The Distributional Impact of Pension System Reforms: An Application to the Italian Case

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Abstract

Between 1992 and 1995, the Italian pension system was deeply reformed, and it is now moving from an earnings-related to a contribution-based scheme. The pre-1992 system was generous and redistributive; however, often redistribution operated from the poor to the rich, notably because the benefit formula was based on the last years of earnings, thus benefiting workers with steep earnings profiles. The new contribution-based scheme may enhance equity by removing (some of) the inequities implicit in the previous system.

Simulations calibrated on Italian male employees show that the contribution-based scheme reduces inequality among all groups considered, with the exception of college graduates employed in the private sector. When taking into account the average level of the benefit as well as its distribution, the analysis shows mixed results depending on the worker’s number of years of contribution and on their retirement age, as well as on the steepness of their earnings profile.

JEL classification: D31, H55.

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I. INTRODUCTION

Earnings-based (EB) pension schemes traditionally include mechanisms that actively redistribute income among the insured workers. Floors, ceilings and survivor benefits are among the tools by which redistribution toward low-income groups occurs. However, in some instances, EB systems may redistribute in the opposite direction, i.e. from the poor to the rich. This kind of redistribution may arise from various features of the EB systems, notably from the benefit computation formula if it takes into account only the last (or the last few) wage(s) and therefore guarantees an overgenerous pension to individuals with steeper earnings profiles, typically high earners.

In this framework, it has been argued (James, 1997) that contribution-based (CB) formulae may enhance equity by removing (some of) the inequities implicit in the earnings-related systems. In particular, an actuarially fair contribution-based scheme would remove unequal treatments such as early retirement benefits and advantages to workers with steep earnings profiles.

This work focuses in particular on the recent reforms undertaken in the Italian pension system: between 1992 and 1995, the Italian system was deeply reformed, and it is now moving from an earnings-related to a contribution-based scheme. The generous pre-1992 system was characterised by high replacement rates and various forms of redistribution of income from the rich to the poor. However, often redistribution operated in a perverse way, as highlighted in Castellino (1995).

The system is gradually moving to a contribution-based scheme with no direct redistributive aim. According to the 1995 reform, after the (long) transition towards the new regime, the pension benefit will be based on the contributions paid during the entire working life, notionally capitalised at the GDP nominal growth rate and converted into an actuarially fair annuity.

The main objective of this paper is to study the distributive implications deriving from the determination of the benefit on the basis of the entire working history of the individual as opposed to an earnings-related scheme in which the benefit is computed on the basis of the last few years of earnings. The possible impact of the reform on retirees’ welfare, taking into account the level of the resulting benefits as well as their distribution, is also considered.

Previous studies of the Italian pension reforms of the 1990s (Brugiavini, 1999; Forni and Giordano, 2001; Fornero and Castellino, 2001) highlighted how the benefit is, ceteris paribus, generally lowered when computed with the new contribution-based scheme, especially for workers with steep earnings profiles.

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1The point has been raised by, among others, Castellino (1995) and James (1997).
2The transition period, however, will be very long, as only workers who entered the labour market in or after 1996 will receive a pension completely computed according to the contribution-based scheme.
3However, there will still be redistribution between married and unmarried individuals and between men and women (see Section II).
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However, for individuals with relatively flat earnings careers and high ages of retirement, the contribution-based benefit has been found to be higher than the earnings-based one. From a distributional point of view, it could be expected that a formula that takes into account the whole working history — as opposed to a formula based only on the last few years — reduces variability in the benefit. The redistirbutive ceilings present in the earnings-based formula, however, also tend to reduce inequality in the benefits, so that the overall effect on the dispersion of benefits is difficult to predict.

This study is conducted through a simulation procedure which allows construction of an earnings profile for each artificial individual. The two benefit formulae have been compared for individuals with continuous careers. Two sets of simulations have been performed, based on two artificial populations differing in their retirement age in such a way that the minimum and maximum eligibility requirements in both the earnings-related and the contribution-based scheme are covered.

The necessary parameters are obtained from an estimation of the income process based on Italian panel data, drawn from the Bank of Italy Survey on Households’ Income and Wealth. Having simulated the earnings profiles for individuals of a particular cohort, the pre-1992 and the post-1995 pensions are computed for each individual and the resulting distribution is analysed.

Section II gives an overview of the Italian pension system and of its recent reforms, while Section III reviews the data and methodology used for simulating the earnings profiles. Section IV describes the structure of the artificial population and Section V presents the results. Section VI concludes.

