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A Decomposition of the Personal Income Tax Changes in Italy: 1995–2000

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The effects of personal income tax changes are usually analyzed by comparing the inequality of income distributions before and after the tax policy change on a fixed pretax income distribution. This constant-population methodology aims at isolating the ''pure'' redistributive effect of the tax legislation. On the basis of the OECD's 1987 analysis, this paper proposes a methodology to disentangle the pure effect of tax changes from the influence of other nontax factors when the pretax income distribution is not fixed. For the Italian case, it is shown that the additional redistributive outcome displayed by changes of tax laws between 1995 and 2000 is only one-fourth of the total change of the redistributive impact in the same period and is outweighed by the effect of inflationary fiscal drag.

Keywords: Redistribution, personal income tax, Italy, decomposition, fiscal drag

JEL classification: H 20, H 23, H 24

1. Introduction

The analysis of the effects of the personal income tax has a long history both in Italy and in other countries. In Italy, this analysis has been at the core of the economic debate since the introduction of the income tax in the seventies of the past century. In other countries, the evaluation of the effects of income tax reforms on inequality, progressivity, social welfare, and/or tax revenues has also attracted a significant amount of empirical analysis.[1]

The greatest part of it, however, has followed two approaches in assessing such reforms. The first has been that of measuring inequality, social welfare, progressivity, and/or the level of tax revenues before and after the policy

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1 Studies on this topic are many. A complete survey of them is beyond the scope of this paper. A large number of references can be found in Lambert (2002), Messere (1999), Slemrod (1996), Creedy (1996), and the recent OECD (2006).

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change on the basis of a fixed pretax income distribution. This methodology, assuming a constant population, has aimed at isolating what has been called the *pure* redistributive effect of tax changes.[2] The second strategy has focused on the measurement of inequality, social welfare, progressivity, and/or the level of tax revenues arising from different tax regimes, using a variable pretax income distribution.

Both strategies have shortcomings: the first, while useful for analyzing the impact of tax reforms, does not fit well into the analysis of redistribution over large time intervals, where a fixed pretax income distribution becomes a hardly tenable assumption, unless one is interested in comparing the potential outcomes of different tax systems.[3] The second, instead, conflates the effects of tax and nontax factors, giving rise to possible over- or underevaluation of the redistributive effect of tax changes, depending on how the pretax income distribution has changed.

This paper innovates in this respect by implementing a third strategy, which aims at disentangling the effects of tax and nontax factors on the total redistributive outcomes of different tax regimes in a context where the pretax income distribution is not fixed.

On this issue, in our view, the existing literature lacks a clear methodology. To this purpose, we make recourse to a decomposition developed by OECD (1987), where some nontax factors (potentially affecting the pretax income distribution) were identified: the growth of average income; the way in which income is distributed; real and inflationary fiscal drags; the change in the number of taxpayers.

The growth of average income may affect the amount of tax revenue collected and in this way the degree of total redistribution at a given point in time. The way in which pretax income is distributed may make a given tax system more or less progressive – showing a different after-tax inequality even in the absence of tax changes. Fiscal drag effects due to real or inflationary income growth may change the progressivity of the income tax if these incomes rise into higher brackets and are subject to additional taxes in real terms. Finally, a change of the number of taxpayers may change the pretax distribution of income as well as average income.

It is worth noting that OECD (1987) confined itself to explaining changes in tax revenue. In this paper, the same methodology is first applied to changes in tax revenue and then extended to encompass redistributive issues. This is done by considering personal income tax changes that occurred in Italy

2 See Redmond and Sutherland (1995). In this case, "pure" means that the change of the redistributive effect is entirely attributed to tax changes, as the pretax income distribution is fixed. However, one must recall that the vertical effect of the tax – after controlling for horizontal inequity – is also sometimes referred to as the pure effect of taxation.

3 See, for example, Gastaldi and Liberati (2000).

between two points in time, 1995 and 2000, and by using two microsimulation models built upon the data from Bank of Italy for the same reference years. This allows us to perform a microsimulation analysis of the redistributive impact of two tax regimes using variable pretax income distributions, at the same time disentangling the effects of both tax and nontax factors.

The paper is organized as follows: Section 2 briefly reviews the main adjustments of the personal income tax that occurred in Italy between 1995 and 2000. Section 3 deals with methodological issues in decomposing tax revenue changes, implementing the OECD methodology. Section 4 extends this methodology to redistributive issues. Section 5 deals with empirical issues and discusses results. Section 6 concludes.

2. The Main Adjustments of the Personal Income Tax in Italy, 1995–2000

The personal income tax was introduced in Italy in 1974 with 32 income brackets and a top marginal tax rate equal to 82%. Since then, it has always been the most important single source of tax revenue for the Italian budget, representing a mounting share of GDP over the years (5.8% in 1980, 8.4% in 1990, and 10.1% in 2000).[4]

Following a general trend in the most industrialized countries – mainly originated by the U.S. tax reforms of the eighties – both the number of brackets and the top marginal tax rates have been steadily reduced over time, with a progressive shrinkage of the distance between the top and the bottom marginal tax rates. Nevertheless, in 1983, the top marginal tax rate was a nonnegligible 65%, and in 1995 it still was 51%.

One of the most important adjustments of the income tax of the last decade occurred in 1998. The two years considered in this analysis (1995 and 2000) capture this change and fit perfectly with the above-mentioned trend, as the top marginal tax rate was further reduced to 45.5%. At the same time,

4 Before the introduction of the modern personal income tax, labor income (from both self-employed people and employees), entrepreneurial income (excluding companies), and capital income were taxed by the *imposta di ricchezza mobile* with a slightly progressive tax schedule and regardless of the personal conditions of the taxpayer. This tax was the most important direct tax, in terms of tax revenue, from the end of the nineteenth century to the time it was abolished. An additional tax – the *imposta complementare progressiva* – was also levied on incomes above a certain threshold. This latter tax was in fact a personal tax, taking into account total family income and applied on a progressive scale based on a formula with basic deductions. It is worth noting that this tax yielded low tax revenues and was almost ineffective in reducing income inequalities. Other kinds of income (basically incomes from land and from immovable property) were taxed with specific taxes on a "cadastral" basis.

the bottom marginal tax rate was increased from 10% to 18.5% in the same period, reducing the range to 27 percentage points.

The top left-hand side panel of table 1 shows that the increased bottom tax rate of 18.5% encompasses all incomes that were previously taxed at both 10 and 22% and a small part of what was previously taxed (at the margin) at 27%. At the same time, in 2000, the top marginal tax rate of 45.5% includes some incomes that were previously taxed at 41%.

Table 1

Main Parameters of 1995 and 2000 Tax Regimes (Values at current prices)

Marginal tax rates (*)

Lower limit	Upper limit	Tax rate in 1995–1996–1997	Tax rate in 1998–1999–2000
0	3,719	10	18.5
3,719	7,437	22	18.5
7,437	7,747	27	18.5
7,747	15,494	27	26.5
15,494	30,987	34	33.5
30,987	69,722	41	39.5
69,722	77,469	41	45.5
77,469	154,397	46	45.5
154,397	∞	51	45.5

(*) Excluding the regional surtax

Tax credit for dependent spouse and dependent children (***)

Lower limit	Upper limit	Euros in 1995	Euros in 1996–1997	Euros in 1998–1999–2000
Spouse				
0	15,494	422	546	522
15,494	30,987	422	497	502
30,987	51,646	422	460	465
51,646	∞	422	422	422
Children				
0	∞	49	174	

(***) For each child

Tax credit for employees (**)

Lower limit	Upper limit	Euros in 1995–1996–1997	Euros in 1998–1999–2000
0	4,700	532	868
4,700	4,803	532	826
4,803	7,747	532	775
7,747	7,798	512	697
7,798	7,850	473	697
7,850	7,902	430	697
7,902	8,057	405	646
8,057	8,212	405	594
8,212	15,494	405	542
15,494	20,658	405	491
20,658	25,823	405	439
25,823	30,987	405	387
30,987	31,142	405	336
31,142	36,152	405	284
36,152	41,317	405	232
41,317	46,841	405	181
46,841	46,688	405	129
46,688	51,646	405	77
51,646	∞	405	52

(**) In 1998, pensioners get a further specific tax credit of 36 euros for incomes below 9,296 euros.

