A study of the factors affecting the individual contributions to income inequality: analytical framework and empirical evidences

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Abstract
The paper aims at proposing the study of the individual contribution to the income inequality. The horizontal analysis of inequality usually concerns with the measurements of appropriate indexes in given social groups and address the relationship between the characteristics of the groups and the inequality observed (Stewart, 2002). This perspective recognizes the role of the grouping criteria (for instance gender, race, culture, age etc.) in determining the variation of the inequality measures across the groups boundaries and requires sufficient theoretical reasons to identify the groups classification criteria. On the other hand, it is also recognized the utility of inequality analysis just concerned with the variation across the parts of a given income distribution, i.e. according to selected distribution percentiles (Hölscher, 2006; Milanovic, Ersado, 2005). According to this perspective, the paper elaborates on the idea of the individual contribution to the inequality level of a given income distribution and proposes its definition as an individual position. Firstly, the concept of individual contribution is proposed and discussed. Secondly it is taken into account the relationship between the individual contribution to inequality and the individual position with respect to three other distinctive individual characteristics: deprivation (Ruciman, 1966), relative poverty and growth if individual income. An empirical investigation is proposed, based on the Household Income Survey of the Banca di Italia' Household Income which is intended to provide examples intended to support the propositions introduced.

Keywords: *inequality, individual position, deprivation, relative poverty, growth*

1. Introduction

Bowles and Gintis (2002) underline the fact that individual positions matters in the analysis of inequality with institutions playing an important role. The points stressed concern with the individual endowments and opportunities and with the specific influence of institutions in shaping them. Scholars elaborate on both these points and emphasize the role of individual socio-economic characteristics in the context of the institutional environment (Piraino, 2007; Isaac, 2007). The analysis of the relationship between the summary inequality measures and the individual characteristics usually requires specific theoretical assumptions. For example, assumptions finalized to the interpretation are drawn from the labour and capital markets theories in order to identifies causes and consequences of the inequality in the economic system (Ravallion, 2001; Sala-i-Martin, 2006) as well as theories about the human capital formation and roles, for example, are at the basis of the inquiry about the relation between individual level of education and inequality (Checchi, 2004). The relationship between the individual condition and the inequality measures at some level of the socio-economic system is implicitly assumed or taken

for granted just because the individual positions are simply summarized by focusing the distribution of the attribute at stake (e.g. the individual income) and thus the attention is shifted toward the comparison among alternative distributions. Atkinson (1970) identifies the theoretical foundations of inequality measures by addressing and solving the problem of comparing two different distributions: while the concept of *equally distributed equivalent* level of income allows to achieve desirable properties of an inequality index, on the other hands it clearly and coherently does not account for individual characteristics. The ranking of the distributions by the social welfare function implies to derive social preferences orderings over income distributions from personal preference orderings (Lambert, 1989, pp.91-93). Thus it seems that a double relationship exists between inequality measures and individual characteristics: on the one hand, conceptual foundation of inequality at socio-economic systems integrate the individual characteristics by focusing on distributions and, on the other hand, the interpretation of the effects of inequality on the individual level is based on assumptions explaining the conditions and the behaviour of the individual agents in the economic systems.

The focus on individualistic measures of inequality is of interest as it provides a basis for the study of the potential determinants of inequality, while the information collected may contribute to corroborate existing theoretical frameworks. They are also of interest in order to depict potential scenarios of the effects of changing degrees of inequality levels. They also are of interest in analyzing the within-countries pattern of inequality.

It seems thus that while individual characteristics may be to some extent of interest in inequality analysis, a not sufficient attention has been paid to their analysis. This study is aimed at investigating this field. It proposes to consider the individual disvantage due to inequality and take into account some defining and accompanying characteristics. In the former are included aspects related simply to the fact that the measure requested has to account for disvantage suffered by an individual due to her/his income. The accompanying properties are considered the relations of the measure proposed with some significant characteristics of the individual positions and, namely: the individual deprivation (Ruciman, 1966), the position with respect to relative poverty and growth, in the latter also systemic aspects are

necessarily considered. The approach adopted is based on the analysis of the data of *Survey on Household Income and Wealth* (Banca d'Italia) in order to provide examples of the propositions introduced. The paragraph 2 presents some analytical aspects of the measure proposed. The empirical investigation is illustrated in the paragraph 3. The last paragraph proposes some final remarks.