II. THE PENSION SYSTEM IN ITALY

The reforms that took place in Italy in 1992 and in 1995 have deeply changed the public pension system. The main features of the traditional pre-1992 system and of the new system resulting after the last reform in 1995 (promulgated during the Dini government) can be summarised as follows.

The traditional system had an earnings-based pension formula; it was generous and redistributive, being characterised by high replacement rates and various forms of redistribution of income from the rich to the poor. However, different schemes were (and still are) in place with different rules. In the main scheme, the Pension Fund for Private Employees (FPLD), the pension was based on the average of the last five years’ earnings multiplied by the number of working years and by the annual accrual rate:

\[
P_{EB} = a \gamma \sum_{i=1}^{5} \frac{W_{age-i+1}}{5}
\]
where age is the individual’s age in their final working year, w is their gross yearly earnings indexed for inflation, γ is the annual accrual rate and a is the number of years the individual has been active in the labour market. This formula is modified for public sector employees in that the average of the last five wages is replaced by the last wage (w_{age}). A redistributive feature of this system is represented by the annual accrual rate γ which is equal to 2 per cent up to a certain threshold and gradually lowered for earnings exceeding that ceiling. In addition, a means-tested minimum benefit was guaranteed to all workers whose benefit was below a certain level. Other redistributive elements included generous survivors’ benefits and the computation of notional contributions for workers temporarily out of the labour force.

While these features were operating in the sense of redistributing from rich to poor, others — notably the inclusion of the last earnings in the benefit computation formula — were operating in the opposite direction, as employees with increasing wage profiles (typically high earners) ended up with overgenerous pensions.

In addition, ‘seniority’ pensions were in place with different rules for different categories of workers: for private sector employees, it was possible to claim a seniority pension after 35 years of work, while public sector employees could retire after 20 years of work (15 years for married women). In both cases, seniority pensions were computed under the same mechanism as old-age pensions, without any actuarial correction for age at retirement.

The effect of within-cohort redistribution in the old system is the result of all these features, and it is not clear a priori in which direction it works.

From a redistributive earnings-related pension formula, the system is gradually moving to a contribution-based one with no direct redistributive feature. After the 1995 reform — that is, after the 1995 reform is fully in place — the pension will be based on the contributions paid during the entire working period notionally capitalised at the GDP nominal growth rate and converted into an actuarially fair annuity. The equality between the internal rate of return on contributions and GDP growth, together with a periodic revision of the annuity rates based on mortality tables, will eventually lead toward the long-run financial equilibrium of the system, although this will be neither complete nor automatic — as discussed in Disney (1999).

The CB pension, for all categories of workers, will then be computed as
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\[
P_{\text{CB}} = \left( \sum_{i=a}^{\text{age}} c_i \left(1 + g \right)^{\text{age}-i} \right) \delta_{\text{age}+1}
\]

where \( c_i \) is the contribution paid by the worker at age \( i \), \( g \) is the GDP nominal growth rate, \( \delta \) is an age-specific annuity rate and \( a \) is the age at which the worker entered the labour market.

The annuity rates \( \delta \) are set by law as the inverse of the present value of a one-unit benefit. This present value has been computed as a weighted average for men and women, taking into account the probability of a worker’s dependants qualifying for a survivor benefit and the amount of the survivor benefit, and assuming that, in a couple, the wife is three years younger than the husband. Until the first revision of the annuity rates, which is planned for the year 2005, the mortality tables used are those issued by the Italian National Statistics Institute (Istat) for 1990, and the interest rate has been set equal to 1.5 per cent (which corresponds to long-run real GDP growth).\(^6\) The benefits are then annually adjusted only for price inflation.

As the coefficients vary only with the age at retirement, redistribution will still occur among men and women, as well as among married and unmarried individuals. Ceilings still apply as contributions are not paid on the fraction of earnings above a given threshold. Since the benefit is computed on the basis of the contributions paid, however, ceilings do not have any redistributive feature.\(^7\)

Different schemes and seniority pensions will gradually disappear, and flexibility of retirement age is to be introduced. In particular, workers can retire before reaching 65, either if they have paid contributions for not less than 40 years or if, having paid contributions for not less than five years, they are aged 57 or over and the benefit they are entitled to is more than 1.2 times the yearly income support provided to needy elderly people.\(^8\) That limit does not apply when workers reach 65: at that age, any worker can claim their pension and, if eligible, means-tested old-age income support.

