growth and inequality components of the change in poverty.



Eliminating G before I produces the path portrayed on the left, with the marginal contribution F(G,I) F(I) for the growth factor, and the contribution F(I) for the inequality effect. Repeating the exercise for the right hand path and then averaging the results, yields the Shapley contributions:

$$\overline{G}_{t,t+n} = \frac{1}{2}\left[F(G,I)\ \mathrm{F(I)}\ \mathrm{F(G)}\right] \tag{14}$$

$$\overline{I}_{t,t+n} = \frac{1}{2}\left[F(G,I)\ \mathrm{F(G)}\ \mathrm{F(I)}\right] \tag{15}$$

which are exactly the same expressions showed in (11) and (12) . However, here there is no assumption of a linear change in poverty function, or better no assumption at all about the shape of $\Delta P_{t,\ t+n}$.

The decomposition can also be applied to multiple periods (more than two dates). A desirable property for such a decomposition scheme is that the growth and inequality components for the sub-periods add up to those for the period as a whole. However, this property will not hold when using the initial date of each sub-period as the reference. The problem would be rectified on noting that the contravention occurs because the reference (μ, L) keeps changing over the sub-periods. The remedy is to maintain a fixed reference date for all decompositions period, and again the initial date of the decomposition periods is a natural choice (as in Datt-Ravallion) or to apply the procedure that has been done here.

3.2. Results for Argentina: 1992/2001

As a first piece of evidence, Tables 7 and 9 show that when the mean income increased (either by the EPH survey or by the National Accounts measurement), poverty did not always fall. It has to be kept in mind that "economic growth" as measured in national accounts is not always reflected in average household living standards as measured in surveys (Ravallion 2001; Deaton 2003).[28] For instance, between 1996 and 1998 poverty increased, while mean income increased as well. The same applies for 1992/1998.

Table 10 gives the estimates of the decomposition of changes in poverty for the GBA in the whole period in percentage points, both in the aggregate and by sub-periods. For instance, the headcount index (H) is estimated to have started at 18.5% in 1992 (the origin in figure B), increasing by 17.1 points to 35.6% in 2001.[29] Denoted by sub-periods, this was made up of an increase in the index of 5.9 points between 1992 and 1998, and 11.2 points between 1998 and 2001.[30] Other standard poverty measures, which include the poverty gap ratio (PGR) and the Sen Index (SI), showed a similar trend (Table 9). It is worth noting that while in 1992/2001 H nearly doubled its value, the PGR and SI multiplied its value by almost three. Roughly speaking, people with income around the poverty line became worse off (given the increase in H) over this period, while the poorest were even worse affected (given increases in the PGR and SI). Figure B below shows this information bi-annually until 1998. The three-years 1998/2001 are taken altogether because they are meant to represent the recession period.

Testing section:

Standard errors of the decomposition

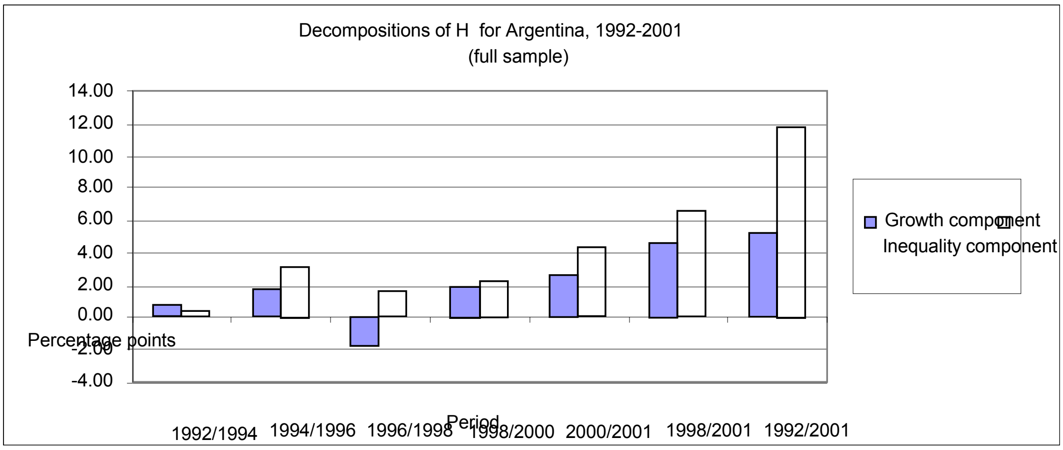
$$se(\widehat{H}_t^* - \widehat{H}_t) = \sqrt{\widehat{H}_t^*(1-\widehat{H}_t^*)/N + \widehat{H}_t(1-\widehat{H}_t)/N}$$ (ref: Agresti and Finlay)

