Inequality Decomposition by
Income Source in Italy
1987 - 1993

di

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Introduction.

After a long period of lack of attention, the issues of income distribution and redistribution seem to have regained a central position in the economic debate in Italy. To this new interest have contributed both the experiences of countries, like the USA and the UK, witnessing a strong increase in inequality during the 1980s, and especially the awareness that the structural changes in the Italian economy and the reforms of the welfare system might produce important consequences on the distribution of incomes.

In Italy, at least according to recent studies (Brandolini-Sestito (1994)), inequality has fallen rapidly from 1977 to 1982, then it increased until 1987, falling again in the following 4 years; the information so far available for the 1990s, however, is not so clear, because inequality seems stable if one looks at consumption, but rapidly increasing among incomes.

This paper analyses the structure and recent evolution of inequality in Italy among households, using the last four available Bank of Italy Surveys of household income and wealth (1987-93), and focuses attention on the distribution of incomes. In particular, it employs a technique not used so far on Italian data, consisting in the decomposition of an inequality index into components representing the contribution made by each income source to overall inequality.

The methodology is described in section 1, and here applied to two inequality indexes: half the squared coefficient of variation, belonging to the generalised entropy family, and the Gini index. The first measure is decomposable according to the unique rule described in what follows, while the second is by far the most commonly used inequality index, and allows to verify the sensitivity of the results to alternative decomposition criteria.

The second section applies the decomposition to the data set, studying the contribution made by each income component to inequality in a given point and to its change over the whole period. The third section summarises the main results and concludes.

1. Decomposition of two inequality indexes by income source
1.1 Half the squared coefficient of variation

Assume that total income of household i, x_i, is obtainable as the sum of K mutually exclusive and exhaustive components: for example, household head's employment earnings, plus wife's earnings, plus investment income, and so on; we can thus write: $x_i = \sum_k x_{ik}$, or $x_k = \sum_i x_{ik}$, where x_{ik} is the amount of income of type k owned by the ith household.

In order to analyse the contribution given to total inequality by each of the K income components, it may be useful to look for a decomposition rule allowing one to express total inequality, summarised by an index I, as the sum of K terms, each representing that part of inequality of which the kth income source is responsible: $I = \sum_k S_k$. If $S_k > 0$, x_k makes total income more unequally distributed, while an equalising effect is indicated by $S_k < 0$.

However, Shorrocks (1982) has shown that for each index there exists a potentially infinite number of possible decomposition rules, since each measure can be written in many alternative but equivalent algebraic formulations, with the consequence that different decomposition rules applied to the same inequality index may produce a great variability in the individual contributions S_k; this makes the choice of a specific rule arbitrary, so that we have to introduce other choice criteria. By

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imposing some further restrictions[1], Shorrocks finds a unique rule satisfying them: if $s_k = S_k/I$ is the contribution of the kth component, then

$$(1) \quad s_k = \frac{\text{cov}\,(x_k, x)}{\sigma^2} = \frac{\rho_k\,\sigma_k}{\sigma}\,,$$

where σ and σ_k are the standard deviations of x and x_k, and ρ_k is the correlation between x_k and x: s_k is thus the estimated slope in a regression of x_k on x. This decomposition rule is unique, i.e. it does not depend on the inequality index used.

For an application, the choice has fallen on one of the indexes belonging to the generalised entropy family, represented by half the squared coefficient of variation:

$$(2) \quad I_2 = \frac{\sigma^2}{2\mu^2}\,.$$

In the case of the kth income component, its inequality index over all the sample households is:

$$I_{2k} = \frac{\sigma_k^2}{2\mu_k^2}\,, \quad \text{so} \quad \sigma_k = \mu_k\,\sqrt{2\,I_{2k}}\,.$$

It thus follows that $s_k = \rho_k\,\dfrac{\mu_k}{\mu}\,\sqrt{I_{2k}/I_2}$, and

$$(3) \quad I_2 = \sum_{k=1}^{K} S_k = \sum_{k=1}^{K} \rho_k\,\frac{\mu_k}{\mu}\,\sqrt{I_{2k}\,I_2}\,.$$

It may now be interesting to proceed further in this decomposition, in order to isolate the effects, on the contribution of the kth income factor, of changes in the number of recipients, i.e. the group of households with $x_{ik} > 0$, and in the inequality of x_k within this same group.

Denoting with n the total number of households, with n_k^+ the number of households with $x_{ik} > 0$, and with μ_k^+ the mean of x_k computed only over these households, it can be shown that

$$(4) \quad I_{2k} = \frac{n}{n_k^+}\,(I_{2k}^+ + \frac{1}{2}) - \frac{1}{2}\,, \quad \text{where} \quad I_{2k}^+ = \frac{\sigma_{k+}^2}{2\mu_{k+}^2} = \frac{1}{2}\,\frac{1}{n_k^+}\,\sum_{k+}\,(\frac{x_{ik}}{\mu_k^+})^2 - \frac{1}{2} \quad \text{is our}$$

inequality index for x_k, computed over the recipient units only. By combining the last two expressions,

$$(5) \quad I_2 = \sum_{k=1}^{K} \rho_k\,\frac{\mu_k}{\mu}\,\sqrt{I_2\,(\frac{n}{n_k^+}\,(I_{2k}^+ + \frac{1}{2}) - \frac{1}{2})}\,.$$

The square root of I_2 can thus be written in a form that depends only on the correlation between each component and total income, the relative importance of the various components, the relative frequency of households with $x_{ik} > 0$, and the inequality within this subgroup; the possibility of observing the role of each of these factors explains why the Shorrocks decomposition rule is applied to an inequality index: with the analysis of the temporal evolution of these different components for

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[1] Apart from additivity, the contributions should not depend on how incomes or households are ordered; if two income sources have the same distribution and constitute total income, they should be assigned the same contribution to inequality.

each income source, it is possible to highlight which elements are responsible for the changes in aggregate inequality. For this purpose, it is useful to decompose the variation of the index between time t and time t+1 into its elementary components: from (3),

$$(6) \quad dI_2 = \sum_{k=1}^{K} \frac{\partial I_2}{\partial \rho_k} d\rho_k + \frac{\partial I_2}{\partial (\mu_k/\mu)} d\frac{\mu_k}{\mu} + \frac{\partial I_2}{\partial I_{2k}} dI_{2k}$$

where:

$$\frac{\partial I_2}{\partial \rho_k} = 2 \frac{\mu_k}{\mu} \sqrt{I_{2k} I_2}$$

$$\frac{\partial I_2}{\partial (\mu_k/\mu)} = 2 \rho_k \sqrt{I_{2k} I_2}$$

$$\frac{\partial I_2}{\partial I_{2k}} = \rho_k \frac{\mu_k}{\mu} \sqrt{I_2 / I_{2k}} \quad .$$