Finally, it is worth noting that individuals’ pension wealth in Italy still basically rests on the public component. Although the reform process of the 1990s also aimed to develop the funded private component, and the fraction of Italian families participating in supplementary private pension schemes has increased over the last decade (Borella, Fornero and Ponzetto, 2004), such schemes still represent no more than a small fraction of the assets of Italian households. They are therefore neglected in the rest of this analysis.

\(^6\)See table A in the reform law (335/1995). The same law states that the coefficients will have to be revised every 10 years, on the basis of changes in longevity and in GDP long-run growth.

\(^7\)In fact, this is an advantage offered to high-income earners if the composition of the pension portfolio is inefficiently unbalanced in favour of the pay-as-you-go component; see Fornero (1995).

\(^8\)Means-tested income support is provided in Italy to every person aged 65 or over.
III. EARNINGS SIMULATION

To compute the exact benefit deriving from the EB and CB schemes, it would be necessary to know the entire earnings profile of each individual. Since such data are not available, a simulation technique has been used to construct an artificial population, parameterised on estimates of the earning processes of individuals.

The necessary parameters have been estimated using the panel data-set in the Bank of Italy Survey of Households’ Income and Wealth (SHIW). The data are available for the years 1989, 1991, 1993, 1995 and 1998. The earning process for each individual is assumed to be the sum of a deterministic observable component and a stochastic unobservable component. The latter is decomposed into a time-invariant random effect (μ_i) and a first-order autoregressive component (z_{it}):

\[ y_{it} = X_{it}' \beta + u_{it} \]

with

\[ u_{it} = \mu_i + z_{it} \]
\[ z_{it} = \alpha z_{i,t-1} + \omega_t \]

where \( y_{it} \) is the natural logarithm of real taxable earnings of the \( i \)th individual aged \( j \) at time \( t \); \( X_{it} \) is a \( k \times 1 \) vector of observable variables; \( \beta \) is a \( k \times 1 \) vector of unknown parameters; and \( u_{it} \) is an error term, which represents unobserved characteristics determining earnings, defined by equations (2), where \( \omega_t \) is an identically and independently distributed (i.i.d.) stochastic process with zero mean and variance \( \sigma^2_\omega \), and \( \mu_i \) is i.i.d. with zero mean and variance \( \sigma^2_\mu \).

Estimates for equation (1) are obtained by ordinary least squares (OLS). The dependent variable is the logarithm of real taxable earnings (net of social security contributions) of male employees working full-time and observed at least for two consecutive waves. Annual taxable earnings have been deflated using the Istat consumer price index, and they are expressed in 1998 Italian lire. The sample has been divided into groups according to two sectors of activity — private and public — and to three education levels — less than high-school or high-school drop-out, high-school graduate and college graduate. In addition, in order to take cohort effects into account, six year-of-birth groups have been created. The youngest cohort is formed by individuals born between 1963 and 1967 inclusive, and the oldest by individuals born between 1938 and 1942.

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9 The analysis in Borella (2004) shows that this is a suitable characterisation of the earning process obtained with Italian data (SHIW).
10 In the SHIW, only after-tax earnings are recorded. There is, however, enough information to obtain taxable earnings taking into account the family structure. The procedure used is described in the Appendix.
inclusive. In the analysis, individuals in the youngest cohort are considered to be aged 24 in 1989, 26 in 1991 and so on. The other cohorts are treated similarly.

Regressions are then performed separately for each group defined by the education level and the sector of activity, using as regressors a polynomial in age and cohort and time dummies. Estimated coefficients for the age polynomial for each education/sector group are then used to construct earnings profiles.

Taxable-earnings–age profiles for the different groups of interest are shown in Figures 1 and 2. The profiles shown are in levels, in 1998 prices, and are those of the youngest cohort (born between 1963 and 1967). Public sector workers display, on average, flatter earnings profiles. In particular, for college and high-school graduate workers, the first wage is quite close in the two sectors considered; however, the average annual growth rate in wages in the private sector is 2 per cent per year for college graduates and 1.5 per cent for high-school graduates, while in the public sector the average annual rates of growth are 0.9 per cent and 0.5 per cent respectively. High-school-drop-out workers

FIGURE 1
Taxable-Earnings–Age Profiles: Private Sector Males

Notes: Taxable earnings are gross of income tax and net of social security contributions. Y-axis labels are expressed in million lire at 1998 prices, for the cohort born 1963–67.

\[\text{It is not possible to identify age, cohort and time effects separately as they are linear combinations of one another. It is therefore assumed in the analysis that the time effects are orthogonal to a time trend.}\]
exhibit similar profiles in both sectors, with an average annual growth rate in wages of about 0.5 per cent.\footnote{The average annual rate of growth of real GDP was 1.5 per cent in Italy between 1989 and 1998.}

Estimation of equations (2) is based on the group-specific OLS residuals obtained from equation (1). As shown in (2), the unobserved component of earnings for individual \(i\) of age \(j\) is decomposed into a time-invariant individual effect (\(\mu_i\)) and a first-order autoregressive component (\(z_{it}\)). The first-order autoregressive component arises from a finite process starting at age \(a\), the age at which the individual entered the labour market.