Tax credit for self-employed

Lower limit	Upper limit	Euros in 1995–1996–1997	Euros in 1998–1999–2000
0	4,235	105	362
4,235	4,287	834	362
4,287	4,390	40	362
4,390	4,708	0	362
4,708	4,803	0	310
4,803	4,958	0	258
4,958	5,113	0	207
5,113	7,747	0	155
7,747	15,494	0	103
15,494	30,987	0	52

Another important characteristic of the Italian tax system has always been the presence of nonrefundable tax credits for earned incomes (in different amounts for self-employed and employees) and for dependent children and spouses (table 1, bottom panels). Again, the two years included in the analysis make no exception for the use of these tools. After a long period in which the earned income tax credit was assigned on a flat basis, its structure was made decreasing with increasing income in 1995. To offset for the increase in the bottom marginal tax rate, the amount of earned income tax credit was increased in 2000, still maintaining a decreasing profile. Note, however, that above 30,000 euros of tax base the amount of tax credit for employees was less generous in 2000 than it was in 1995. As reported in table 1, differentiation with respect to income was much more refined in 2000, also for self-employed taxpayers. Finally, in 2000, an additional tax credit of 36 euros was introduced for pensioners with incomes below 9,296 euros.

Tax credits for dependent children and for dependent spouses are also included in both tax systems. Table 1, in the top right-hand panel, shows that while the tax credit for dependent children was significantly increased in nominal terms (from 49 to 174 euros without income limits), the tax credit for a dependent spouse was increased most at lower income levels in 1996 and was almost invariant afterwards. The total of all other admissible tax credits (for interest expenses, insurance premiums, etc.) was finally reduced from 22% to 19% of the total expenditures (not reported in table 1).

Finally, since 1998, Italy has applied a local surtax on personal incomes that has replaced health contributions and a few minor local taxes. At the regional level, the amount was initially set at a standard rate of 0.5% (0.9% since 2001) with the option given to regions to increase the rate by up to 1 percentage point.

In the sequence of adjustments, one can perceive at least three aims of the Italian tax reforms during the period observed. The first – and perhaps the most widely debated – was the need to reduce the distortionary effects of taxes on incentives to work. The reduction of the top marginal tax rates has been a step in this direction. The second aim was to redistribute some tax burden away from larger households, especially those with children. This step was accomplished by increasing tax credits for dependent children, possibly to encourage fertility and achieve demographic targets. The third aim – following again a major trend in industrialized countries – was to use the personal income tax to replace some grants paid to lower government levels in order to reduce the occurrence of soft budget constraints at the local level. Finally, all these targets have been constrained by the need for raising sufficient tax revenues to meet the criteria of the Maastricht Treaty and of the Stability and Growth Pact. As a matter of fact, tax revenue from the personal income tax increased by slightly more than 30 billion euros from 1995 to 2000 (from 83.2 to 113.6 billion euros).

Whether the government, by implementing these changes, succeeded in shaping a more desirable tax regime is not crystal clear. From a social-welfare perspective, Gastaldi and Liberati (2005) found ambiguous social-welfare prescriptions on comparing the two tax regimes. From a descriptive point of view, Emiliani et al. (2004) argue that the total amount of redistribution in the tax regime of 2000 is higher only because of a higher average tax rate (i.e., more resources were collected by the income tax) and not because of a higher Kakwani index, i.e., a more disproportionate distribution of tax liabilities. As it stands, the redistributive debate in Italy does not shed a clear light on the relative merits of these two tax regimes, nor it does when comparing alternative tax regimes in other years (Marino and Rapallini, 2003). In this paper, we take a different perspective and add to the existing literature, using 1995 and 2000 mainly as a laboratory, to show how the change of both tax revenues and the redistributive effects of different tax regimes may be shaped by the action of nontax factors.

3. Methodological Issues: Decomposing Tax Revenue Changes

The change in tax revenues between two points in time – especially in the case of sufficiently large intervals – may be the result not only of changes of tax laws but also of how the pretax income distribution varies over time. There is indeed no doubt that a fixed tax system may give rise to different tax revenues in the presence of a variable pretax income distribution. Also, non-revenue-neutral tax systems give rise to different tax revenues when applied to the same income distribution. The most common case is when tax and nontax factors interact in shaping how much tax revenue different tax regimes may extract from different populations. Therefore, a natural question to ask is whether there exists a methodology to disentangle the influences of the two.

This methodology has been developed by OECD (1987), which has identified the following set of factors that are potentially able to determine changes in tax revenues: the number of taxpayers; the level of average income; the distribution of income; inflationary fiscal drag; real fiscal drag; tax laws.

3.1. Number of Taxpayers (NT)

On average, the effect of changing the number of taxpayers can be represented by a proportional increase of the income tax equal to the ratio between the number of taxpayers in the final year observed and the number of taxpayers in the base year. Considering 1995 as the base year and 2000 as the final year, this ratio will be $k = n_{00}/n_{95}$, where n denotes the number of taxpayers. The change of tax revenue due to NT can therefore be expressed as follows:

$$NT = kT_{95}(Y_{95}) - T_{95}(Y_{95}), \tag{1}$$

where Y_{95} denotes the pretax income distribution in 1995, and $T_{95}(Y_{95})$ is the monetary value of the tax revenue obtained by applying the tax regime of 1995 (T_{95}) to the income distribution Y_{95}.

The expression (1) shows that the effect of changing the number of taxpayers gives rise to an additional tax revenue that is measured by the difference between a proportional scaling (k) of the original distribution of tax liabilities and the original tax liabilities themselves.[5] In principle, the NT effect should exclude the variation of the number of taxpayers that is imputable to tax laws (e.g., the change of the minimum taxable income or the definition of dependent children or dependent spouse). Any such change, if resulting from a change in legislation, should be included in the tax-law effect (see below). Quite obviously, if the number of taxpayers were equal in the two years, we would have $k = 1$ and $NT = 0$.

3.2. Average Income (AI)

Other things being equal, the variation of average income may cause tax revenue to change. To quantify this effect, the following expression is used:

$$AI = gkT_{95}(Y_{95}) - kT_{95}(Y_{95}), \tag{2}$$

where g indicates the ratio between average incomes in the two periods and the other symbols have the same meaning as in (1).

The expression (2) shows that the effect of a change of average income can be measured by a proportional change of the tax revenue g. The additional tax revenue imputable to a change of average income must indeed be at least g times as much the tax revenue obtained in the absence of such a change. This exhausts the change of tax revenue in the case of a proportional income tax. It does not, however, if interactions with formal progressivity occur, for in that case the average income growth may cause a more than proportional increase of tax revenue.[6] Obviously, if the average income does not grow (i.e., $g = 1$), then $AI = 0$.

5 The additional tax revenue is therefore measured as if each taxpayer of the original distribution were counted k times. Obviously, this effect exhausts the change of tax revenue in the (unlikely) case that the new population of taxpayers is an exact replica of the original one. In all other cases, a change in the number of taxpayers is likely to cause other effects, e.g., altering the mean income or the way in which it is distributed.

6 Note that AI in (2) is measured over the changed number of taxpayers (implicit in k) to capture the fact that average income may increase either because the income of existing taxpayers increases or because new taxpayers enter the income distribution or for both reasons.