Moreover, it follows from (4) that $dI_{2k} = (I_{2k}^+ + \frac{1}{2}) d\frac{n}{n_k^+} + \frac{n}{n_k^+} dI_{2k}^+$, thus:

$$(7) \quad dI_2 = \sum_{k=1}^{K} 2 \frac{\mu_k}{\mu} \sqrt{I_{2k} I_2} \, d\rho_k + \sum_{k=1}^{K} 2\rho_k \sqrt{I_{2k} I_2} \, d\frac{\mu_k}{\mu} +$$

$$\sum_{k=1}^{K} \rho_k \frac{\mu_k}{\mu} \sqrt{I_2 / I_{2k}} \, (I_{2k}^+ + \frac{1}{2}) d\frac{n}{n_k^+} + \sum_{k=1}^{K} \rho_k \frac{\mu_k}{\mu} \sqrt{I_2 / I_{2k}} \frac{n}{n_k^+} dI_{2k}^+$$

In this expression all the variables, except those in difference form, may be interpreted as averages of base and current period values. In the following paragraph the application of (7) will allow us to analyse the evolution of inequality much more deeply than with rule (1) only.

The use of these decomposition techniques actually conceals the potentially ambiguous nature of the search for an exact decomposition of an inequality index in the sum of K terms, each representing the 'contribution' given by the kth income source to total inequality. Shorrocks (1988) describes four alternative meanings that could be attributed to the 'contribution' of the kth income type:

A) The inequality due to this income source alone: $S_k^A = I(x_k)$.

B) The reduction in total inequality which would be originated by the elimination of this income type: $S_k^B = I(x) - I(x - x_k)$.

C) The inequality that would be observed if x_k was the only income source not equally distributed: $S_k^C = I(x_k + \mu - \mu_k)$.

D) The reduction in inequality observed in the case of a uniform distribution of x_k: $S_k^D = I(x) - I(x - x_k + \mu_k)$.

The same author shows, however, that no inequality index satisfying some essential requirements (symmetry, the Pigou-Dalton principle of transfers, continuity in x and normalisation to zero in case of perfect equality) may be decomposed according to these four criteria, respecting at the same time the condition $I = \sum_k S_k$, necessary if we want to speak sensibly of individual contributions. The variance, perhaps the simplest measure of dispersion, can for example be

decomposed according to this scheme only in the case of no correlation among the K income types, clearly an unrealistic hypothesis.

In the case of I_2, however, the contribution of each income source can be expressed as the mean of the interpretations C and D:

$$(8) \quad S_k = \frac{1}{2} \left(\frac{\sigma_k^2}{2\mu^2} + \frac{\sigma_k^2 + 2\,\text{cov}\,(x_k, x - x_k)}{2\mu^2} \right).$$

Note that, although all sensible, the four meanings given to the contribution of a single factor do not necessarily have the same sign: according to rule C, the contribution is surely positive, even if a factor is strongly negatively correlated with total income (for example, an unemployment benefit), unless x_k is constant, while in the case of D the sign may be negative: pension income, for example, may show a contribution positive for C, and negative for D. The use of an index that identifies at least some of the different meanings of the expression 'contribution to inequality' allows to clarify more precisely the role actually played by each income source in the distribution of total income.

Looking at rule (1), it is easy to note that if an income source is evenly distributed among all units, its contribution to total inequality is zero; in the same way, the increase of an income x_k by a constant amount causes a reduction in total inequality (unless the chosen index is the variance), but the relative contribution given by (1) doesn't decrease, although this change has clearly an equalising effect. The insensitivity to transfers of this kind, explicitly imposed, is a price that must be paid, in terms of lower generality, if we want to rule out the potential arbitrariness implicit in the search for a decomposition rule.

1.2 The Gini index

Let G_k be the Gini index for the kth income source over all the families of our sample, and μ_k the mean of x_k. Thus $\mu = \sum_k \mu_k$ is average income, and $L_k = \mu_k/\mu$ is the share of x_k in total income.

Finally, denote with C_k the concentration coefficient (or pseudo-Gini) for x_k, defined as one minus twice the area under the concentration curve, obtained after the association of each proportion of families (ranked by increasing values of total income) to the share of x_k that they own. The Gini index can be written (Rao (1969)) as a weighted average of the K concentration coefficients, with the weights given by the relative importance of each income source: $G = \sum_{k=1}^{K} \frac{\mu_k}{\mu} C_k$; on the other hand, C_k can be expressed as $C_k = \frac{2}{\mu_k} \text{cov}\,(x_k, F(x))$, where $F(x)$ is the distribution function of total income, so that

$$G = \sum_{k=1}^{K} \frac{2}{\mu} \text{cov}\,(x_k, F(x)) \ ;$$

multiplying and dividing by $\mu_k \, \text{cov}(x_k, F(x_k))$, we obtain:

$$(9) \quad G = \sum_k L_k R_k G_k$$

where thus $C_k = R_k G_k$, and $R_k = \dfrac{\text{cov}\,(x_k, F(x))}{\text{cov}\,(x_k, F(x_k))}$ is the 'Gini correlation', and measures the degree of association existing between the kth income source and overall income: if positive, the

distribution of x_k is positively correlated with that of x, while if $R_k<0$, x_k belongs mainly to the less well off households, causing a reduction in inequality. R_k may be negative only if the concentration coefficient is negative.

In this way, the total inequality index has been disaggregated into three elementary components: each income source contributes to total inequality through its relative importance, its correlation with total income and its Gini index. As before, we now proceed a bit further in the decomposition, in order to isolate the degree of inequality attributable to each income source not in the whole sample, but only over the subsample of units with a positive amount of it: it will thus be possible to examine whch are the effects on overall inequality of a change in the inequality among those families with $x_{ik} \neq 0$. For some income sources, the observation of G_k may not be very interesting, since their concentration in a limited subsample of families makes G_k always very high. Changes in the number of households owning x_{ik} bring about changes in G_k, even without modifications in the inequality of x_k among them.

In general, the Gini index is not decomposable by population subgroups, unless we admit the presence of a residual possibly causing a perverse behaviour of the global index after changes in the inequality inside the groups. This residual, however, is present only in case of overlapping among the incomes of the various groups, but if the criterion for the groups' definition is the presence of a certain income type in a positive amount, there is no overlapping between the two subsamples, as far as that given income type is concerned.

If there are J groups of families, the Gini index in the case of non overlapping may be written (Mookherjee-Shorrocks (1983)):

$$(10) \quad G = \sum_{j=1}^{J} \left(\frac{n_j}{n}\right)^2 \frac{\mu_j}{\mu} G_k + 1/2 \sum_{j=1}^{J}\sum_{l=1}^{J} \frac{n_j}{n} \frac{n_l}{n} \left| \frac{\mu_j}{\mu} - \frac{\mu_l}{\mu} \right|$$, where j and l are two of the J

groups.