The variances of this process can be summarised by the following recursions:

\[
Var(u_i^t) = \sigma_{\mu}^2 + Var(z_{it})
\]

where

\[
Var(z_{it}) = \sigma_z^2
\]

and

\[
Var(z_{it}) = \alpha^2 Var(z_{it-1}) + \sigma_{\omega}^2 \quad \text{with} \quad j > a.
\]

Estimation is carried out using the minimum distance method, which compares the sample moments with the theoretical ones (Chamberlain, 1984). Denoting the \(m \times 1\) vector of sample moments as \(\pi\) and the vector of theoretical moments as \(\pi(\alpha)\), which depends on \(n \times 1\) unknown parameters (with \(n < m\)), the minimum distance method performs the following minimisation:

\[\mu_{\pi - \pi(\alpha)}^2\]
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(6) \[ \min_{\alpha} (\pi - \pi(\alpha))^T V (\pi - \pi(\alpha)) \]

where \( V \) is a weighting matrix. When \( V \) is taken to be the inverse of the matrix of fourth moments, the estimator is the well-known optimal minimum distance (OMD).\(^{13}\) However, Altonji and Segal (1996) warn about the bias that arises when estimating covariance structures of this type, and suggest the use of the equally weighted minimum distance (EWMD) which replaces \( V \) with the identity matrix. The latter strategy has been used in the estimation here.

Estimates are computed by splitting the residuals obtained from equation (1) into four groups, arising from two education groups for each sector, public and private. The two education groups are less than high school / high-school drop-outs (2,864 individuals, of whom 2,106 were employed in the private sector) and high-school / college graduates (2,367 individuals, of whom 1,223 were employed in the private sector). College graduates on their own would form samples of 222 and 425 observations in the private and public sectors respectively, which were considered too small to be treated separately in the analysis.

Parameter estimates are shown in Table 1. In the public sector, the random effect variance has been found to be small and not significantly different from zero; therefore, for the public sector, only the specification that excludes this component is reported. While the variance of unobservable earnings is higher in the private than in the public sector, shocks are more persistent in the latter:

| TABLE 1 |
| Parameter Estimates for the Earning Process |

<table>
<thead>
<tr>
<th></th>
<th>Private sector</th>
<th>Public sector</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High-school drop-out</td>
<td>High school / college</td>
</tr>
<tr>
<td>( \sigma^2_{\mu} )</td>
<td>0.027 (0.0049)</td>
<td>0.032 (0.0082)</td>
</tr>
<tr>
<td>( \alpha )</td>
<td>0.545 (0.1007)</td>
<td>0.533 (0.1650)</td>
</tr>
<tr>
<td>( \sigma^2_{\omega} )</td>
<td>0.034 (0.0038)</td>
<td>0.034 (0.0049)</td>
</tr>
<tr>
<td>( \sigma^2_{a} )</td>
<td>0.032 (0.0165)</td>
<td>0.045 (0.0232)</td>
</tr>
<tr>
<td>Sum of squared residuals</td>
<td>0.0229</td>
<td>0.0558</td>
</tr>
<tr>
<td>No. of observations</td>
<td>2,106</td>
<td>1,223</td>
</tr>
</tbody>
</table>

Note: Standard errors are given in parentheses.

\(^{13}\)Chamberlain, 1984.
autoregressive coefficient has been estimated to be around 0.54 in the private sector and 0.75 in the public sector. In both cases, its estimated value is well below 1, indicating that the processes are stationary. In the simulations, all the unobservable components are assumed to be drawn from normal distributions, with zero mean and variance given by the variance estimates.