3.3. Income Distribution (ID)

The way in which pretax income is distributed may affect the amount of tax revenue that any given tax regime may yield, other things being equal. This effect is quantified as follows:

$$ID = gT_{95}\left(\frac{Y_{00}}{g}\right) - gkT_{95}(Y_{95})\,. \tag{3}$$

It is worthwhile exploring some characteristics of (3). This is best done by assuming, for the moment, $k = 1$. In order to express the change in tax revenue due to the way in which pretax income is distributed and not to its mean, differences in mean incomes must be neutralized. Therefore, one must compare the income distribution in the base period (Y_{95}) with an equal-mean income distribution in the final period. This latter is obtained by scaling all incomes in year 2000 by g (the average income growth), which gives rise to the distribution Y_{00}/g. Obviously, there is no reason to expect Y_{00}/g to be distributed exactly in the same way as Y_{95}, unless all incomes have grown at the same rate. If $y^i_{95} = y^i_{00}/g\ \forall i$ (where y^i denotes the income of the ith taxpayer), a given income tax structure (T_{95}) would produce exactly the same tax revenue if applied to either Y_{95} or Y_{00}/g, which implies $gT_{95}(Y_{00}/g) = gT_{95}(Y_{95})$ and $ID = 0$. Therefore, with the same number of taxpayers, $ID = 0$ only when the new income distribution is a version of the original one scaled by a constant factor g. If, instead, $y^i_{95} \neq y^i_{00}/g$ for at least one i, then $ID \neq 0$. With a different number of taxpayers ($k \neq 1$), the expression (3) will be equal to zero only when $k = \frac{T_{95}(Y_{00}/g)}{T_{95}(Y_{95})}$.

3.4. Fiscal Drag (FD)

The fiscal drag effect is quantified by the additional tax burden that is caused by incomes falling into different income brackets (and therefore under different marginal tax rates). We have already observed [see (2) above] that when incomes increase, tax revenue increases at least proportionally (this is what is captured by AI). However, if incomes fall into different income brackets as a consequence of their growth, fiscal drag effects occur because of the interactions with tax progressivity. Formally, the additional tax revenue due to fiscal drag is given by

$$FD = T_{95}(Y_{00}) - gT_{95}\left(\frac{Y_{00}}{g}\right)\,. \tag{4}$$

Consider the first term on the RHS of (4). This is the straightforward result of applying the 1995 tax regime to the income distribution of the year 2000. Consider now the second term on the RHS of (4). Applying T_{95} to Y_{00} scaled by g – as if income growth were absent – and multiplying the result by g gives the tax revenue that T_{95} would have produced if it were a proportional tax.

In this latter case, the application of a given tax regime to deflated incomes (Y_{00}/g) and the revaluation of all tax liabilities by g is equivalent to applying that same tax regime directly to the nondeflated incomes (Y_{00}), leading to $FD = 0$. However, with a progressive tax (and $g > 1$), the first term will generally be higher than the second one. Therefore, the difference between the two gives the additional tax revenue generated by incomes falling in higher brackets because of progressivity. The FD effect may be further split into two parts: inflationary fiscal drag and real fiscal drag.

3.4.1. Inflationary Fiscal Drag (IFD)

This effect captures the variation of tax revenue due to incomes moving across income brackets because of inflation. The following expression quantifies IFD:

$$IFD = T_{95}(Y_{00}) - hT_{95}\left(\frac{Y_{00}}{h}\right), \tag{4a}$$

where h is the price index between the two years. The interpretation of (4a) is analogous to that of (4), just replace g with h.

3.4.2. Real Fiscal Drag (RFD)

This effect isolates the additional tax revenue imputable to real income growth. This is given by

$$RFD = hT_{95}\left(\frac{Y_{00}}{h}\right) - gT_{95}\left(\frac{Y_{00}}{g}\right). \tag{4b}$$

The interpretation of (4b) is now straightforward, as it is obtained by subtracting the inflationary fiscal drag (4a) from the total fiscal drag effect (4). Since the income distribution is scaled by inflation in the first term and by total growth (inflation + real) in the second term, the difference must be the additional tax revenue due to real income growth. Obviously, if the growth is only inflationary (i.e., $g = h$), then $RFD = 0$.

3.5. Tax Law (TL)

It is worth noting that until now, all effects have been calculated by applying T_{95} – the tax regime of the base period – to various income distributions. This means that all effects quantify changes of tax revenue imputable to nontax factors. The tax-law effect, instead, isolates the impact of tax factors; consequently it neutralizes any tax revenue change that is due to the action of nontax factors. It is given by

$$TL = T_{00}(Y_{00}) - T_{95}(Y_{00}). \tag{5}$$

The interpretation of (5) is obvious. It will be equal to zero only when the tax regime is either unchanged or revenue-neutral.[7]

In summary, the change in tax revenue, ΔT, will be

$$\Delta T = T_{00}(Y_{00}) - T_{95}(Y_{95}) = NT + AI + ID + IFD + RFD + TL\,. \quad (6)$$

4. Methodological Issues: Decomposing the Redistributive Effect

The methodology proposed by OECD (1987) to break up tax revenue changes is now extended to encompass a decomposition of the total redistributive change occurring between 1995 and 2000. This is done by using the Reynolds–Smolensky index (*RS*), obtained as the difference between the Gini indices of the distribution before and after a given tax change.[8]

Compared with other indices, *RS* is particularly useful in that it can be further decomposed to consider how much of the total redistributive change is due to the amount of tax resources collected (the size of the redistribution) and how much of that same effect is due to a nonproportional way of collecting them (the degree of progressivity of taxation).[9] The main shortcoming of this latter decomposition is that a residual term may appear.[10]

Using *RS* requires first measuring the Gini indices of pretax and after-tax inequality of income distributions in both 1995 and 2000. In each year, one has

$$RS = G_{Yxx} - G_{Yxx-Txx} = \tau_{Txx}\Pi_{Txx} - R_{xx}\,, \quad (7)$$

where xx denotes either 95 or 00. This expression defines the *RS* index and its decomposition. This latter is given by the product of the implicit average tax rate ($\tau_{Txx} \equiv \frac{t_{Txx}}{1-t_{Txx}}$) and the Kakwani index (Π_{Txx}), where, in turn, the general definition of the average tax rate is $t_{Txx} = \frac{T_{xx}(Y_{xx})}{Y_{xx}}$.[11] The implicit average tax rate τ_{Txx} measures the size of the redistribution (how much income is redistributed); the Kakwani index measures how disproportional the income tax is in comparison to the benchmark case of a proportional income tax.

7 In this latter case, it is likely there will be effects on the redistribution side (see below). It will become clearer in the empirical section that *TL* encompasses the constant-population methodology.

8 See Reynolds and Smolensky (1977).

9 See Kakwani (1977) and Kakwani (1984) for the consideration of a reranking term.

10 Extensions to other inequality indices is straightforward, but is not pursued in this paper, as the main point is clearly achieved by using the *RS* index.

11 Note that the *implicit* average tax rate is therefore given by the ratio of the average tax rate to one minus the average tax rate, as required by the decomposition in (7). See Lambert (1993).

The Kakwani index is obtained as the difference between the concentration coefficient of the income tax and the Gini index of the pretax income distribution:[12]

$$\Pi_{Txx} = C_{Txx} - G_{Txx}\,. \tag{8}$$

With a proportional income tax, $C_{Txx} = G_{Txx}$. As a consequence, $\Pi_{Txx} = 0$. With a progressive income tax, $C_{Txx} > G_{Yxx}$, as a progressive tax is more concentrated than the initial incomes. Therefore the Kakwani index is positive and increases with the progressivity of the income tax.

Finally, the term on the far right of (7) is the reranking effect (R_{xx}), which measures the change of the relative position of taxpayers after the income tax, compared to their position before it. Note that as $R_{xx} > 0$, it subtracts from the total redistributive effect, because the product of the implicit average tax rate and the Kakwani index includes some redistribution that simply derives from switching the relative positions of individuals. The reranking effect may also be interpreted as a part of a wider horizontal inequity effect, which includes unequal treatment of equals that does not cause reranking.[13]

Now, when applying the methodology of section 2 to redistributive issues, it is necessary to convert tax revenue changes into changes of the redistributive outcome. Comparing the two tax regimes selected in this paper, the redistributive change ΔRS can be given the following expression:

$$\Delta RS = \underbrace{[G_{Y_{00}} - G_{Y_{00}-T_{00}}]}_{RS_{T_{00}}} - \underbrace{[G_{Y_{95}} - G_{Y_{95}-T_{95}}]}_{RS_{T_{95}}}\,. \tag{9}$$

This expression simply describes the fact that the application of T_{00} and T_{95} to the corresponding income distributions (Y_{00} and Y_{95}) gives rise to two redistributive outcomes ($RS_{T_{00}}$ and $RS_{T_{95}}$). The difference between the two measures is ΔRS. Now, analogously to the decomposition of tax revenue changes, ΔRS may be decomposed into the same factors: number of taxpayers, average income, income distribution, fiscal drags, and tax laws.