In our case, this formula becomes:

$$G_k = \left(\frac{n_k^+}{n}\right)^2 \frac{\mu_k^+}{\mu_k} G_k^+ + \frac{n_k^+}{n} \frac{n_k^0}{n} \frac{\mu_k^+}{\mu_k}$$

where μ_k^+ is the mean of x_k over the households with $x_k \neq 0$, n_k^+ is the number of these families, and G_k^+ is the Gini of x_k for this group, while G_k is the Gini over the whole population. The first term represents what is left of the weighted average of the within groups inequalities, after the elimination of the term for the inequality in the subgroup where $x_k=0$, while the second term is the contribution of within-group inequality.

After the substitution for G in the starting formula, and noting that $\mu_k = \frac{n_k^+}{n} \mu_k^+$, we obtain:

$$(11) \quad G = \sum_{k=1}^{K} \frac{\mu_k}{\mu} R_k \left(\frac{n_k^+}{n} G_k^+ + \frac{n_k^0}{n} \right) .$$

The bracketed expression is G_k, always greater than G_k^+ as a linear combination between 1 and the same G_k^+, bounded between 0 and 1.

The analysis of the changes in total inequality may be carried out with a decomposition of the change in the Gini index: since

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$$G = \sum_{k=1}^{K} L_k R_k G_k = \sum_{k=1}^{K} L_k R_k \left(\frac{n_k^+}{n} (G_k^+ - 1) + 1 \right), \qquad \text{it follows that}$$

$$(12) \quad \Delta G = G(t) - G(t-1) = \sum_{k=1}^{K} R_k G_k \Delta L_k + \sum_{k=1}^{K} L_k G_k \Delta R_k + \sum_{k=1}^{K} L_k R_k G_k^+ \Delta \frac{n_k^+}{n} + \sum_{k=1}^{K} L_k R_k (n_k^+/n) \Delta G_k^+$$

The weights are still the averages of the first and second period values, apart from G_k^+ in the third term, given by $\frac{1}{2} (G_k^+(t+1) + G_k^+(t) + 2)$.

2. Decomposition of family income inequality in Italy, 1987-93.

The decompositions described in the previous section have been applied to the study of the evolution of inequality over the period 1987-93 using the last four biennial Bank of Italy's Surveys of Household Income and Wealth available.

The shortness of the period allows, probably, to reach only provisional results, open to likely revisions when new data will become available, but the consideration of previous surveys would have necessarily caused the narrowing of the analysis to a much lower number of income types, due to the frequent modifications imposed on the data collection criteria in the surveys of the 1970s and early 1980s [2].

The sufficiently homogeneous characteristics of the last four surveys permits to define a fairly detailed decomposition of household income; in particular, I have distinguished nine income sources:

- x1: Household head's employment earnings.
- x2: Household head's self-employment income.
- x3: Wife's employment and self-employment income [3].
- x4: Employment and self-employment income of other household members.
- x5: Pensions linked with previous earnings (labour pensions).
- x6: Pensions not linked with previous earnings (non-labour pensions, e.g. invalidity, widows', war pensions, etc.).
- x7: Interests on bank and postal accounts.
- x8: Interests on government bonds.
- x9: Other incomes (cash rents of estates, incomes from participations, interests on other financial assets).

To solve the problem of the strong sensitivity of I_2 to extreme outliers, I have dropped from each survey the units with negative or zero equivalent income, and the ten richest households [4]; while the index turned out to be very sensitive to this selection, some calculations have shown that

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[2] Many investment incomes are for example collected only since 1982, and dividends since 1986. Brandolini and Sestito (1994), who consider the whole period 1977-91, study an income definition given by the sum of employment and self-employment earnings, pensions and income from real wealth, ruling out interests on financial assets.

[3] If in the household there is a married couple, the head is always male: for reasons of homogeneity, I have thus corrected all the cases, particularly frequent in 1993 (nearly 5%, against an average of 1.5% in the previuos three surveys), where the wife was assigned the head's role.

[4] The discarded households are 20 out of 8027 in 1987, 35 out of 8274 in 1989, 32 out of 8188 in 1991 and 41 out of 8089 in 1993. This selection makes also the last three surveys more consistent with that of 1987, which dropped the observations with negative self-employment income.

further exclusions of rich households would have changed it only marginally. Among the income sources, I have not included the imputed rents of owner-occupied housing and other not rented estates, and some components like family allowances, unemployment benefits and scholarships, poorly collected, as well as bequests and lottery wins, because of their transitory nature[5].

Incomes from financial assets are not the data originally collected, but are the result of the corrections made by Cannari and D'Alessio (1993), who tried to solve the problems of *non-reporting* (the household declares that it does not hold financial assets, when it actually does) and *under-reporting* (the household declares to hold financial assets, but does not report the true amount) which made wholly unreliable the reported values, correcting them on the basis of the 1987 Banca Nazionale del Lavoro Survey, containing more reliable data on the financial behaviour of the families. More specifically, the financial incomes used here stem from the first of the two adjustment procedures suggested by the authors, aimed only at solving the problems of *non-reporting* and *under-reporting*, while we do not have used the results of the second procedure, which increases the values obtained from the first correction until they match the data of the national accounts. The use of this second series would have forced, for consistency, to correct according to the national account data also the other income components, particularly self-employment incomes, surely underestimated[6].

The unit of analysis is the household, while the income variable analysed is household equivalent income, obtained by adjusting total income by an equivalence scale taken to be the square root of the household size: without this correction, the comparison of incomes of heterogeneous units would be meaningless. The choice of an appropriate scale is not an easy problem to solve. In Rossi (1996), for example, a scale built from a much broader set of informations is used; on the other hand, the square root of household size is used in many recent studies[7] and, although based only on a single characteristic, like the scale used by the Italian Commission of Inquiry on Poverty and Exclusion (Carbonaro (1985)), it gives more importance than this last one to household economies of scale[8].

Table 1 shows the disaggregation of total equivalent income accruing to each decile in the last year.

Tab. 1 - Disaggregation of total income by components and deciles, 1993

	1	2	3	4	5	6	7	8	9	10	total
Head's employment income	21.7	27.3	35.9	36.7	31.2	31.0	29.6	28.1	27.8	21.4	27.8
Head's self-employment income	14.0	11.1	7.1	8.6	6.8	7.6	9.1	7.4	7.7	14.8	9.9
Wife's earnings	4.0	2.7	2.4	5.0	5.5	8.0	14.6	15.0	16.6	12.4	11.1
Other members' earnings	3.6	3.7	3.6	4.8	5.7	9.8	9.5	12.7	13.8	9.4	9.3
Labour pensions	21.9	30.0	28.4	26.1	28.3	22.8	21.3	18.3	15.5	13.2	19.7
Non-labour pensions	27.7	19.7	15.4	10.5	12.2	9.8	5.8	5.1	4.2	1.6	7.2
Interests on deposits	4.0	3.1	2.8	2.6	3.1	2.8	2.5	2.6	2.6	2.9	2.8
Interests on gov. bonds	1.9	1.7	3.5	4.4	5.5	5.0	5.1	5.9	7.5	11.7	6.9
Other incomes	1.2	0.8	0.7	1.1	1.7	3.1	2.4	4.8	4.3	12.6	5.4
total	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*

[5] Since all reported incomes are net of taxes, in this paper no account is taken of the contribution of the tax system to total inequality.