IV. THE STRUCTURE OF THE ARTIFICIAL POPULATION

Two simulated populations have been constructed, calibrated on the structure of Italian workers employed in the private and in the public sector. In both populations, of the artificial 20,000 observations, 23 per cent are public sector and 77 per cent are private sector employees. In order to take into account cohort effects on the age of entry into the labour market, the age of retirement and the education structure of the employed population, cohort-specific statistics have been drawn from the SHIW data-set. In Table 2, sample averages of the age of entry into the labour market by education attainment and by sector of activity are displayed; these are computed from the data-sets for 1998 and 2000, for male employees born between 1953 and 1973. The survey reports both the age of entry into the labour market (‘Age at entry, 1’ in the table) and the number of years a worker has paid contributions to the social security system; with this information, it is possible to construct an alternative measure, which reflects age

<table>
<thead>
<tr>
<th>Education</th>
<th>Age at entry, 1</th>
<th>Age at entry, 2</th>
<th>No. of observations</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private sector</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-school drop-out</td>
<td>17.0</td>
<td>20.7</td>
<td>1,369</td>
<td>50.5</td>
</tr>
<tr>
<td>High-school graduate</td>
<td>20.3</td>
<td>21.8</td>
<td>1,130</td>
<td>41.7</td>
</tr>
<tr>
<td>College graduate</td>
<td>25.8</td>
<td>26.5</td>
<td>212</td>
<td>7.8</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>2,711</td>
<td>100.0</td>
</tr>
<tr>
<td>Public sector</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-school drop-out</td>
<td>18.0</td>
<td>21.1</td>
<td>292</td>
<td>28.3</td>
</tr>
<tr>
<td>High-school graduate</td>
<td>21.0</td>
<td>22.4</td>
<td>526</td>
<td>51.0</td>
</tr>
<tr>
<td>College graduate</td>
<td>25.4</td>
<td>26.1</td>
<td>213</td>
<td>20.7</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>1,031</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Notes: Male employees born between 1953 and 1973, observed in 1998 and 2000. Age at entry is defined according to the respondent’s definition (1) or according to the number of years the worker declares he has contributed to the social security system (2).

14In 1999, there were about 3,377,000 public sector employees in Italy, out of a total of 14,825,000 employees (data available from Istat (2000 and 2002)).
## TABLE 3
### Artificial Populations: Ages of Entry and Exit

<table>
<thead>
<tr>
<th></th>
<th>No. of observations</th>
<th>Population 1</th>
<th>Population 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Age at entry</td>
<td>Age at first benefit</td>
</tr>
<tr>
<td>Whole sample</td>
<td>20,000</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Private</td>
<td>15,400</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>High-school drop-outs</td>
<td>7,700</td>
<td>22</td>
<td>57</td>
</tr>
<tr>
<td>High-school graduates</td>
<td>6,160</td>
<td>22</td>
<td>57</td>
</tr>
<tr>
<td>College graduates</td>
<td>1,540</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>Public</td>
<td>4,600</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>High-school drop-outs</td>
<td>1,380</td>
<td>22</td>
<td>57</td>
</tr>
<tr>
<td>High-school graduates</td>
<td>2,300</td>
<td>22</td>
<td>57</td>
</tr>
<tr>
<td>College graduates</td>
<td>920</td>
<td>25</td>
<td>60</td>
</tr>
</tbody>
</table>
at entry into the labour market under the hypothesis of a continuous career (‘Age at entry, 2’). The observed differences between the two definitions reflect both the fact that workers may be unemployed for some periods and the fact that workers may, especially at the beginning of their careers, be employed in a non-official fashion, so that they do not accumulate pension rights. As workers are assumed to have continuous careers in the simulations, the second measure of age at entry into the labour market seems a more appropriate guide for choosing entry values for the artificial observations.

Respondents to the SHIW are also asked when they expect to retire: as shown in Jappelli, Padula and Bottazzi (2003), individuals’ retirement expectations changed considerably over the 1990s as a result of the reforms. In order to avoid the difficulties of interpreting simulation results assuming an age of retirement based on expectations that are still changing, the artificial populations have been constructed in order to cover the minimum and maximum eligible age in the CB regime and the minimum and maximum eligible number of years of contribution in the EB regime in Italy.

The two artificial populations differ in that in Population 1 individuals are assumed to work (and to contribute to the pension system) for 35 years, while in Population 2 individuals are assumed to work for 40 years, before retiring. College graduates are designed to start working three years later than other workers in both populations and to retire from the labour market three years later. Details of the ages of entry and exit in the two artificial populations are given in Table 3.