2. Theoretical framework

The individual positions concerning inequality are considered, even implicitly, in literature under various standpoints. Sala-i-Martin (2006) argues that using countries as unit of analysis in investigating inequality requires at least to take into account population-weighted distributions of per capita income. Nonetheless this approach does not account for within countries dispersion and thus appears to be inadequate o depict the 'true individual inequalities' (Sala-i-Martin, 2006, pp. 352-354). Analogously, it has been pointed out that the magnitude and change of the inequality is necessarily interpreted using subjectively defined criteria (Moran, 2003, p. 365). More in details, the measures summarizing the Lorenz curve – like the popular Gini index – imply that the same size of the area underlying the Lorenz curve can be associated with different shapes (*statistical effect*) (Moran, 2003, p. 357). Furthermore, the Gini index cannot distinguish between 'convergence' to the global mean and 'clustering' around local means: as a consequence difference existing among societal groups may be obscured even though they should be appreciated (Moran, 2003, p. 357). While the validity of summary measures rest indubitable, it is also recognized that they could not provide information about the real pattern of the inequality (Moran, 2003). A focus on the individual condition in the inequality analysis is basically proposed in the conceptualization of the inheritance of inequality (Bowles, Gintis, 2002). Noteworthy, this perspective sheds light on the influence of basic institutions – e.g. the family – on the individual condition and well-being level and change and thus helps the comprehension of the 'true individual inequalities' patterns and determinants.

Furthermore, a direct relationship between individual position and inequality measures is identified by scholars through the concept of deprivation (Yitzhaki, 1979). A person is thought to be relatively deprived of a good X when: a) he does not have the good X, b) he sees some other person or persons

having the good X; c) he wants X; and d) he sees as feasible that could have the good X (Ruciman, 1966, p.10). Wang and Tsui, (2000) show that that the elements of the calculus of the Gini's index can be interpreted as marginal effect on aggregate deprivation index.

On the other hand, the focus on the individual position can be also conceptualized in terms of horizontal inequality. Horizontal inequality is usually defined as the inequality within groups obtained by large income distribution by discriminating criteria derived from the individuals socio-economic characteristics (e.g., gender, race etc.) (Stewart, 2005). It has been namely suggested the idea that individual position can be thought of as expression of *atomistic group* in whole distribution (Jayaraj, Subramanian, 2006, p. 132). Finally, Perugini and Martino (2007) ranking the individual Euclidean distances interpreted as components of the Gini's index, proposed an analysis of the determinants of the inequality in Italian Rural and urban regions. All these perspectives, recognize the systemic nature of the inequality and of the measures related, but point out the meaning of individual positions as basic condition of inequality.

The well-known theoretical framework introduced by Atkinson integrates the individualistic positions in the analysis of social welfare function. Conversely, this study elaborate on the framework mentioned above and considers the possibility of characterize the individual positions in terms of contribution to inequality measure of a distribution.

Consider a income-distribution (i.e., a non-negative, non-decreasingly ordered n-vector $\mathbf{y}=(y_1 \ldots y_i \ldots y_n)$ where y_i is the income of the i^{th} poorest person in a society comprising n individuals, and $0 \leq y_i \leq y_{i+1}$. a straightforward way to account for individual contribution to inequality overall measure can be derived from the Lorenz curve. Let P_i, the fraction of the population made of the first *I* poorest persons and $Q_j = Y_i/Y$ the amount of income belonging to this fraction, with $Y_i = y_1 + y_2 + \ldots + y_i$ and Y being equal to the total amount income.

The individual contribution to inequality can be defined as follows:

(1) $$c_i = P_i - Q_i$$

as difference between the Lorenz curve coordinates, the case $c_i = 0$ indicates that the individual gain a position corresponding to the equally distribution case, whereas the case $c_i > 0$ indicates concentration. Moving from the j^{th} position to the k^{th} position in the distribution implies the change Q_j to Q_k. If the change is: $Q_k - Q_j < P_k - P_j$ then $P_k - Q_k > P_j - Q_j$ i.e., the increase in the income fraction is lower than the increase in the population fraction in such a way that the new contribution increases, indicating that the disvantage increases, according to the 'insufficient' increase of the fraction of income (the opposite holds if $Q_k - Q_j > P_k - P_j$, even though it has to be pointed out that it is ever $P_i \geq Q_i$). The problem with the measure proposed is that it includes effects related to poorest *i* units and cannot be directly referred to the individual characteristics. The difference:

(2) $\Delta c_i = (P_i - Q_i) - (P_{i-1} - Q_{i-1})$

is instead directly referred to the i^{th} individual and after elementary manipulation can be expressed by:

(3) $$\Delta c_i = \frac{1}{n}\left(1 - \frac{y_i}{\bar{y}}\right)$$

where the term in brackets is just an element of the calculation of the well known *relative mean deviation* (Cowell, 1995). Jaraj and Subramanian (2006) introduced index of inequality a groups level (horizontal inequality) and consider the case of vertical measures on inequality as referred to *atomistic groups* including just one component. One of the index proposed is:

(4) $$d_j^1 = \left(\frac{m(j)}{n} - \frac{Y(j)}{Y}\right) m(j)$$

Where *m(j)* is the number of the individuals in the group *j* and *Y(j)* is the total income of the individual of the group (Jaraj Subramanian, 2006, pp. 125-126). It is easy to show that in the case of atomistic group the index become:

(5) $$d_i^1 = \left(1 - \frac{y_i}{\bar{y}} \right)$$

Which can be directly referred to the (3).

The individual index d_i^1 increases if the individual income decrease, while it decreases if the income increases. Furthermore the larger is the index the larger is overall inequality measured in terms of relative mean deviation. These two very simply properties provide a basis for using the (3) as measures of individual relative disvantage (individual contribution to inequality).

3. Empirical analysis: accompanying characteristics

In order to characterize the concept of individual relative disvantage it is worth to consider its relationship with two distinctive, individually grounded characteristics of the income distribution: deprivation and poverty. Furthermore the relationship between Δc_i and growth is considered. The approach is based on a simple empirical investigation, conducted by the *Survey on Household Income and Wealth* 2004 and 2006 of the Banca d'Italia.

The deprivation and the individual disvantage are different concepts. The table 1 shows the reduction of the individual deprivation according to the distribution of the Net Disposal Income

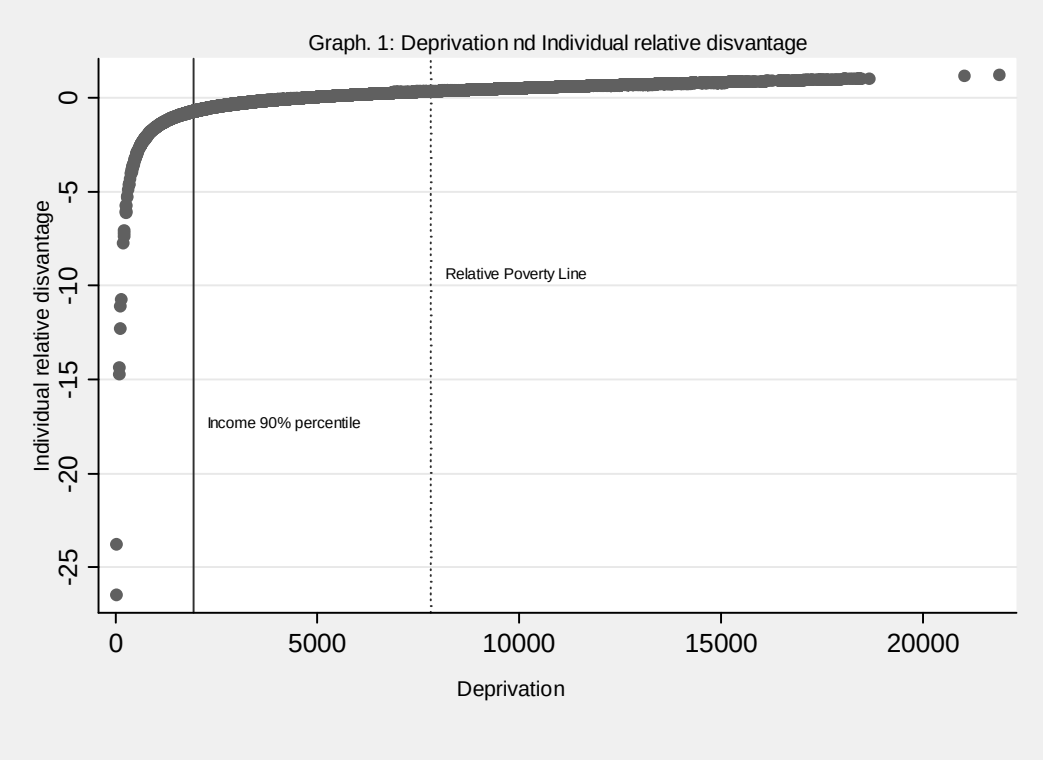
Table 1: *Mean and variance of the Marginal deprivation function*