[6] Studying the evolution of the contributions of the various components to total inequality, the underestimation of some of these may be less serious than one can think, if non-reporting and under-reporting behaviour does not change significantly over the years of the surveys.

[7] For example Brandolini-Sestito (1994), or Atkinson et al. (1995).

[8] The Carbonaro scale is derived from the application of the Engel law, and computes the increase in total expenditure necessary to maintain at the same level as before the food budget share, after a unit increase in the number of family members; its adoption would leave substantially unchanged the inequality measures (the Gini index, for example, would take the values, in the four surveys, of 0.323, 0.311, 0.305 and 0.346, to be compared with the values in tab. 4), but would drive large families into the lower deciles of the distribution by equivalent income.

The distribution of self-employment income is very uneven, reaching the highest levels in the first and tenth deciles; the shares of wife's and other family members' earnings are almost steadily increasing, implying that secondary workers are concentrated in rich families. Interests on treasury bonds are also always increasing, while an opposite tendency is shown by non-labour pensions.

The results from the decomposition of half the squared coefficient of variation are shown in tab.2.

Tab. 2 - Decomposition of I_2 by income sources

		Head's empl. earnings	Head's self-empl. income	Wife's income	Other members' income	Labour pensions	Non-labour pensions	Interests on deposits	Interests on gov. bonds	Other incomes	Total
μ_k/μ	1987	0.3090	0.1574	0.0977	0.1060	0.1479	0.0679	0.0395	0.0441	0.0305	1
	1989	0.2932	0.1384	0.1175	0.1103	0.1564	0.0594	0.0473	0.0535	0.0240	1
	1991	0.2768	0.1199	0.1108	0.1128	0.1722	0.0733	0.0373	0.0615	0.0356	1
	1993	0.2782	0.0987	0.1107	0.0927	0.1969	0.0716	0.0280	0.0694	0.0536	1
ρ_k	1987	0.2711	0.4598	0.3809	0.3901	0.0185	-0.0825	0.4694	0.4058	0.4041	1
	1989	0.2209	0.4580	0.4202	0.3244	0.0501	-0.0651	0.3959	0.4829	0.3799	1
	1991	0.2114	0.3590	0.3808	0.3602	0.1291	0.0205	0.3245	0.4769	0.4960	1
	1993	0.2857	0.4020	0.4088	0.2871	0.2197	-0.0608	0.2620	0.5130	0.5409	1
n_{k+}/n	1987	0.4715	0.1902	0.2143	0.1924	0.3065	0.2176	0.9319	0.3121	0.1431	1
	1989	0.4590	0.1810	0.2389	0.2039	0.3408	0.2102	0.9576	0.3409	0.1480	1
	1991	0.4365	0.1701	0.2366	0.2082	0.3504	0.2347	0.9459	0.3549	0.1472	1
	1993	0.4146	0.1638	0.2403	0.1894	0.3714	0.2463	0.9390	0.3436	0.1823	1
I_{2k+}	1987	0.1233	0.3218	0.1263	0.1893	0.1314	0.1839	1.2677	1.1804	3.0700	0.2156
	1989	0.1134	0.3281	0.1107	0.1339	0.1446	0.1860	1.8651	1.5834	2.3125	0.1982
	1991	0.1176	0.2516	0.1099	0.1375	0.1442	0.2412	1.5372	0.8636	1.4079	0.1821
	1993	0.1356	0.4251	0.1579	0.2005	0.1618	0.2581	6.5373	1.1140	1.2296	0.2575
I_{2k}	1987	0.8218	3.8200	2.4224	3.0818	1.5598	2.6414	1.3858	4.8817	24.420	0.2156
	1989	0.8364	4.0740	2.0564	2.6095	1.3919	2.8652	1.9700	5.6120	18.491	0.1982
	1991	0.9151	3.9185	2.0781	2.5617	1.3385	2.6583	1.6537	3.3418	12.453	0.1821
	1993	1.0328	5.1452	2.2367	3.1971	1.2816	2.5777	6.9935	4.1960	8.9825	0.2575
s_k	1987	0.1635	0.3047	0.1247	0.1562	0.0074	-0.0196	0.0470	0.0852	0.1309	1
	1989	0.1330	0.2873	0.1590	0.1299	0.0208	-0.0147	0.0590	0.1376	0.0880	1
	1991	0.1312	0.1997	0.1425	0.1524	0.0603	0.0057	0.0364	0.1256	0.1462	1
	1993	0.1592	0.1775	0.1334	0.0938	0.0965	-0.0138	0.0383	0.1438	0.1713	1
S_k	1987	0.0353	0.0657	0.0269	0.0337	0.0016	-0.0042	0.0101	0.0184	0.0282	0.2156
	1989	0.0264	0.0569	0.0315	0.0257	0.0041	-0.0029	0.0117	0.0273	0.0174	0.1982
	1991	0.0239	0.0364	0.0259	0.0277	0.0110	0.0010	0.0066	0.0229	0.0266	0.1821
	1993	0.0410	0.0457	0.0343	0.0241	0.0248	-0.0035	0.0099	0.0370	0.0441	0.2575
$\Delta \% I_2$	87-89	-4.12	-4.08	2.19	-3.71	1.16	0.61	0.74	4.12	-5.01	-8.11%
	89-91	-1.26	-10.35	-2.83	1.01	3.50	1.98	-2.57	-2.22	4.65	-8.08%
	91-93	9.39	5.10	4.62	-1.98	7.56	-2.56	1.82	7.73	9.62	41.3%
	87-93	2.64	-9.27	3.49	-4.45	10.73	0.33	-0.09	8.61	7.38	19.36%

The bottom rows of the table contain the decomposition of the percent change in the overall index: the last column is simply the sum of the previous nine (see Jenkins (1995)).

In assessing the results of the decomposition, it is convenient to look separately at the contribution made by each income source to total inequality in a certain time and at the temporal evolution of the same during the seven available years.