[28] Deaton (2003) explains this statement by the fact that richer households are less likely to participate in surveys and that growth in the national accounts is upwardly biased. Moreover, consumption in the national accounts contains large and rapidly growing items that are not consumed by the poor and not included in surveys. So it is possible for consumption of the poor to grow less rapidly than national consumption, without any increase in measured inequality.

[29] For a random sample, the standard error of the headcount index can be readily calculated using well-known results on the sampling distribution of proportions; the standard errors of the headcount index H is $\sqrt{H(1-H)/N}$, where N is the sample size. The standard error for the smallest sample, for 2002, is 0. 6% of the estimated headcount index; for 1998, the largest sample, the standard deviation was: 0.4%.

[30] Between 2001 and 2002, the headcount ratio increased by 21.26 percentage points, 21.05 due to the growth component and 0.21 due to the inequality component. However, a profound analysis of this year is beyond the scope of this work.

Figure B: Decompositions GBA, 1992/2001



Between 1992 and 2001, distributionally neutral growth accounted only for 5.2 points, and distributional shifts accounted for 11.9 points. For the headcount ratio, the *inequality component* (I) dominates the *growth component* (G) (in absolute value) for the 1992/2001 period, the former being 2.3 times bigger than the latter. The *inequality component* also dominates G for the 1994/1996 and 1998/2001 sub-period, while the G component is slightly larger than the I component in 1992/1994 and 1996/1998.

When performing the original Datt –Ravallion decomposition (i.e. taking the residual into account) results show that the residual is not negligible, (i.e. it is not small compared to both *growth* and *inequality components*). Therefore, this is proof that the decomposition is sensitive to a change of reference from the initial to the final year (See Table 12),.

The relative importance of the two components varies according to which measure of poverty is used. This is most remarkable for 1992/2001. For H, while the *growth component* contributed to the increase in poverty by only 30%, in the case of the PGR (the average distance of people from the poverty line), changes in growth (3.9 percentage points) explained 39% of the total change in the poverty gap ratio (9.9 percentage points) and 53% of the change in SI. Therefore, in relative terms, the lack of growth contributed more to changes in poverty among the poorest, while worsening inequality was less severe among the poor than among the entire sample.

As opposed to what was found in cross-country studies (Li, Squire and Zou, among others), for many countries, over long periods, inequality has been surprisingly persistent, and where inequality has changed, on average, it has risen (Szekely 2003). The Argentine data seems to back this regularity.[31] The magnitude of I has a mixed explanation that I intend to explore further.[32]

Datt and Ravallion (1991) also argued that a conventional inequality index can be a poor guide to the way distributional shifts can affect poverty measures. To illustrate this issue, it is shown below how the Gini index and the *inequality component* have shifted over time.

The change in I for the whole period (11.9 percentage points) was 3 percentage points higher than the change in the Gini index in the same period (8.9 percentage points). In 1992/1994, when the reforms took place, the Gini index changed to a much bigger extent than I, but this difference was more than offset later on. In particular, from 1998 on the differences between the two levels widened (the *inequality component* was 2 percentage points higher than the Gini variation between 1998/2000 and 1.5 higher between 2000 and

[31] The relative importance of I has increased not only over time, but across groups as well. Results on decompositions for different sub-groups (male/female, employed/unemployed, etc) are available under request.

[32] Returns to education, gender-wage gap, returns to experience, dispersion in the endowment of unobservable factors and their returns, hours of work, labour market participation and the education of the economically-active population may have been some of the responsible of the distributional changes. They are related to three sources of change: the first is concerned with changes in the structure of wages in the economy, the second has to do with changes in the occupational choice of household members between work and inactivity, the third source comprises changes in the socio-demographic structure of the population, in this case specifically characterized by the level of education of the economically active population. Of course, these three sources are not independent of each other.