12 Just recall that, in this case, the concentration coefficient must be measured on the pretax income distribution.

13 See Aronson et al. (1994) – in particular the graphical tool of overlapping and nonoverlapping "fans." The decomposition of the redistributive effect into horizontal, vertical, and reranking effects is not pursued in this paper. The reason is that this further decomposition does not help isolate the effects of nontax factors from those of tax changes. Rather, it would be a further step in explaining the effects due to tax changes, which has however no immediate relevance to the purpose of this paper.

4.1. Number of Taxpayers (NT)

The redistributive consequence of a change in the number of taxpayers (NT) is expressed by[14]:

$$\begin{aligned}\Delta RS_{NT} &= (G_{Y_{95}} - G_{Y_{95}-kT_{95}}) - (G_{Y_{95}} - G_{Y_{95}-T_{95}}) \\ &= \left(\tau_{kT_{95}} \Pi_{kT_{95}}^{Y_{95}}\right) - \left(\tau_{T_{95}} \Pi_{T_{95}}^{Y_{95}}\right). \end{aligned} \tag{10}$$

In (10), $\tau_{kT_{95}} = \frac{t_{kT_{95}}}{1-t_{kT_{95}}}$ is the implicit average tax rate arising from the distribution of kT_{95}, where $t_{kT_{95}} = \frac{kT_{95}(Y_{95})}{Y_{95}}$ is the average tax rate obtained by dividing the tax revenue of 1995 – after multiplying all tax liabilities by k – by the pretax income distribution of the same year (Y_{95}). Analogously, $\tau_{T_{95}} = \frac{t_{T_{95}}}{1-t_{T_{95}}}$ is the implicit average tax rate arising from the distribution of T_{95}, where $t_{T_{95}} = \frac{T_{95}(Y_{95})}{Y_{95}}$ is the average tax rate obtained by dividing the tax revenue of 1995 by the corresponding pretax income distribution.[15]

According to (8), the two Kakwani indices of (10) can be further expanded:

$$\begin{aligned}\Pi_{kT_{95}}^{Y_{95}} &= C_{kT_{95}}^{Y_{95}} - G_{Y_{95}}, \\ \Pi_{T_{95}}^{Y_{95}} &= C_{T_{95}}^{Y_{95}} - G_{Y_{95}}. \end{aligned} \tag{10a}$$

Now, it is worth noting that $\Pi_{kT_{95}}^{Y_{95}} = \Pi_{T_{95}}^{Y_{95}}$. The ways in which T_{95} and kT_{95} are distributed on Y_{95} is indeed the same, as the latter set of tax liabilities is only a proportionally scaled version of the former one. The concentration coefficient is therefore the same in both cases. Therefore, a change of the number of taxpayers isolates an average tax rate effect and not a Kakwani effect, as the change of the Kakwani index will be zero.

4.2. Average Income (AI)

The redistributive effect of a change of average income is identified by the following expression:[16]

$$\Delta RS_{AI} = \left(\tau_{gkT_{95}} \Pi_{gkT_{95}}^{Y_{95}}\right) - \left(\tau_{kT_{95}} \Pi_{kT_{95}}^{Y_{95}}\right). \tag{11}$$

14 Note that, in what follows, concentration coefficients and Kakwani indices will appear with both a subscript and a superscript. The subscript indicates the variable whose concentration is measured, while the superscript indicates the variable *on which* the concentration is calculated. For example, Π_{T95}^{Y95} denotes the concentration of taxes paid in 1995 on the pretax income distribution of the same year. The Gini index does not need a double indicator, as the variable whose concentration is measured and that on which the concentration is measured are the same. All formulas below, to save notation, omit indicating the difference between the corresponding reranking terms, but all must be taken as including a term ΔR.

15 Different implicit tax rates across the elements of the decomposition will therefore arise according to what distribution of taxes is taken into account and to what is the proper income distribution at the denominator.

16 The difference between Gini indices as in (10) is omitted for simplicity. Full details of formulas are given in table 3.

Again, one can note that also in this case the two Kakwani indices are equal. Indeed,

$$\Pi^{Y_{95}}_{gkT_{95}} = C^{Y_{95}}_{gkT_{95}} - G_{Y_{95}} ,$$
$$\Pi^{Y_{95}}_{kT_{95}} = C^{Y_{95}}_{kT_{95}} - G_{Y_{95}} , \tag{11a}$$

from which it is clear that the tax concentration coefficients are equal, as the two distributions of tax liabilities differ only by a scalar g. The Gini index of the pretax income distribution is also the same. Therefore, as before, the average income effect embodies only an average-tax-rate effect, as the change of the Kakwani index is zero.

Implicit average tax rates, in this case, are instead based on the following average tax rates: $t_{gkT_{95}} = \frac{gkT_{95}(Y_{95})}{Y_{95}}$ and $t_{kT_{95}} = \frac{kT_{95}(Y_{95})}{Y_{95}}$.

4.3. Income Distribution (ID)

The effect of a change of the way in which income is distributed is measured as follows:

$$\Delta RS_{ID} = \left(\tau_{gT_{95}} \Pi^{Y_{00}/g}_{gT_{95}}\right) - \left(\tau_{gkT_{95}} \Pi^{Y_{95}}_{gkT_{95}}\right) . \tag{12}$$

In turn, the two Kakwani indices are defined by the following expressions:

$$\Pi^{Y_{00}/g}_{gT_{95}} = C^{Y_{00}/g}_{gT_{95}} - G_{Y_{00}/g} ,$$
$$\Pi^{Y_{95}}_{gkT_{95}} = C^{Y_{95}}_{gkT_{95}} - G_{Y_{95}} . \tag{12a}$$

In this case the Gini indices of the two pretax income distributions differ. These have the same mean, but can obviously differ in the way income is distributed, unless all incomes have grown at the same rate. It follows that the ways in which gkT_{95} and gT_{95} are distributed on two different pretax income distributions are likely to be different, leading to a different Kakwani index. Implicit average tax rates, in this case, are calculated on the basis of $t_{gT_{95}} = \frac{gT_{95}(Y_{00}/g)}{Y_{00}/g}$ and $t_{gkT_{95}} = \frac{gkT_{95}(Y_{95})}{Y_{95}}$. Therefore, the redistributive impact of a change of the way income is distributed contains both an average tax rate and a Kakwani effect. It is also worth noting that the Kakwani effect is imputable partly to different pretax income distributions and partly to the way in which the tax is distributed.

4.4. Fiscal Drag

4.4.1. Inflationary Fiscal Drag (IFD)

The redistributive impact of IFD is given by

$$\Delta RS_{IFD} = \left(\tau_{T_{95}} \Pi^{Y_{00}}_{T_{95}}\right) - \left(\tau_{hT_{95}} \Pi^{Y_{00}/h}_{hT_{95}}\right) . \tag{13}$$

In this case, the Kakwani indices assume the following form:

$$\Pi_{T_{95}}^{Y_{00}} = C_{T_{95}}^{Y_{00}} - G_{Y_{00}} \,,$$
$$\Pi_{hT_{95}}^{Y_{00}/h} = C_{hT_{95}}^{Y_{00}/h} - G_{Y_{00}/h} \,. \tag{13a}$$

In (13a), the Gini index of the pretax income distributions is the same, as Y_{00}/h is only a scaled version of the original Y_{00}; but the concentration coefficients of taxes will differ, leading to different Kakwani indices. Implicit average tax rates are in this case based on $t_{T_{95}} = \frac{T_{95}(Y_{00})}{Y_{00}}$ and $t_{hT_{95}} = \frac{hT_{95}(Y_{00}/h)}{Y_{00}/h}$. Therefore *IFD* will have both a Kakwani effect and an implicit average-tax-rate effect, but note that the Kakwani effect is only imputable to different concentration coefficients of taxes. Quite obviously, these effects disappear if $h = 1$.