Examining the 1993 situation, a first indicator of the distributive ability of the various sources may be given by the ratio between the relative contribution to inequality s_k and the relative importance of the same income type x_k, i.e. μ_k/μ. Head's employment earnings and pensions have a relative contribution much lower than their share, the ratio being around 0.5, while the opposite is true for head's self-employment earnings $(s_k/(\mu_k/\mu) = 1.8)$ and above all for government bonds and other capital incomes. The contributions of the remaining three income sources, on the other hand, are not far from their shares. Thus, from these simple figures we can infer that if pensions and head's wages and salaries were eliminated, the residual income would be much more unequally distributed (see above the meaning B of the contribution to inequality).

As far as the role of the various income components on the evolution of inequality is concerned, we can observe first of all that the shares of head's employment and self-employment income undergo a nearly constant reduction, particularly severe in the case of self-employment income; for this source, the clear drop in μ_k/μ is not matched by the fall in the share of households owing it (n_{k+}/n), from 19% in 1987 to 16.4% in 1993 (but the number of self-employed wives or other members could have increased). The share of labour income of wife and other components is almost stable, while labour pensions and interests from treasury bonds (these last ones from 4.4% to 7%) clearly have an increasing quantitative importance.

On the whole, it seems that during only seven years significant modifications in the structure of family budgets have taken place: the share of labour income falls by nearly 10 points, from 67% to 58%, while those of both pensions (from 21.6% to 26.8%) and incomes from real and financial assets (from 11.4% to 15.1%) increase markedly. Moreover, these results do not appear to have been substantially influenced by the peculiar characteristics of 1993, a year of deep economic crisis, since for almost every income source the falling or rising trend clearly emerges from the previous years.

The reliability of these dynamics is of course dependent on the quality of the sample data, particularly on the different degrees by which the various types of income under-estimate the national accounts. In this work, no income source has been corrected on the basis of the aggregate statistics (not even, as said, interests from financial assets): this must lead to great caution when evaluating the composition of family budgets in a single moment, but shouldn't affect the contribution of each factor to the dynamics of inequality, to the extent that under-reporting and concealing behaviour has not significantly changed, for each source, over the period.

In order to take account of these under-estimation problems, I have also proceeded to a simulation where the original data have been inflated by coefficients specific for each income type, chosen (arbitrarily, but see Brandolini (1992)) so as to reflect the most realistic degrees of underestimation (head's self-employment incomes have been raised by 30%, the third and fourth component by 10%, pensions by 20%, while incomes from assets have been corrected following the second procedure of Cannari-D'Alessio); none of the results described in what follows changes significantly, so we will keep using the original data only.

In the comparison between 1987 and 1993, at the end of the period all the four inequality indices I_{2k}^+ associated to labour incomes have increased, after a U-shaped trend, with a sharp rise in the last year.

As for self-employment income, in particular, inequality has clearly increased in the subsample of recipient households, (and thus also over the whole sample), and the share of units

with $x_{ik}>0$ has fallen; however, these two effects have been amply outweighed by the reduction both in the relative importance (μ_k/μ) and in the correlation with total income; even if we look at the two last surveys only, it would be wrong to assign a decisive role to the sensitivity of self-employment incomes to the business cycle when explaining the increase in inequality. Considering the whole period 1987-93, the net effect of self-employment income has been clearly equalising: its relative contribution to total inequality falls by almost 13 points; between 1987 and 1993 inequality has increased by 19.4% (last row of the table), but self-employment income would have originated a reduction in it by 9.3%. The main cause of this result lies in the dominating effect of the fall in the share of self-employment in total income and in its correlation with it. Thus, we have to look elsewhere for the roots of the recent strong increase in inequality; in particular, from tab.2 it is apparent that in the last year the inequality of *all* income sources (excluding the last category) has increased, with different consequences on overall inequality, depending on the shares and correlations with total income.

As far as household head's wages and salaries are concerned, the two main phenomena are an almost constant reduction in its share in total income, and a fall in the number of recipient units (from 47.1% to 41.5%). Over the seven years these two effects have had equally important but opposite influences, leaving the contribution to inequality substantially unchanged.

The slight increase in the proportion of households with a working wife has reduced the impact of the increasing inequality of wives' labour incomes in the same subsample, with s_3 fairly stable. The strong reduction in the correlation with total income which took place in 1993 explains the fall in the contribution of labour incomes of other members of the household.

A clear association between labour pensions and rising inequality is on the other hand apparent: the correlation with total income, negligible in 1987, becomes positive and always rising, reaching 0.22 in 1993 (thus still lower than every labour income), while there is also an increase in the relative importance of this income source. Among pensioners, inequality rises over 7 years by 23% (from 0.13 to 0.16): without disaggregating I_{2k} into a component representing the relative frequency and into a term I_{2k}^+ showing the concentration of the kth income only among the recipient households, we would have observed only I_{2k}, and concluded that inequality among pension incomes has steadily declined (because the frequency effect is stronger). Of less importance seems the evolution of non-labour pensions, but we may note a lower effectiveness in reducing global inequality, as well as a greater dispersion among households holding this type of income.

Together with pensions, it seems that capital incomes (different from the interests on bank and postal savings) have played the greatest role in the increase in inequality. The rise in their shares and correlations with total income have been decisive: without significant changes in the proportion of households receiving these incomes and in their internal inequality, an increase in their share is enough to raise inequality.

Fig.1 shows the decomposition of the percentage change of total inequality in the contributions given by the nine components in each available couple of years, and in the whole period (black bars).

Fig. 1 - Contribution to the variation in total inequality ($\Delta\%I_2$)
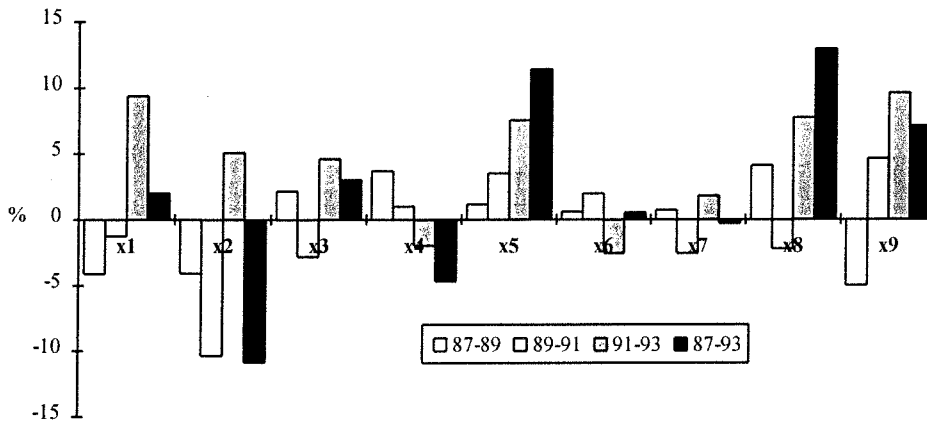

Apart from the variability naturally expected in a research constrained to very narrow temporal limits, the strong increase in inequality in 1993 can be accounted for mainly by the changes in the composition of family budgets: from labour incomes to transfers and capital incomes. While in 1987 labour incomes explained 74.9% of total inequality, this share has fallen in 1993 to 56.4%; pension and capital incomes have respect'vely moved from -1.2% and 26.3% to 8.3% and 35.3%.