2001). From 1998/2001, the household survey mean decreased by 15.5% during a severe economic contraction. One could then argue that after a given change in inequality, a reinforced (and belated) variation in poverty ensues in particular during recessions.

Figure C: Inequality component vs Gini index changes, 1992/2001

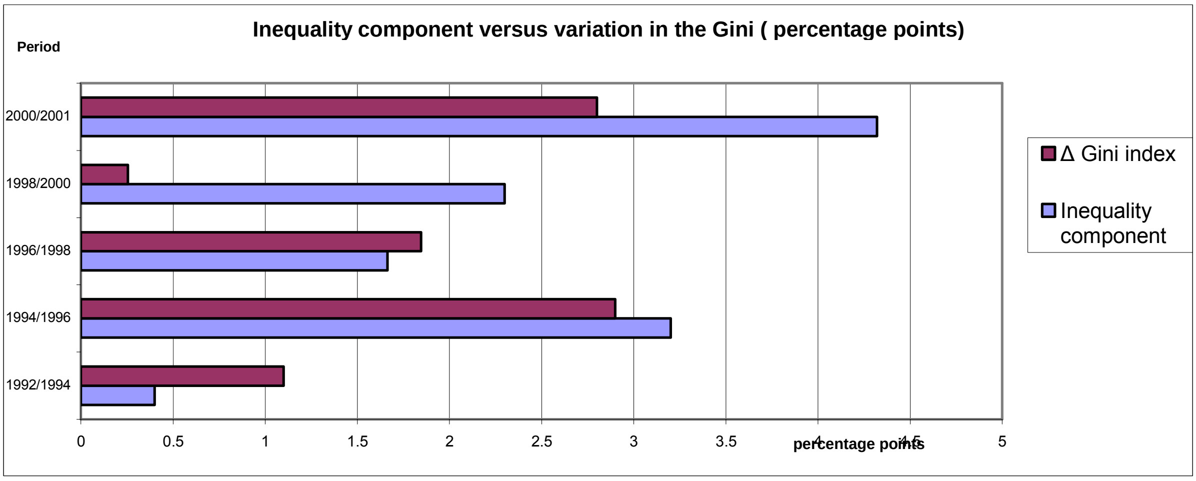


Figure C suggests the following: first, that recessions have strong negative effects on inequality, as can be seen more noticeably in 1998/2001 (Morley 2000) and in particular on the marginal effects that inequality may have on poverty, as measured by I . During growth spells, as in 1996/1998, inequality also worsened, but less severely. Second, that the marginal response of poverty to inequality changes has started to diverge deeply from changes in the Gini in 1998/2000, exactly when the recession started. A general conclusion that could be drawn is that the *inequality component* seems to give more information than the Gini index, in terms of distributional and poverty analysis. It must be remembered that a single statistic cannot necessarily reveal all relevant aspects of the distribution; the same value of the Gini coefficient may be consistent with different distributional shapes and different responses from poverty rates. Besides, the *inequality component* is an important measure of "trickle down" growth and provides an insightful examination on the manners in which poverty and inequality have interplayed during the 1990s in Argentina.

3.3. Possible extensions

This simulation was somewhat mechanical but illustrates, from a policy analysis point of view, both the importance of growth in income in any plan to reduce poverty as well as the importance of how gains in national income are distributed among the population. From a methodological point of view, it gives more information than any simple inequality or poverty measure. It also gives a new insight in order to check the stability of the effects of income inequality (or growth) on poverty within a country. Nonetheless, this type of decomposition has many limitations. Three of the most relevant concerns will be highlighted. First, the capability of implementation of growth policies versus redistribution policies. Fields (2001) argues that developing countries experience shows that growth policies are more effective in reducing poverty than redistributive policies. By only comparing the changes of poverty against changes in income or changes in inequality, results may be misleading since a reduction in the Gini coefficient of 10% is much harder to execute than a 10% increase in the mean income.