4.4.2. Real Fiscal Drag (RFD)

The change of the redistributive impact of *RFD* is measured as follows:

$$\Delta RS_{RFD} = \left(\tau_{hT_{95}} \Pi_{hT_{95}}^{Y_{00}/h}\right) - \left(\tau_{gT_{95}} \Pi_{gT_{95}}^{Y_{00}/g}\right) , \tag{14}$$

where the Kakwani indices are

$$\Pi_{hT_{95}}^{Y_{00}/h} = C_{hT_{95}}^{Y_{00}/h} - G_{Y_{00}/h} \,,$$
$$\Pi_{gT_{95}}^{Y_{00}/g} = C_{gT_{95}}^{Y_{00}/g} - G_{Y_{00}/g} \,. \tag{14a}$$

The Gini indices of the pretax income distributions are again the same, as both are obtained by scaling the original distribution by either a factor h or a factor g. However, the tax concentration coefficients are different, unless $h = g$. The Kakwani indices will therefore be different. Again, the change of the Kakwani index is entirely imputable to the change of the concentration coefficients and not to the inequality of the corresponding pretax income distribution. Implicit average tax rates will also differ, as they are based on $t_{hT_{95}} = \frac{hT_{95}(Y_{00}/h)}{Y_{00}/h}$ and $t_{gT_{95}} = \frac{gT_{95}(Y_{00}/g)}{Y_{00}/g}$. As in the previous case, the change of the redistributive impact caused by *RFD* will therefore be a mixture of the change of the implicit average tax rate and the change of the Kakwani effect.

4.5. Tax Law (TL)

Finally, the tax-law effect may be quantified as follows:

$$\Delta RS_{TL} = \left(\tau_{T_{00}} \Pi_{T_{00}}^{Y_{00}}\right) - \left(\tau_{T_{95}} \Pi_{T_{95}}^{Y_{00}}\right) , \tag{15}$$

with the two Kakwani indices defined by

$$\Pi_{T_{00}}^{Y_{00}} = C_{T_{00}}^{Y_{00}} - G_{Y_{00}} \,,$$
$$\Pi_{T_{95}}^{Y_{00}} = C_{T_{95}}^{Y_{00}} - G_{Y_{00}} \,. \tag{16}$$

The Gini indices of (16) are obviously the same. However, it is likely that T_{95} and T_{00} are distributed in different ways. This entails different Kakwani indices, because of different concentration coefficients. Note that this difference is now entirely imputable to changes in tax regimes and not to variations of the pretax income distributions. Furthermore, if the two tax regimes are not revenue-neutral, the implicit average tax rates will also be different, being based on $t_{T_{00}} = \frac{T_{00}(Y_{00})}{Y_{00}}$ and $t_{T_{95}} = \frac{T_{95}(Y_{00})}{Y_{00}}$.

Table 2, for each effect, summarizes the presence of an implicit average-tax-rate effect and of the Kakwani effect in shaping the change of the redistributive impact, as well as which factors (pretax income distribution and/or tax concentration) contribute to determining the Kakwani index. Table 3 summarizes all formulas so far discussed. Analogously to (6), the total change of the redistributive impact may be written as

$$\Delta RS = \Delta RS_{NT} + \Delta RS_{AI} + \Delta RS_{ID} + \Delta RS_{IFD} + \Delta RS_{RFD} + \Delta RS_{TL} \,. \quad (17)$$

Table 2

Decomposition of the Redistributive Impact and Effects Involved

Effect	*Implicit average tax rate effect*	*Kakwani effect*	*Does pre-tax income distribution affect Kakwani?*	*Does tax concentration affect Kakwani?*
Number of taxpayers (NT)	Yes	No	–	–
Average income (AI)	Yes	No	–	–
Income distribution (ID)	Yes	Yes	Yes	Yes
Inflationary fiscal drag (IFD)	Yes	Yes	No	Yes
Real fiscal drag (RFD)	Yes	Yes	No	Yes
Tax law (TL)	Yes	Yes	No	Yes

5. Empirical Results

5.1. Data and Microsimulation Models

The results of the decomposition of both tax revenue and redistribution are obtained by using two static microsimulation models. Both are built using the Survey of Household Income and Wealth (SHIW) by the Bank of Italy on net incomes. This entails introducing a grossing-up procedure to reconstruct gross incomes from the net ones according to the tax legislation prevailing in each year. One model (AWARETAX) is built using SHIW 1995; the second model (TAXPOL) is built using SHIW 2000.

Both models use a detailed set of information on households, including incomes, demographic structures, and other sociodemographic variables. Both models produce a set of taxpayers with information on taxable incomes, gross taxes, tax credits, the imputation of the main cash benefits (e.g., child

Table 3

The Analytical Decomposition of Redistributive Changes

Effect	*ΔRS*	*Kakwani decomposition*	*Kakwani indexes*	*Average tax rates*
Number of taxpayers (NT)	$(G_{Y_{95}} - G_{Y_{95}-kT_{95}}) - (G_{Y_{95}} - G_{Y_{95}-T_{95}})$	$\left(\tau_{kT_{95}} \Pi^{Y_{95}}_{kT_{95}}\right) - \left(\tau_{T_{95}} \Pi^{Y_{95}}_{T_{95}}\right)$	$\Pi^{Y_{95}}_{kT_{95}} = C^{Y_{95}}_{kT_{95}} - G_{Y_{95}}$ $\Pi^{Y_{95}}_{T_{95}} = C^{Y_{95}}_{T_{95}} - G_{Y_{95}}$	$t_{kT_{95}} = \frac{kT_{95}(Y_{95})}{Y_{95}}$ $t_{T_{95}} = \frac{T_{95}(Y_{95})}{Y_{95}}$
Average income (AI)	$(G_{Y_{95}} - G_{Y_{95}-gkT_{95}}) - (G_{Y_{95}} - G_{Y_{95}-kT_{95}})$	$\left(\tau_{gkT_{95}} \Pi^{Y_{95}}_{gkT_{95}}\right) - \left(\tau_{kT_{95}} \Pi^{Y_{95}}_{kT_{95}}\right)$	$\Pi^{Y_{95}}_{gkT_{95}} = C^{Y_{95}}_{gkT_{95}} - G_{Y_{95}}$ $\Pi^{Y_{95}}_{kT_{95}} = C^{Y_{95}}_{kT_{95}} - G_{Y_{95}}$	$t_{gkT_{95}} = \frac{gkT_{95}(Y_{95})}{Y_{95}}$ $t_{kT_{95}} = \frac{kT_{95}(Y_{95})}{Y_{95}}$
Income distribution (ID)	$(G_{Y_{00}/g} - G_{Y_{00}/g-gT_{95}}) - (G_{Y_{95}} - G_{Y_{95}-gkT_{95}})$	$\left(\tau_{gT_{95}} \Pi^{Y_{00}/g}_{gT_{95}}\right) - \left(\tau_{gkT_{95}} \Pi^{Y_{95}}_{gkT_{95}}\right)$	$\Pi^{Y_{00}/g}_{gT_{95}} = C^{Y_{00}/g}_{gT_{95}} - G_{Y_{00}/g}$ $\Pi^{Y_{95}}_{gkT_{95}} = C^{Y_{95}}_{gkT_{95}} - G_{Y_{95}}$	$t_{gT_{95}} = \frac{gT_{95}(Y_{00}/g)}{Y_{00}/g}$ $t_{gkT_{95}} = \frac{gkT_{95}(Y_{95})}{Y_{95}}$
Inflationary fiscal drag (IFD)	$(G_{Y_{00}} - G_{Y_{00}-T_{95}}) - (G_{Y_{00}/h} - G_{(Y_{00}/h)-hT_{95}})$	$\left(\tau_{T_{95}} \Pi^{Y_{00}}_{T_{95}}\right) - \left(\tau_{hT_{95}} \Pi^{Y_{00}/h}_{hT_{95}}\right)$	$\Pi^{Y_{00}}_{T_{95}} = C^{Y_{00}}_{T_{95}} - G_{Y_{00}}$ $\Pi^{Y_{00}/h}_{hT_{95}} = C^{Y_{00}/h}_{hT_{95}} - G_{Y_{00}/h}$	$t_{T_{95}} = \frac{T_{95}(Y_{00})}{Y_{00}}$ $t_{hT_{95}} = \frac{hT_{95}(Y_{00}/h)}{Y_{00}/h}$
Real fiscal drag (RFD)	$(G_{Y_{00}/h} - G_{(Y_{00}/h)-hT_{95}}) - (G_{Y_{00}/g} - G_{(Y_{00}/g)-gT_{95}})$	$\left(\tau_{hT_{95}} \Pi^{Y_{00}/h}_{hT_{95}}\right) - \left(\tau_{gT_{95}} \Pi^{Y_{00}/g}_{gT_{95}}\right)$	$\Pi^{Y_{00}/h}_{hT_{95}} = C^{Y_{00}/h}_{hT_{95}} - G_{Y_{00}/h}$ $\Pi^{Y_{00}/g}_{gT_{95}} = C^{Y_{00}/g}_{gT_{95}} - G_{Y_{00}/g}$	$t_{hT_{95}} = \frac{hT_{95}(Y_{00}/h)}{Y_{00}/h}$ $t_{gT_{95}} = \frac{gT_{95}(Y_{00}/g)}{Y_{00}/g}$
Tax law (TL)	$(G_{Y_{00}} - G_{Y_{00}-T_{00}}) - (G_{Y_{00}} - G_{Y_{00}-T_{95}})$	$\left(\tau_{T_{00}} \Pi^{Y_{00}}_{T_{00}}\right) - \left(\tau_{T_{95}} \Pi^{Y_{00}}_{T_{95}}\right)$	$\Pi^{Y_{00}}_{T_{00}} = C^{Y_{00}}_{T_{00}} - G_{Y_{00}}$ $\Pi^{Y_{00}}_{T_{95}} = C^{Y_{00}}_{T_{95}} - G_{Y_{00}}$	$t_{T_{00}} = \frac{T_{00}(Y_{00})}{Y_{00}}$ $t_{T_{95}} = \frac{T_{95}(Y_{00})}{Y_{00}}$