All these phenomena may be better and more succinctly observed using the rule from eq.(7), decomposing the change in I_2 between two time periods into the sum of four variations, pertaining to the correlation with total income, the relative quantitative importance, the proportion of households with $x_{ik}>0$ and the inequality in this subsample. More than tab.3, difficult to read, fig.2, containing the same informations, may be useful.

Tab. 3 - Decomposition of the variation in I_2, 1987-1993

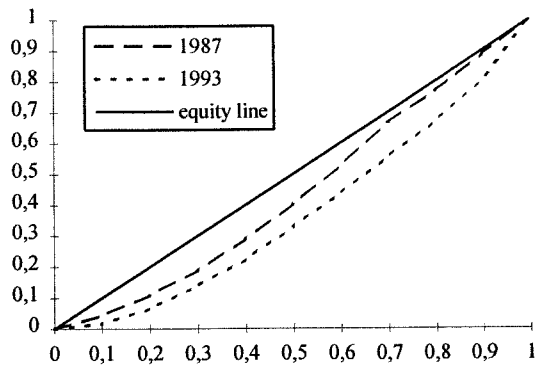|	var. ρk	var. μ_k/μ	var. n/n_{k+}	var. I_{2k+}	total
x1	0.004	-0.008	0.008	0.001	0.005
x2	-0.015	-0.052	0.010	0.007	-0.050
x3	0.004	0.008	-0.004	0.002	0.01
x4	-0.018	-0.008	0.0005	0.0005	-0.025
x5	0.040	0.007	-0.003	0.0008	0.045
x6	0.002	-0.0004	0.0006	-0.0005	0.002
x7	-0.013	-0.008	-0.0001	0.020	-0.0008
x8	0.013	0.024	-0.003	-0.001	0.033
x9	0.022	0.040	-0.010	-0.030	0.022
total	0.039	0.004	-0.003	0.0005	0.041

Fig. 2 - Decomposition of the variation in I_2, 1987-1993
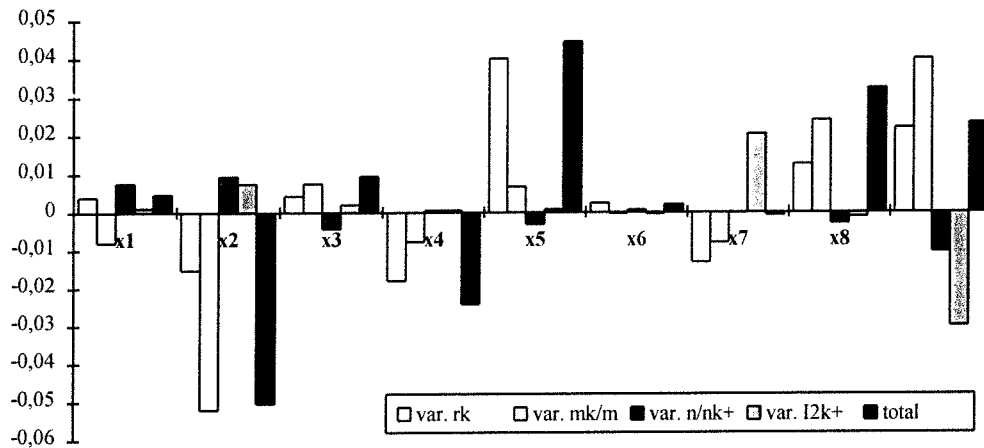
In the case of self-employment income, it is apparent from the figure that the increase in I_{2k}^+ would have originated a greater concentration, but this effect has been outweighed by its lower share in total income, as well as by its lower correlation with it: what happened to household head's self-employment income would have caused I_2 to fall, ceteris paribus, by almost 5 points (e.g., from 0.21 to 0.16). The conclusion that this income source is not responsible for the trend in inequality in these 7 years is supported by the analysis of inequality on the subsample of households whose head does not own self-employment income: the index I_2 takes, in the four surveys, the values of 0.189, 0.165, 0.162 and 0.208, showing the same U-shaped path already observed for the whole sample. The corresponding values for the Gini index are 0.32, 0.30, 0.29 and 0.32.

Pensions from labour, interests on government bonds and other incomes from assets have more than compensated the effects of self-employment and other members' incomes on total inequality, causing a clear rise in it. But while the positive role played by incomes from assets is due to the strong increase in their shares in households' budgets, for pensions the decisive effect comes from the rising correlation with total income: the following graph illustrates the shift of the concentration curve of pensions from labour from 1987 to 1993.

Fig. 3 - Concentration curve of labour pensions.

Equation (7) is now applied to assess the causes of the sharp increase in total inequality in the last available survey, conducted in 1993.

Tab. 4 - Decomposition of the variation in I_2, 1991-1993

	var. ρk	var.μ_k/μ	var.n/n_{k+}	var.I_{2k+}	total
x1	0.019	0.0003	0.002	0.001	0.023
x2	0.009	-0.016	0.002	0.009	0.005
x3	0.004	0.0	-0.0006	0.003	0.006
x4	-0.012	-0.010	0.003	0.003	-0.016
x5	0.018	0.005	-0.001	0.0006	0.022
x6	-0.009	0.0	0.0	0.0	-0.009
x7	-0.004	-0.005	0.0	0.013	0.004
x8	0.004	0.007	0.001	0.006	0.018
x9	0.006	0.028	-0.008	-0.004	0.023
total	0.036	0.009	-0.002	0.032	0.075

With the exception of non-labour pensions and earnings of other household members, all income components made a positive contribution to the rise in inequality; the marginal role of self-employment incomes is, however, confirmed, while there is an increase in the contribution of head's wages and salaries, due to a greater correlation with total income. Labour pensions, head's employment earnings and investment incomes (interests on deposits excluded) have very similar contributions, around 0.02 points of I_2 for each.

Until now, in assigning to each source a contribution to inequality we have actually set aside the cautionary words of the first section, where it was said that no inequality index, I_2 included, may be decomposed in the sum of K 'contributions' reasonably defined, according to at least one of the four alternative meanings indicated.

I_2, however, like all the indexes derived from the variance, may be expressed as the average of the third and fourth definition: while decomposition C computes, for each source, the inequality level that would be observed if x_k was the only component not evenly distributed, decomposition D shows by how much would inequality be reduced in the case of an equal distribution of x_k. If the contribution is positive, x_k causes an increase to total inequality, while a negative value points out that x_k has an equitative effect: if distributed more evenly, inequality would rise.