Second, the method applied in this section does not analyze possible endogenous interactions between growth and inequality, further affecting poverty. Several recent studies suggest that some egalitarian redistributions can have positive efficiency effects, producing higher growth rates and therefore reducing poverty (Benabou 1996). The underlying argument has many precursors including the early nutrition-based efficiency wage theories (Dasgupta and Ray 1987).

Finally, the simulation relies on summary measures of inequality and poverty rather than the full distribution. Also, related to the statistical nature of the decomposition some authors agree that these decompositions are useful for policy analysis but may be a wrong approximation to reality as they do not take into account the behavioural equations behind household income generation (Bourguignon, Ferreira et al. 2001; Ferreira and Leite 2003). This hinders any scrutiny on how to implement particular poverty-reduction policies (such as education policies or labour market polices, for instance) and therefore, we cannot state what would be the sign of any particular effect, such as gender, employment, education or experience on poverty changes. All these critiques will be left as possible extensions for my future research.

4. Conclusions

Many attempts have been made to separately measure the impact of changes in mean income and income inequality on poverty using regressions. These attempts had some problems: firstly, the procedure was not very accurate, and secondly it required an enormous amount of data. The method developed in the present work provides an alternative means of separating the effects of mean income growth and changes in inequality on poverty.

Antecedent procedures often placed constraints on the type of poverty functions which could be used to perform a decomposition (including the Kakwani axiomatic approach presented here), or were proven to violate some intuitively natural axioms. Only certain forms of functions yielded a set of contributions that added up to the amount of poverty that requires explanation. [33] Therefore, these methods required the introduction of a vaguely defined residual or "interaction" term in order to maintain the decomposition. In fact, that residual was explained by the fact that inequality in a distribution can change in innumerable ways that are not taken into account by a single (Lorenz curve) parameterization and also by the fact that the importance of the reference date was neglected when decomposing poverty .

Here, by applying the axiomatic approach proposed by Kakwani (1997), an exact decomposition procedure was derived, introducing the idea of average growth and inequality effects, the sum of which is equal to the total change in poverty. Moreover, a generalization of the way the *inequality component* is measured in the decomposition was

[33] These functional constraints have been also placed in the case of inequality indices decompositions.

attempted and proven to be effective using the cumulative (empirical) density function instead of parameterized Lorenz curves.

From an empirical perspective, it has been noted in the literature that income inequality is relatively stable within countries, providing some support for the pessimistic conclusion that poverty will tend to persist as countries grow. In agreement with this result, many authors using the Datt-Ravallion procedure, have found that the *growth component* explains the largest part of observed changes in poverty for African, Latin-American and East and Southeast Asian countries. The decompositions in Section 3 have proven that there is a different regularity for Argentina: the *inequality component* explained the largest part of observed changes in poverty during the 1990s (11.9 percentage points, out of an increase of 17.1 percentage points in the headcount ratio). Besides, when applying the Datt-Ravallion decomposition, this paper's results show that the residual is not negligible compared to both *growth* and *inequality components*, which demonstrates the necessity of performing a more general and intuitive decomposition instead.

Moreover, by comparing the evolution of the *inequality component vis a vis* the Gini coefficient, one could argue that, given a certain change in the Gini coefficient, a reinforced variation in poverty ensues in particular during recessions.

Another interesting finding is that the lack of growth contributed more to changes in poverty among the poorest, while worsening inequality was less severe among the poor than among the entire sample, as shown with the decomposition of the Sen Index.

Certainly, I cannot rule out the possibility that there are complex interactions between inequality and growth not captured by this method that net out to small changes in the former that are uncorrelated with the latter. Furthermore, when comparing the change of poverty with respect to growth and with respect to inequality, one should not fall into the trap of thinking that is as easy to lower inequality by 10% as it is to achieve 10% economic growth; the former is far more difficult than the latter. In countries' actual experience, it has proved far easier to generate economic growth than to change the Gini coefficient (Deininger and Squire 1998).[34] Besides, even the finding that economic growth nearly always reduces poverty may be misleading, since not every individual is made richer by economic growth, or even every population sub-group. Further research should address these topics following a micro-based path.

[34] In the developing world, GDP per capita grew by 26 per cent between 1985 and 1995 (World Bank 1997), while Gini coefficients in the world barely changed over the same period (Deininger and Squire 1998, table 5)

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