benefits) on the expenditure side, and all other required parameters able to shape the tax liability (e.g., interest expenses).[17] In this respect, the information embodied in the two models is the widest possible, as each record of the file is a single taxpayer. On the other hand, no behavioral reactions have been included in the two models for the purpose of this paper, as behavioral reactions are to some extent embodied in the fact that this microsimulation analysis is based on a variable pretax income distributions between the two years.[18]

Table 4 reports the main summary statistics of the two SHIW waves and the basic outcomes of the two microsimulation models, as well as the official data on tax revenues, to examine the degree of proximity of our estimates to the actual tax figures.

Table 4
Summary Statistics

	AWARETAX (1995)	TAXPOL (2000)
Number of observations on individuals	23,924	22,269
Number of observations on households	8,135	8,001
Weighted number of individuals	56,582,937	56,518,384
Weighted number of households	19,599,998	20,782,701
Average household size	2.88	2.72
Estimated personal income tax (billions of euros)	77.3	108.0
Actual income tax revenue (billions of euros)	83.2	113.6
Number of taxpayers (millions)	36.5	37.8

Source: Authors' calculations on AWARETAX and TAXPOL.

5.2. Specific Redistributive Issues

Unlike the case of tax revenue, in which the decomposition has an aggregate nature, the redistributive decomposition requires us to state across whom redistribution is measured and, consequently, what is the appropriate indicator of living standard to compare households.

The choice adopted in this paper falls on household incomes. This procedure is rather standard in the redistributive literature, and also recommended;

17 No use is made of detailed tax files, as they are not for public use.

18 On the use and aims of microsimulation techniques, see the recent book by Gupta and Kapur (2000).

it aims at verifying the impact of tax policies on the most comprehensive unit of analysis.[19]

As is well known, with the household as a unit of analysis, nominal incomes cannot be taken as a proper variable to measure redistribution, as households differ in size and composition. A high nominal income may be shared among a large number of household members, giving rise to a low standard of living. For this reason, the measure of well-being is taken to be *equivalent* household incomes obtained by deflating nominal incomes by an equivalence scale.[20] All redistributive outcomes, therefore, will be measured on a distribution of equivalent incomes; this entails that equivalent incomes will provide the basis for the calculation of both the average tax rates and the Kakwani indices summarized in table 3.

5.3. Decomposing the Change of Tax Revenue

Table 5 reports the outcome of the decomposition of tax revenue changes, according to the methodology developed in section 3. The estimated absolute tax revenue change is about 30 billion euros. This is equivalent to an increase of about 2.1 percentage points in the total average tax burden.

The greatest contribution to the change of tax revenue is imputable to the increase of average income (about 16.6 billion euros – slightly more than half of the total change). A significant part (about 24%) of the additional tax revenue arises from total fiscal drag, both inflationary (7.2 billion euros) and real (4.6 billion euros). Smaller positive contributions also arise from the income distribution effect (4 billion euros) and from the change of the number of taxpayers (2.9 billion euros, 10% of the total change). Adding up all these positive figures gives rise to a total effect of more than 35 billion euros. It must therefore be that changes of tax laws have pushed tax revenue downward. This is indeed reported in table 5, where the effect of tax law enters with a negative sign (−4.7 billion euros).

The decomposition of the tax revenue change gives interesting insights. The first, somewhat expected, is that external factors have pushed tax revenue upwards, but this has occurred at the same time as an announced policy choice of reducing it. In other words, without the negative contribution of TL, the increase of tax revenue would have been larger. The usefulness of this methodology appears clearly from the previous decomposition, as it neatly disentangles the intended effects of tax policies from the influence of all other factors indirectly affecting the functioning of the tax systems.

19 See, for example, the document by the Canberra Group (2001).

20 The equivalence scale chosen is the OECD scale that assigns the value 1 to the first member of the household, 0.7 to all other adults, and 0.5 to children.

Table 5
The Decomposition of the Change of Tax Revenue

	(billions of euros)
Estimated tax revenue 1995 [a]	77.3
Estimated tax revenue 2000 [b]	108.0
Estimated tax revenue change	30.6
Actual tax revenue change [c]	30.4
Average tax rate in 1995	18.1
Average tax rate in 2000	20.1
Change of average tax rate (percentage points)	2.1
Decomposition of estimated tax revenue change	
Number of taxpayers (NT)	2.9
Average income (NT)	16.6
Income distribution (ID)	4.0
Inflationary fiscal drag (IFD)	7.2
Real fiscal drag (RFD)	4.6
Tax law (TL)	–4.7
Parameters used to calculate the decomposition	
Number of taxpayers in 1995	36,452,716
Number of taxpayers in 2000	37,836,428
Total average income in 1995 (euros)	11,748
Total average income in 2000 (euros)	14,177
k (number of taxpayers 2000 over number of taxpayers 1995)	1.04
g (average income 2000 over average income 1995)	1.21
h (price index 2000, 1995=1)	1.12

[a] Estimates by AWARETAX
[b] Estimates by TAXPOL
[c] Official Italian figures, RGSEP corresponding years

Source: Authors' calculations on AWARETAX and TAXPOL.

The second interesting insight can be gained by comparing the effects of tax changes (TL) with the additional tax revenue caused by inflation (IFD). Consider the following line of reasoning. If T_{00} were a perfect indexation of T_{95} (and nothing else), the reduction of tax revenue imputable to TL should have been of the same magnitude as IFD with an opposite sign (−7.2 billion euros). This point can be best illustrated by further decomposing TL. Ideally, changes in tax law can be split between those needed to provide indexation of the existing system and those implemented to change the tax structure. In symbols,

$$TL = TL(I) + TL(S) \\ = \underbrace{\left[T^I_{95}(Y_{00}) - T_{95}(Y_{00})\right]}_{TL(I)} + \underbrace{\left[T_{00}(Y_{00}) - T^I_{95}(Y_{00})\right]}_{TL(S)}, \quad (18)$$

where T^I_{95} denotes the indexed 1995 tax regime, i.e., the tax system prevailing in 1995 with all monetary parameters upgraded to take account of inflation.