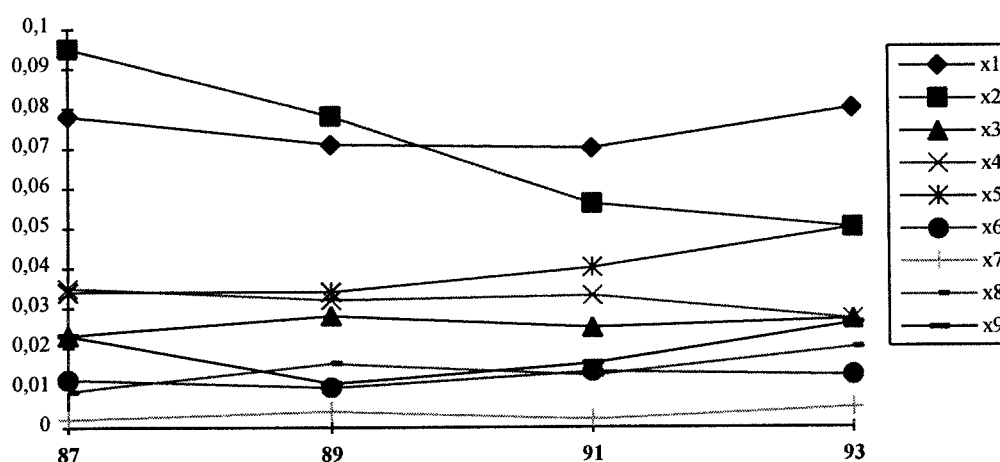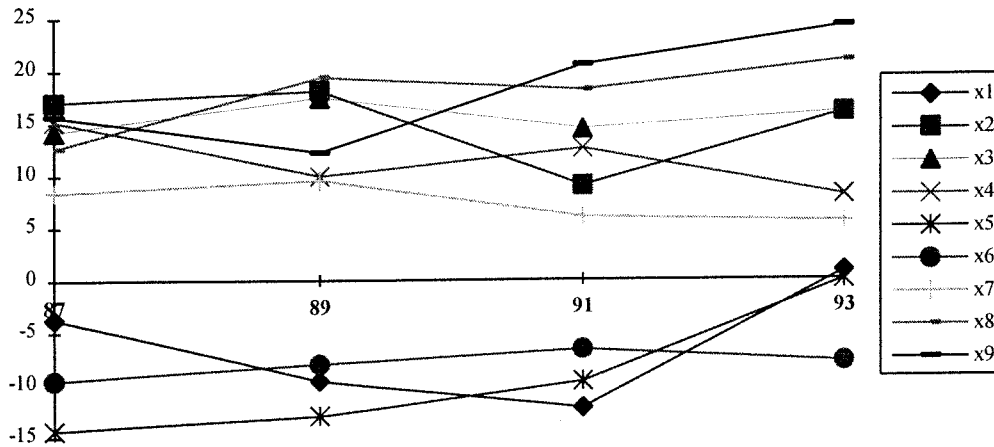**Fig. 4 - Contribution C**

Fig. 5 - Contribution D (in percent of I_2)

According to the first decomposition, the contribution is largely dependent on the relative weight on total income and on the proportion of recipient units; this explains the dominant role of head's labour incomes, and the importance of labour pensions, owned by nearly 35% of the sample households. If, in 1993, head's employment earnings had been the only income not evenly distributed, total inequality would have been 0.08. The most important event of the period involves the contributions of self-employment incomes and labour pensions: in 1987 the latter was 1/3 of the former, after seven years they are equal.

As for the second decomposition, if an income source is not very concentrated and is owned by many households, it will cause a reduction in total inequality, even if it is positively correlated with x. It is thus easy to understand why, at least until 1991, head's employment earnings and pensions had an equalising effect, in the sense of a reduction in the inequality that would be observed if differences in these factor incomes were eliminated. For example, a perfectly even distribution of labour pensions in 1987 would have been followed by a rise in total inequality by 15%; in the same way, eliminating differences in the distribution of the last category would have led to a fall by 15.7 % of inequality, to 0.183. In the last two years, the sharp rise in the contribution of head's wages and salaries is apparent, and the redistributive role of investment incomes is clearer than with rule C.

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As for the decomposition of the Gini index, tab.5 corresponds closely to tab.2, and doesn't contain the terms of the decomposition already shown there (like μ_k/μ).

Tab. 5 - Decomposition of the Gini index by income sources

|		Head's empl. earn.	Head's self-empl. income	Wife's income	Other members' income	Labour pens.	Non-labour pens.	Interests on deposits	Interests on gov. bonds	Other inc.	Total
R_k	1987	0.364	0.570	0.631	0.629	0.092	-0.155	0.639	0.639	0.795	1
	1989	0.325	0.535	0.656	0.567	0.074	-0.117	0.586	0.659	0.719	1
	1991	0.291	0.460	0.605	0.596	0.197	-0.050	0.483	0.642	0.751	1
	1993	0.409	0.468	0.639	0.552	0.275	-0.077	0.521	0.675	0.772	1
G_{k+}	1987	0.242	0.393	0.265	0.327	0.278	0.317	0.582	0.519	0.671	
	1989	0.232	0.362	0.237	0.272	0.286	0.342	0.573	0.567	0.625	
	1991	0.231	0.342	0.250	0.281	0.286	0.357	0.576	0.502	0.576	
	1993	0.262	0.427	0.303	0.336	0.294	0.374	0.615	0.518	0.605	
G_k	1987	0.642	0.885	0.842	0.870	0.779	0.851	0.611	0.850	0.953	
	1989	0.647	0.884	0.818	0.852	0.757	0.862	0.592	0.852	0.944	
	1991	0.665	0.888	0.822	0.850	0.750	0.849	0.599	0.823	0.938	
	1993	0.694	0.906	0.832	0.874	0.738	0.846	0.638	0.834	0.928	
$L_k R_k G_k$	1987	0.072	0.079	0.052	0.058	0.011	-0.009	0.015	0.024	0.023	0.326
	1989	0.062	0.065	0.063	0.053	0.009	-0.006	0.016	0.030	0.016	0.309
	1991	0.053	0.049	0.055	0.057	0.025	-0.003	0.011	0.032	0.025	0.306
	1993	0.079	0.042	0.059	0.045	0.040	-0.005	0.009	0.039	0.038	0.347
$L_k R_k G_k/G$	1987	0.222	0.244	0.159	0.178	0.033	-0.027	0.047	0.074	0.071	1
	1989	0.200	0.212	0.204	0.172	0.028	-0.019	0.053	0.097	0.053	1
	1991	0.175	0.160	0.180	0.187	0.083	-0.010	0.035	0.106	0.082	1
	1993	0.228	0.121	0.170	0.129	0.115	-0.013	0.027	0.113	0.111	1
$\Delta\%G$	87-89	-3.23	-4.25	3.41	-1.46	-0.56	0.91	0.31	1.87	-2.08	-5.08%
	89-91	-2.65	-5.35	-2.55	1.27	5.4	0.94	-1.81	0.78	2.85	-1.09%
	91-93	8.33	-2.31	1.23	-4.08	4.75	-0.52	-0.48	2.17	4.36	13.4%
	87-93	2.07	-11.5	2.16	-4.08	9.03	1.32	-1.86	4.65	4.72	6.5%