V. RESULTS

Having simulated the earnings profiles for a number of individuals, it is possible to compute the benefits resulting from the two scenarios considered: the earnings-related formula and the contribution-based formula. The comparison is performed on the basis of the first benefit received by each worker at retirement; this procedure assumes that the indexation mechanisms are the same in the two regimes. In fact, until 1992, pension benefits in Italy were indexed to wages; since 1993, however, all benefits, including those computed according to the pre-1992 rules and those already in payment, are linked only to the cost of living. In addition, the distribution of the first benefit does not take into account individuals’ life expectancies at retirement. When the different groups of workers are analysed separately, this procedure is valid; when individuals are

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15In the CB scheme, it is possible to claim the benefit after age 65, but there is no actuarial correction for this; in the EB scheme, it was not possible to accumulate more than 40 years of contribution.
<table>
<thead>
<tr>
<th></th>
<th>No. of observations</th>
<th>Last wage, level</th>
<th>EB benefit, level</th>
<th>CB benefit, level</th>
<th>EB benefit gross replacement rate</th>
<th>CB benefit gross replacement rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole sample</td>
<td>20,000</td>
<td>44.016</td>
<td>30.752</td>
<td>27.306</td>
<td>0.699</td>
<td>0.620</td>
</tr>
<tr>
<td>Private</td>
<td>15,400</td>
<td>45.140</td>
<td>31.548</td>
<td>27.395</td>
<td>0.699</td>
<td>0.607</td>
</tr>
<tr>
<td>High-school drop-outs</td>
<td>7,700</td>
<td>34.098</td>
<td>24.598</td>
<td>22.611</td>
<td>0.721</td>
<td>0.663</td>
</tr>
<tr>
<td>High-school graduates</td>
<td>6,160</td>
<td>49.658</td>
<td>34.696</td>
<td>28.518</td>
<td>0.699</td>
<td>0.574</td>
</tr>
<tr>
<td>College graduates</td>
<td>1,540</td>
<td>82.278</td>
<td>53.706</td>
<td>46.819</td>
<td>0.653</td>
<td>0.569</td>
</tr>
<tr>
<td>Public</td>
<td>4,600</td>
<td>40.253</td>
<td>28.088</td>
<td>27.010</td>
<td>0.698</td>
<td>0.671</td>
</tr>
<tr>
<td>High-school drop-outs</td>
<td>1,380</td>
<td>35.954</td>
<td>25.162</td>
<td>24.332</td>
<td>0.700</td>
<td>0.677</td>
</tr>
<tr>
<td>High-school graduates</td>
<td>2,300</td>
<td>39.715</td>
<td>27.739</td>
<td>26.316</td>
<td>0.698</td>
<td>0.663</td>
</tr>
<tr>
<td>College graduates</td>
<td>920</td>
<td>48.044</td>
<td>33.347</td>
<td>32.759</td>
<td>0.694</td>
<td>0.682</td>
</tr>
</tbody>
</table>

Notes: Values are expressed in millions of 1998 lire. Final wage is gross of income tax and of social security contributions paid by the worker. EB and CB benefits are gross of income tax.
TABLE 5
Simulation Results (Averages): Population 2

<table>
<thead>
<tr>
<th></th>
<th>No. of observations</th>
<th>Last wage, level</th>
<th>EB benefit, level</th>
<th>CB benefit, level</th>
<th>EB benefit gross replacement rate</th>
<th>CB benefit gross replacement rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole sample</td>
<td>20,000</td>
<td>45.350</td>
<td>36.007</td>
<td>38.763</td>
<td>0.794</td>
<td>0.855</td>
</tr>
<tr>
<td>Private</td>
<td>15,400</td>
<td>46.740</td>
<td>37.069</td>
<td>38.980</td>
<td>0.793</td>
<td>0.834</td>
</tr>
<tr>
<td>High-school drop-outs</td>
<td>7,700</td>
<td>34.113</td>
<td>28.110</td>
<td>31.654</td>
<td>0.824</td>
<td>0.928</td>
</tr>
<tr>
<td>High-school graduates</td>
<td>6,160</td>
<td>53.676</td>
<td>42.189</td>
<td>40.753</td>
<td>0.786</td>
<td>0.759</td>
</tr>
<tr>
<td>College graduates</td>
<td>1,540</td>
<td>82.138</td>
<td>61.386</td>
<td>68.518</td>
<td>0.747</td>
<td>0.834</td>
</tr>
<tr>
<td>Public</td>
<td>4,600</td>
<td>40.697</td>
<td>32.451</td>
<td>38.037</td>
<td>0.797</td>
<td>0.935</td>
</tr>
<tr>
<td>High-school drop-outs</td>
<td>1,380</td>
<td>36.339</td>
<td>29.062</td>
<td>34.016</td>
<td>0.800</td>
<td>0.936</td>
</tr>
<tr>
<td>High-school graduates</td>
<td>2,300</td>
<td>40.087</td>
<td>31.999</td>
<td>36.860</td>
<td>0.798</td>
<td>0.920</td>
</tr>
<tr>
<td>College graduates</td>
<td>920</td>
<td>48.758</td>
<td>38.665</td>
<td>47.011</td>
<td>0.793</td>
<td>0.964</td>
</tr>
</tbody>
</table>