Quantiles of Net Disposal Income	Mean	Standard deviation
I	7039.543	4213.652

II	7027.76	4143.086
III	6670.452	4147.232
IV	6702.789	4192.481
V	6883.716	4217.233

Source: Elaboration of SHIW 2006 data

There is a tendency for deprivation to be less important as the income increases. The pattern of the relationship between Δc_i and the income is directly predictable by definition (Wang, Tsui, 2000), but not without interpretation. This can be elaborated by examining the relationship between the marginal deprivation and the income. The coefficient of correlation between the Net Disposal Income and the individual "per Euro" deprivation, defined according to Wang and Tsui (2000), is -0.589. The relationship between Δc_i and the deprivation requires a more complex interpretation (Graph.1). First, note that Δc_i increases rapidly only for the large income (according to the (3), the income larger than the mean give raise to a negative index). The solid vertical line indicates the level of deprivation corresponding to the 90° percentile of the Net Disposal Income. This is the approximate threshold beyond which the rate of growth of Δc_i drastically changes. It is also easy to see how the new rate of growth is very low and does not change very much in the very large range of deprivation (the dot vertical line indicates the level of deprivation corresponding to a relative poverty line of 12500 Euro/year). Individual disvantage and deprivation are both connected to individual income, but a income threshold exists for deprivation to be substantiated or not by the individual relative disvantage Δc_i. The disjunction between Δc_i and deprivation underlines the subjective nature of the deprivation compared with the Δc_i which I turn capture aspects of the income availability. The individual disvantage allows one to identify a range of deprivation values which are not related to significant income differences (on the left side of the 90° percentile line) but appear rather expression of a just positional perception of personal income.



Sala-i-Martin (2006) points out the poverty analysis can be affected by the subjective choices about the poverty lines adopted. In this study four different measures of relative poverty have been used in order to examine the relationship between Δc_i and poverty (5000, 7500, 10000, 12500 Euro/year per capita). The table 2 shows the Pearson correlation coefficients with Δc_i (Spearman coefficients correlation are larger).

Table 2: *Individual disvantage and poverty - Correlation matrix* (2006)

	Δc_i	RPov_1	RPov_2	RPov_3	RPov_4
Δc_i	1.00				
RPov_1	0.2039	1.00			
RPov_2	0.2914	0.6129	1.00		
RPov_3	0.3308	0.4919	0.8025	1.00	
RPov_4	0.3764	0.3675	0.5997	0.7472	1.00

Source: Elaboration of SHIW 2006 data

The positive relationship between poverty (each variables takes the values 1 if the observed unit has a Net Disposal Income lower than the poverty line assumed) and Δc_i indicates that the poors suffer a larger relative disvantage that the richer units. Albeit this may be predicted by the definition of Δc_i, it has to be pointed out that a complex relationship is expected according to the fact that poverty and inequality are differently concerned and based (Cowell, 1995, p. 10; Ravallion, 2001; Cornia, Atksinson, 2004, pp. 43-44).

The analysis of the relationship between the growth and the individual relative disvantage has been conducted by taking into account the growth of the individual Net disposal income between the 2004 and 2006 and the average rate of growth of the Gross Product and regional level through the period 2000-2006. In the first case the goal is to capture the effect of the individual income change on the individual disvantage. The second view aims at capturing the effects of the changes at level of territorial economic system. Furthermore, the analysis has been conducted considering the role of the institutional environment. A recent approach emphasises the distributional nature of term 'horizontal' and suggests that horizontal inequality is due to the effectiveness of the society in allowing the exploitation of individual endowments. More precisely, Audet *et al.* (2008) argue that the economic systems contains market's mechanisms and public interventions – here assumed as connected to institutional environment

- able to transform the socio-demographic characteristics of the individual into income. Thus these characteristics are expected to give raise to the predicted income $\hat{y}$ provided the effectiveness of the market's mechanisms and the public interventions. Therefore, the inequality index calculated by the observed income, $I(y)$, can be decomposed into the vertical inequality $I^{v}=I(\hat{y})$ - which reflects the conditions expected on the basis of the socio-demographic characteristics – and horizontal inequality, $I(y) = I^{v} - I(\hat{y})$, which is an outcome of the market's mechanisms and public intervention (Audet *et al.* 2008, p. 470). The relationship between the individual disvantage (Δc_i) and the growth has been investigated with respect to the total and vertical inequality.