The first term on the RHS of (18), $TL(I)$, is therefore the change in tax revenue that would have occurred if the tax system of 1995 were only indexed. Obviously, with zero inflation we have $TL(I) = 0$, as $T^I_{95} = T_{95}$. In general, with positive inflation we have $TL(I) < 0$; i.e., with progressivity, indexation must raise less tax revenue than leaving the tax system unchanged in nominal terms. Therefore, the negative magnitude of $TL(I)$ denotes how much of the additional tax revenue raised by IFD is actually compensated by indexation. With perfect indexation, $TL(I) = IFD$ in absolute values.

The second term of (18), $TL(S)$, is instead the change of tax revenue that can be imputed to a variation of the tax structure beyond what is needed for indexation. If the new tax system were only an indexed version of the old one, then $TL(S) = 0$. If not, the sign of the change of tax revenue will obviously depend on how tax parameters are changed.

The expression (18) may help to interpret the meaning of the TL effect of −4.7 billion euros in table 5. Now, if the tax system of 1995 were only indexed to inflation, then $TL = TL(I)$, and the reduction of tax revenue would have been 7.2 billion euros. Since $TL = -4.7$, either T_{00} is less than a perfect indexation of T_{95} or the implicit $TL(S)$ is a positive 2.5 billion euros, which means that the policymaker has eroded part of what it would have given back to taxpayers with a perfectly indexed tax system.

The decomposition of (18) also provides a third interesting insight of the exercise, which is methodological. It should indeed be clear, now, that the widely used constant-population methodology corresponds to what is measured as $TL(S)$ in (18). That term measures the performance of different tax systems, whose tax parameters are expressed in real terms with respect to a base year and whose effects are compared on the income distribution of that same year.

5.4. Decomposing the Change of the Redistributive Impact

The extension of the previous methodology to a redistributive decomposition is illustrated in table 6. The first part of the table recalls the values of the Gini index (of both gross and net incomes) in both 1995 and 2000 (with five decimals) and introduces the corresponding confidence intervals at 95%

Table 6
The Decomposition of Redistributive Changes

	1995		2000		Changes	
Gini index of gross incomes	**0.37305**		**0.38860**			
Confidence interval	*0.37297*	*0.37313*	*0.38849*	*0.38871*		
Gini index of net incomes	**0.34251**		**0.34950**			
Confidence interval	*0.34243*	*0.34259*	*0.34940*	*0.34959*		
Total redistributive impact	**0.03054**		**0.03910**		**0.008562**	
Confidence interval	*0.03052*	*0.03056*	*0.03908*	*0.03913*	*0.008558*	*0.008568*
Implicit average tax rate	0.180		0.235		0.0550	
Kakwani index	0.192		0.182		−0.0103	
Reranking	−0.0040		−0.0036		0.0004	

	Change of Reynolds–Smolensky index (ΔRS)	*Change of implicit average tax rate*	*Change of Kakwani index*
Total changes	0.0086	0.0550	−0.0103
Number of taxpayers (NT)	0.0013	0.007	0.0000
Average income (AI)	0.0078	0.049	0.0000
Income distribution (ID)	0.0074	0.037	−0.0037
Inflationary fiscal drag (IFD)	−0.0062	−0.015	−0.0148
Real fiscal drag (RFD)	−0.0041	−0.010	−0.0110
Tax law (TL)	0.0023	−0.013	0.0191

Source: Authors' calculations on AWARETAX and TAXPOL.

calculated following the methodology developed by Ogwang (2000) and based on the jackknife standard errors. The confidence intervals are very narrow.

The summary figures of the corresponding redistributive impacts, again with the associated standard errors, are also shown. Also in this case, the confidence intervals are very narrow. The total redistributive impact has increased from 0.03054 (T_{95} on Y_{95}) to 0.03910 (T_{00} on Y_{00}), corresponding to a change of 0.008562 points of the Gini index.

In aggregate, this increase has been driven by a significant increase of the implicit average tax rate (from 18% to 23.5%) that more than compensates the reduction of the Kakwani index from 0.192 to 0.182. A rough interpretation of this decomposition is that T_{00} is a less disproportional regime than T_{95}, but with a higher implicit average tax rate. The main aim of the following decomposition is to understand in more detail how much of this total effect is imputable to changes of tax law and how much of it is imputable to nontax factors.

Moving to the decomposition – reported in the second panel of table 6 – the picture is indeed more interesting. The first row summarizes the changes to be explained by the decomposition. As in the case of tax revenue, there are a number of issues that merit discussion.

5.4.1. Average Income

One of the most important positive contributions to the change of the redistributive impact comes from average income (0.0078). However, this contribution emerges exclusively from a higher average tax rate (4.9 percentage points), for the change of the Kakwani index is zero in this case (recall table 2). This is quite obvious, as the relevant taxes in calculating this effect are those of 1995 scaled by k and g, on the one hand, and those of 1995 scaled by k, on the other hand. As g is greater than 1, the total amount of taxes should increase at least by this factor. But since the original tax liabilities are all scaled proportionally, the concentration coefficient of taxes does not change, and the Kakwani index stays the same.

5.4.2. Number of Taxpayers

A similar line of reasoning applies to the case of the number of taxpayers (whose contribution is 0.0013). Again, it is the average tax rate that drives the increase in the redistributive impact, as the change in the Kakwani index is again zero. In this case, however, the positive contribution is lower than in the case of average income, as k is still greater than 1 but much lower than g (1.04 and 1.21, respectively – recall table 5).

5.4.3. Income Distribution

More interesting is the analysis of the income distribution effect, which also contributes positively to the measured redistributive change (0.0074). This positive change is again partially explained by the impulse of the average tax rate (3.7 percentage points). This depends on the fact that incomes scaled by g, evidently, reallocate themselves across income brackets in a revenue-increasing way compared with the distribution of incomes in 1995. On the other hand, there is a slight negative impulse originating from a lower Kakwani index (−0.004). Quite interestingly, this lower Kakwani index is not imputable to the way in which the tax liabilities of 1995 are concentrated, as the tax concentration coefficient (not reported in table 6) is indeed higher when the 1995 tax regime is applied to Y_{00}/g (0.577) than when it is applied to Y_{95} (0.565). Rather, the overall effect is driven by the higher inequality of the (pretax) income distribution Y_{00}/g – as measured by the Gini index (0.389) – compared with the inequality of the (pretax) income distribution Y_{95} (whose Gini index is 0.373). Therefore, it is this higher inequality of the pretax income distribution that drives down the disproportionality of T_{95} when applied to Y_{00}/g. In any case, it must be that a higher proportion of taxes falls on the lowest part of the income distribution, if one has to have a less disproportional distribution. However, this negative impulse does not outweigh the positive impulse of the higher average tax rate, so that the total redistributive change is positive.

5.4.4. Inflationary Fiscal Drag

The redistributive power of fiscal drag merits particular attention. In both cases (real and inflationary), its contribution to the total redistributive effect is negative. Consider first the inflationary fiscal drag (*IFD*). In table 6, its overall impact is –0.0062, i.e., it contributes negatively to redistribution. A reduction of both the implicit average tax rate and the Kakwani index now drives this outcome.

With regard to the implicit average tax rate, the meaning of a negative change may be better explained by observing the behavior of the corresponding numerators, (average tax rates) in the case of *IFD* (table 3):[21]

$$t_{T_{95}} - t_{hT_{95}} = \frac{T_{95}(Y_{00})}{Y_{00}} - \frac{hT_{95}(Y_{00}/h)}{Y_{00}/h}\,. \tag{19}$$

Now, at lower income levels, scaling incomes by h is likely to make scaled incomes fall in lower tax brackets or have the right to larger amounts of tax deductions and/or tax credits, if these latter are inversely related to income. Therefore, h times the tax paid on scaled incomes is always lower than the tax paid on nominal incomes, when there is inflation and tax progressivity. This entails that the numerator of the second term on the RHS of (18) is everywhere smaller than the numerator of the first term. This is consistent with the idea – and with our previous findings in table 5 – that inflationary fiscal drag causes an increase of the absolute amount of tax revenue, unless the income tax is proportional, in which case both numerators provide the same tax revenue. But in general, $T_{95}(Y_{00}) > hT_{95}(Y_{00}/h)$.