Even if, as will be presently shown, the evolution of the different contributions is very similar for the two indexes, they offer partly different pictures of the decomposition of inequality in a given moment; in 1993, for example, the contributions of income from labour, pensions and capital are respectively 56.4%, 8.3% and 35.3% in the case of I_2, and 64.8%, 10.2% and 25.1% for the Gini index. These differences depend on the characteristics of the indexes: I_2 is very sensitive to the presence of outliers, and thus gives greater weight to those components more likely to possess such values. On the other hand the decomposition followed for I_2 is consistent with the axiomatic approach leading to the identification of a unique rule, while the decomposition of the Gini index, although the 'natural' one, is only one of the many alternatives available.

From a dynamic perspective, however, the similarities are clearly prevailing. The evolution of the correlation with the ranking of total income (R_k) is very similar to that of ρ_k; inside each of the four groups of market income, the trend of inequality is U-shaped as before, and inequality among pensioners in still uniformly increasing.

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The whole set of distributive and demographic changes has produced relevant modification in the contributions of the nine components; head's self-employment income, for example, gave 7.9 points to the Gini index in 1987, and only 4.3 seven years later. Labour pensions, on the other hand, raise the index by 4 points in 1993, against only 1 in 1987, so their relative contribution to inequality is 11.5%. The ability of non-labour pensions to reduce inequality falls from 1 to 0.5 points of the Gini index, while the last two components mark strong increases in their contributions.

Fig. 6 corresponds to fig.1, and shows the contributions to the change in inequality for each couple of years, as well as for the whole period (black bars); almost all sources have consistent changes from one year to the other. It is apparent, in particular, the role of head's employment earnings in the last year, and the role of labour pensions over the whole period.

Fig. 6 - Contribution to the variation in total inequality (Δ%G)
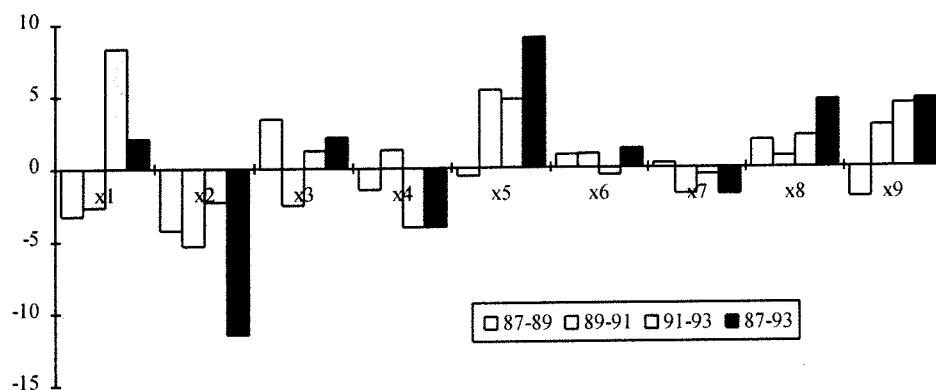
Finally, the following table is similar to tab.3, with results definitely consistent with it.

Tab. 6 - Decomposition of the variation in the Gini index, 1987-1993

	var. μ_k/μ	var. R_k	var. n_{k+}/n	var. G_{k+}	total
x1	-0,008	0,009	0,005	0,001	0,007
x2	-0,027	-0,012	0,001	0,0004	-0,037
x3	0,007	-0,0001	-0,001	0,0006	0,007
x4	-0,007	-0,007	0,0001	0,0001	-0,013
x5	0,007	0,024	-0,001	0,0002	0,029
x6	-0,0004	0,005	0,0001	-0,0001	0,004
x7	-0,004	-0,002	-0.00006	0,0006	-0,006
x8	0,014	0,002	-0,0004	-0,0009	0,015
x9	0,017	-0,0009	-0,00048	-0,0004	0,015
total	-0,002	0,018	0,0023	0,0024	0,021

3. Conclusions

This paper has analysed the relationship between households' incomes and the dynamics of their internal evolution, disaggregating total equivalent disposable income into nine components and studying the contribution of each of these to the trend of inequality in Italy over the period 1987-93.

To this end, I have used the possibility of decomposing by income sources two of the most common inequality indexes, namely half the squared coefficient of variation and the Gini index, verifying also how important is, on final results, the choice of a unique decomposition rule instead of a 'natural', but not unique one.

The results of the analysis are presumably very dependent upon the exceptional characteristics of the last year considered, 1993, when some long-term measures where adopted to cut public sector deficits, and real gdp fell for the first time since 1975, and upon the quality of the data used (in particular, the results are based on the non verifiable assumption that the reticiency behaviour in declaring some income components is constant over the period). The nature itself of the data at hand has also prevented the study of the effects of tax policies on the level and trend of inequality.

Despite these limits, the paper should have shed light on some of the main forces influencing the distribution of incomes; in particular, some broad tendencies seem to emerge .

In 1993 labour incomes made a contribution of nearly 60% to overall inequality, followed by capital incomes and pensions.

During the seven years considered, however, the changes in the composition of households' budgets caused an increase in the contributions of these two last income sources, while the contribution of labour incomes fell by 10 points: pensions and investment incomes can explain almost all the increase in inequality from 1987 to 1993.

Looking only at the last two surveys available (1991-1993), the sharp rise in inequality turns out to be the consequence of the same factors already cited, plus a strong positive contribution from head's wages and salaries.

Even if examined only from the side of cash transfers, the role of public redistributive activity is thus central: public pensions and interests on government bonds increased their contributions to inequality of total income (more correctly, in the case of pensions, they decreased their ability to lower total inequality) even in the years when it was falling, each contributing to the growth of the other. If the pension system had been less generous, public debt would have probably had a lower increase, together with a lower expansion of the share of interests on government bonds in households' incomes; the expansion that actually took place, however, could have caused crowding out effects against the rest of the economy, with a consequent fall in the share of incomes from labour in total income.

In the last period, these long-term phenomena have been strengthened by the impact of the economic recession, bringing about a jump in inequality.

On the other hand, recent events like the reform of the pension system and the reduction in the interest rates structure, together with the recovery, could reduce the relative importance of non-market incomes, with uncertain consequences on overall income inequality, largely dependent on the ability of self-employment incomes to regain their share in total income, as well as on the dynamics of earnings differentials among dependent workers.

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