Notes: See Table 4.
The Distributional Impact of Pension System Reforms

grouped together, the analysis is conducted conditionally on them being alive.\textsuperscript{16} In order to simplify the comparison between the two regimes, a constant contribution rate of 32.7 per cent has been applied, as this is the rate effective since 1995. The rate that the worker pays is 8.89 per cent, while that of the employer is 23.81 per cent.\textsuperscript{17}

Tables 4 and 5 report, for the two artificial populations, the average final wage and the first pension computed both with the EB and with the CB formula. Gross yearly earnings (gross of social security contributions paid by the worker and of income tax) and gross yearly pensions are reported. For Population 1 (Table 4), the whole population (20,000 observations) displays a final-year gross wage of roughly 44 million lire; the yearly gross pension computed with the earnings-related formula is about 31 million lire, while the benefit computed with the contribution-based formula is about 27 million lire.\textsuperscript{18}

The replacement rate (that is, the ratio of the first pension to the last wage) in the EB formula, abstracting from floors and ceilings, ensures a benefit that is approximately the same fraction of the last wage for all workers.\textsuperscript{19} Conversely, the replacement rate that results from the CB formula depends on the individual’s contributions paid over their working life, on the rate of growth of GDP and on the age at retirement. In the simulated populations, the average gross replacement rate is about 70 per cent for the EB pension and 62 per cent for the CB benefit, where the figures are obtained by dividing the average gross pension benefit by the average final-year gross wage. Turning to the subgroups considered, the replacement rate in the private sector is always higher when the benefit is computed with the EB formula.

The rate of growth of GDP used to capitalise contributions in order to compute the CB benefit — \( g \) in the (CB) formula in Section II — is equal to 1.5 per cent in all the simulations, as this has been the average rate of growth of real GDP experienced in Italy between 1989 and 1998, the period over which the earnings profiles have been extrapolated.\textsuperscript{20}

For individuals with longer working careers (i.e. for Population 2), the resulting benefits and replacement rates are correspondingly higher, as shown in Table 5. The CB benefit in this case is higher than the EB benefit for all groups

\textsuperscript{16}If wealthier individuals live longer, the distributional implications of differential mortality are quantitatively important (Coronado, Fullerton and Glass, 2000). In Italy, mortality tables differentiated for socio-economic group are unfortunately not available; hence the analysis is conducted on the basis of the first benefit.

\textsuperscript{17}Floors and ceilings are in place in the earnings-based system, and lower and upper limits on pensionable earnings have also been introduced in the new contribution-based system; computation of the benefits for individuals in the simulated populations takes into account these features.

\textsuperscript{18}All monetary values are expressed in 1998 Italian lire.

\textsuperscript{19}If the benefit is computed on the last year’s earnings only, as in the case of public sector employees, and there are no floors and ceilings, then the replacement rate is exactly equal to the number of years spent in the labour force times 0.02.

\textsuperscript{20}The distribution of the CB benefit under alternative assumptions would be the same, although the level would, of course, differ.
considered with the exception of high-school graduates employed in the private sector. This result derives from the steepness of the wage profile of that group combined with the relatively young age of retirement assumed in the simulation (62). Conversely, college graduates, retiring at 65, benefit from the actuarial correction included in the CB formula and end up with a replacement rate of 83 per cent in the CB regime compared with 75 per cent in the EB regime.

Turning to the distribution of the computed benefits, in Table 6 a few measures of inequality are computed for the two pensions, and for the different groups considered, in order to summarise the departure of the distributions from equity. Results on the distribution are shown only for Population 1: as the earning process has been estimated to be stationary, inequality measures for Population 2 are very similar to those displayed in Table 6. Among the inequality measures presented, the coefficient of variation is the ratio of the standard deviation of the variable of interest to its mean: the higher the coefficient of variation, the higher the inequality. The standard deviation of the variables in logarithms is also shown, and higher values again represent higher inequality. Finally, the Gini coefficient is computed: it is defined as the ratio to the mean of half the average over all pairs of the absolute deviations between people. If the distribution of the variable considered is perfectly egalitarian, the Gini coefficient is 0; if one individual owns the total amount available while the others own nothing, the Gini coefficient is 1.