To this purpose, according to Audet *et al.* (2008) the observed net disposal income has been regressed on the vector of the x_i socio-demographic characteristics of the i^{th} individual (the characteristics utilized are: *sex*, *civil status*, *age*, *study degree*, *area*, *professional qualification* and *branch of activity*). Thus Δc_i has been determined with respect to both observed and estimated net disposal income. Analogously, the growth rate of the income has been calculated in the two cases. In the table 3 are summarized the coefficients estimated in quantile and OLS regressions.

The coefficients of the log of the growth rate (*LGy*) are negative and significant in the case of the regressions run on Net Disposal Income observed. This means that the larger is the growth rate of the income, the smaller is the individual relative disvantage: the individual who gain a larger income appear able to achieve a better position in the income distribution. In other word there would be an association among the causes which causes the growth of individual income up to the current level and the causes which may promote a reduction in the individual inequalities. While the effect of *LGy* on Δc_i is almost the same at median and in the OLS regression, it is larger in the first two percentiles and smaller in the last, suggesting a stratification of the causes of inequalities with the lower-income individuals position more sensible to the changes observed in the income level. The rate of growth of the Regional Gross Product (*Grgp*) reflects the growth of the regional economies and thus indicates the changes in the potential base for distribution. The coefficients related are negative and significant in the first two models, but their size is considerable different with respect to the OLS regression. In the last two model

the coefficient are not statistically significant. The tentative interpretation proposed is that the increasing of the potential opportunities for individual position improvements is effective in the case of the low income percentiles, while it does not in the remaining case and the OLS regression does not account for this stratified situation.

Tab. 3: Quantile regression estimates for different quantiles

	Percentiles				**OLS**
	0.1	**0.25**	**0.50**	**0.75**	
			Net Disposal Income observed		
Constant	- 0.521	-0.123	0.181	0.443	0.069
	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)
LGy	-4.86	-0,378	-0,281	-0.172	-02.43
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Grgp	-4.021	-1.739	-0.474	-0.026	-1.414
	(0.00)	(0.00)	(0.14)	(0.94)	(0.01)
			Net Disposal Income estimated		
Constant	-0.627	-0.270	0.007	0.288	-0.023
	(0.00)	(0.00)	(0.66)	(0.00)	(0.08)
LGyhat	-0.003	-0.055	-0.089	-0.099	0.066
	(0.7986)	(0.02)	(0.00)	(0.578)	(0.066)
Grgp	0.874	0.379	-0.29	0.427	0.409
	(0.00)	(0.58)	(0.32)	(0.17)	(0.09)

Source: Elaboration of SHIW 2006 data, in brackets prob of t-students

In the case of Net Disposal Income estimated the coefficients of *LGyhat* are not statistically significant in the first and the last percentile: the growth of the individual income due just to individual endowments does not affect the relative disvantage in these cases. Conversely, in the centrale percentiles the influence is negative and different from the OLS outcomes. The coefficients of the variables GPIL: are just significant in the first quantile model and in OLS regression. These may appear a little bit controversial outcomes and difficult to interpret. On the one hand, it would be the case of invoking a stratification of the population, on the other hand one should also point out that the significant coefficient (percentile 0.1) would indicate that, taken for granted the individual endowments, the growth of the economy would not benefit the corresponding strata.

In summarizing the analysis, the defining properties of the measure proposed are very simple: a) as it increases the corresponding overall measure on inequality increases; b) an increase (decrease) of the

income of the individual reduces (increases) the size of the individual relative disvantage measure. The accompanying characteristics, explored by the empirical analysis are the following: a) the measure is positively related to individual deprivation, but discriminate among its values and identifies a positional area in its range; b) the measures increase with poverty; c) the measure decrease with the growth of income and the improvements of the economy, even though in various ways according to income stratification.

5. Final remarks

The paper assumes that the analysis of the individual contribution to inequality is of interest for both corroborating theories and for identifying the consequences of the changing levels of inequality. The measures proposed is just the derived from the coordinates of the Lorenz curves and measures the individual relative disvantage according to Jaraj and Subramanian (2006). Its relationships with other distinctive individual aspects of inequality are empirically examined and interpreted in terms of the existing theories. It also showed that while changes in actual individual income may or not affect the individual relative disvantage, the growth at system level, as index of the potential opportunities provided by the economy, reduces the disvantage. This stress on the role of institutional framework and on the potential divergence between institutions supporting the income production and institutions governing or promoting distribution. The complexity of the framework should be better investigated by widening the extent of empirical analysis and by assuming that individual participate to organization which, according to North, are primarily in contact with institutions.

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