Consider now the denominators of the two terms of (18). As the calculation is made by scaling all incomes by h, with inflation the denominator on the RHS of (18) will be lower than the denominator of the RHS by a factor h. This will hold in aggregate and for every single income.

Therefore, in aggregate, the sign of (18) will depend on the rate of change of the numerator in the two alternatives, because that of the denominator is h in both. The conclusion is that the sign will be positive if the ratio between $T_{95}(Y_{00})$ and $hT_{95}(Y_{00}/h)$ is greater than h, and negative in the opposite case.

A natural question to ask now is who are those taxpayers for whom the numerator grows faster than h, which leads to a positive difference between average tax rates. In order to explore this issue (and to interpret the negative change of the implicit average tax rate) it is worth observing that the ratio

21 Just recall that the average tax rates involved in the redistributive outcome are expressed in equivalent figures.

between $T_{95}(Y_{00})$ and $hT_{95}(Y_{00}/h)$ does not behave in the same way across taxpayers. First, this ratio tends asymptotically to 1 for very large incomes. The intuition is simple. In the case of a very rich individual, most of the income falls in the area of proportionality beyond the top marginal tax rate, so that the additional tax she pays with a nonindexed tax system is a very tiny fraction of the total amount of tax. In this case, the absolute amount of taxes grows slower than income, i.e., slower than h.

The opposite occurs at lower levels of income. With progressivity, a nonindexed tax system makes the absolute amount of taxes grow faster than income, i.e., $T_{95}(Y_{00})$ grows faster than h, which means that the additional tax revenue is a significant fraction of the total amount of tax.

Therefore, the negative change of the (implicit) average tax rate in table 6 must be the result of matching a number of taxpayers for whom the (implicit) average tax rate increases and a number of taxpayers for whom the (implicit) average tax rate decreases. The final result will depend on these two opposing forces. In the case of table 6, the negative contribution of the implicit average tax rate means that there are more people for whom the additional tax would grow slower than income in the switch from a perfectly indexed tax regime applied to real incomes to a nonindexed tax regime applied to nominal incomes.

Note again that the appearance of a negative sign on the change of the average tax rate is perfectly compatible with the fact that inflation – with progressivity – increases tax liabilities of all taxpayers, the difference being in the rate of growth of this increase. In other words, all taxpayers are hurt by the fact that the tax system is not indexed, but some are hurt proportionally more than others.

Finally, the change of the Kakwani index in IFD is negative (–0.015), which means that $T_{95}(Y_{00})$ behave in a less disproportional way than $hT_{95}(Y_{00}/h)$. This is a direct consequence of the previous discussion. If taxes grow more than proportionally at lower income levels, a nonindexed tax system will impose a greater share of total taxes on low-income households. Indeed, the reduction of the Kakwani index is now entirely driven by a lower tax concentration coefficient (0.566 against 0.551 – not reported in table 6), as the Gini indices of Y_{00} and Y_{00}/h are the same. The effect of inflation, as expected, is therefore that of making the tax system less disproportional.[22]

5.4.5. Real Fiscal Drag

An analogous line of reasoning holds for the real fiscal drag; therefore the issue will not be discussed any further. Note that also in this case, the changes of

22 For an analysis of the impact of inflation on income taxes in a wider perspective, see Immervoll (2000).

both the implicit average tax rate (−0.010) and the Kakwani index (−0.011) are negative. It is of some interest to note that the sum of the changes induced by inflationary fiscal drag and real fiscal drag amounts to −0.01 points of the Gini index, which is more than the total (positive) change ΔRS (0.0086). This implies that the positive contributions of all other effects have to compensate the loss determined by the total fiscal drag.

5.4.6. Tax Law

Finally, the tax-law effect contributes positively to the change of the redistributive impact by 0.0023 points. Note that this outcome is only slightly more than one-fourth of the total redistributive change. In this case, the direction of the average tax rate and that of the Kakwani index conflict. The implicit average tax rate actually declines (−0.013), signaling that tax changes have contributed to reducing the tax burden, a result already captured by the decomposition of tax revenue changes, in which case the contribution was also negative. The change of the Kakwani index is instead positive, which implies that the tax structure of the year 2000 (T_{00}) is more disproportional than T_{95} when applied to the same income distribution (Y_{00}). As the initial income distribution is the same, the change of the Kakwani index is entirely driven by a change of the tax concentration coefficient, which is higher for T_{00} than for T_{95} (0.570 against 0.551 – not reported in table 6). This positive impulse outweighs the negative contribution of the implicit average tax rate in shaping the total redistributive change associated with changes in tax law.

Of particular importance is again the size of the impact of tax-law changes. This positive contribution (in absolute values) is much lower than the negative contribution imputable to IFD – slightly more than one-third of it. This means that, on the redistribution side, the tax regime of the year 2000 is not even sufficient to recover the negative effect of inflation. In other terms, the tax regime of 2000 is not equivalent to a perfect indexation of T_{95} in terms of redistributive outcomes.[23]

This is actually the most striking result of the analysis. If use had been made of a fixed pretax income distribution, the only possible conclusion would have been that the redistributive power of the tax system had improved between 1995 and 2000. With our methodology, this conclusion can be accommodated by the observation that this improvement is only about one-fourth of the total redistributive change over the period and that the positive contribution of changes of tax regimes is only slightly more than one-third of the perverse

23 The sensitivity of results has been tested by reversing the exercise, i.e., by assessing tax revenue and redistributive effects going from 2000 to 1995 (data not reported in text). This amounts to changing the base of the exercise. As expected, it changes the absolute size of the effects but not their relative weight.

effect of inflation. It implies that, other things being equal, changes of tax systems from 1995 to 2000 did not even recover the loss of the redistributive power caused by the implicit choice of not indexing the 1995 tax system.

6. Conclusions

Using a methodology proposed by OECD (1987), this paper has implemented a decomposition of the change of the redistributive effect of two tax regimes in Italy. This procedure is innovative, in that it allows one to take into account the contributions of both tax and nontax factors in shaping redistributive outcomes and thereby to move beyond the traditional ways in which redistribution analysis is carried out in a microsimulation context.

Some interesting insights emerge from the analysis. First, it highlights that nonnegligible increases in tax revenue may be obtained by the action of nontax factors while at the same time the revealed choice may be to push taxes downward. Obviously, such a tax policy choice could be justified by the fact that reducing taxes may be required to compensate for the natural increase of tax revenue imputable to some external factors (e.g., average income). Whatever the direction of causality might be, it is particularly interesting that even in periods of low inflation, the lack of indexation of the personal income tax may result in heavy additional tax burdens. About one-fourth of the additional tax revenue in the period, indeed, can be imputed to the action of inflation. On the tax-revenue side, neutrality to inflation would require that the intended reduction in taxes be at least equal, in absolute terms, to the increase in taxes generated by inflation. The paper shows that this is not the case if one considers the interval between 1995 and 2000. The tax reduction embodied in the tax structure prevailing in 2000 is indeed less than the tax increase embodied in inflation. On the redistributive side, inflation is thought to be more harmful at low income levels, where nominal increases may cause incomes to rise into brackets with higher marginal tax rates. More important is the fact that changes of tax laws are not able to compensate this negative redistributive effect. Their contribution is indeed positive, but less than what would be required to neutralize the adverse impact of inflation, which is instead compensated by the action of other, nontax factors. This marks an important step in the study of the redistributive effects of public policies, which is of wide interest, as it shows how meaningless might be the comparison of the effect of the personal income tax over time in a given country or across countries when the pretax income distribution changes. Confining ourselves to the total redistributive change, we would have concluded that T_{00} is more redistributive than T_{95}. Using a fixed pretax income distribution, we would have concluded that T_{00} is again more redistributive than T_{95}, but by much less. The analysis proposed in this paper has allowed us to shed some light on the fact that the contribution of tax factors is just one-fourth of the total redistributive change and it does not compensate the perverse effect of inflation – quite a different picture of the effects of the personal income tax in Italy.

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