The various indices give the same picture: the pension computed with the CB formula appears to have a more equal distribution than the EB pension, except for college graduates employed in the private sector, the high-earner group for which the redistributive ceilings in the EB formula were mostly effective. In the

<table>
<thead>
<tr>
<th>Inequality Measures: Population 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>All sample</td>
</tr>
<tr>
<td>Private</td>
</tr>
<tr>
<td>High-school drop-outs</td>
</tr>
<tr>
<td>High-school graduates</td>
</tr>
<tr>
<td>College graduates</td>
</tr>
<tr>
<td>Public</td>
</tr>
<tr>
<td>High-school drop-outs</td>
</tr>
<tr>
<td>High-school graduates</td>
</tr>
<tr>
<td>College graduates</td>
</tr>
</tbody>
</table>
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public sector, the reduction in inequality induced by the CB pension is substantial, as the EB pension in the public sector was computed on the basis of the last wage, thus reflecting its variability, and not on an average wage.\textsuperscript{21}

Graphical analysis based on Lorenz curves has been performed to compare the inequality displayed by the different distributions (Figures 3 to 5). As the Lorenz curves for the two distributions are very close to each other, the transformed Lorenz curve has been drawn for the whole populations and for the different sectors and education groups considered. The x-axis reports the cumulative fraction of the population — starting from the poorest — as in the standard Lorenz curve. The y-axis shows the difference (instead of the level) between the cumulative fraction of the variable of interest and the line of complete equality (the 45-degree line). The lower the curve, the less unequal is the distribution of the variable considered. As the variables of interest differ in their means, the generalised Lorenz curves (Shorrocks, 1983) are also plotted. These are plots of the cumulative fraction of the population against the cumulative fraction of the variable of interest multiplied by its mean. In this setting, the end point of the curve is the overall mean, so the distribution with the higher mean cannot be dominated; but if the distribution with the higher mean is also more unequal than the other, it is possible that the curves cross each other and neither of the distributions dominates the other. Generalised Lorenz dominance of one variable over another implies that the social welfare associated with the former is greater than the social welfare associated with the latter.\textsuperscript{22} In this exercise, the population considered is only a subgroup of the overall population (namely, one generation of retiring employees); this means that the implications drawn are valid only for the generation considered and do not take into account the welfare of society as a whole. In particular, it should be borne in mind that, with the assumed payroll tax combined with a low retirement age, the EB system generates a deficit — whose general equilibrium effects are not accounted for in the generalised Lorenz curves comparison — while the CB system is in long-term balance.\textsuperscript{23}

Figure 3 shows the transformed and the generalised Lorenz curves both for the whole of Population 1 and for the whole of Population 2. The transformed Lorenz curve shows the reduction in inequality deriving from the application of the CB formula rather than the EB formula in both populations; both graphs show that the two curves do not cross each other, so that, in terms of inequality, the distribution of the CB benefit always Lorenz dominates the distribution of

\textsuperscript{21}It should be noted that none of the inequality measures considered here exhibits the property of decomposition, so that overall inequality cannot be decomposed in an additive way into inequality within and between groups. Nonetheless, it is possible to assess the effect of the different pension formulae within the subgroups considered in the analysis.

\textsuperscript{22}Where the social welfare function is non-decreasing in each of its arguments and s-concave. For an overview of these concepts, see Atkinson (1983) and Deaton (1997).

\textsuperscript{23}With the caveats raised in Disney (1999).
the EB pension. As the earning processes are stationary, the distributions of the two benefits for the two populations (one retiring at greater ages than the other) are very similar. The generalised Lorenz curves for Population 1, however, show how the reduction in inequality driven by the CB pension does not compensate the loss in the level of benefit: while for the first 50 per cent of the population the two curves are very close to each other, for the highest part of the distribution the higher EB pension ensures a higher welfare. Conversely, for Population 2, which retires at greater ages, the CB benefit dominates the EB benefit.

**FIGURE 3**

**Transformed and Generalised Lorenz Curves: Population 1 and Population 2**
Analysis of the transformed Lorenz curves for each of the subgroups considered in Population 1 (Figures 4 and 5) reveals that the CB pension dominates the EB benefit in all groups with the exception of college graduates employed in the private sector, as expected after inspection of Table 6. However, in spite of the (slight) increase in within-group inequality for college graduates, their relative position in the overall population does not change.

**FIGURE 4**

**Transformed Lorenz Curves for the Private Sector: Population 1**

- **High-school drop-outs**
- **High-school graduates**
- **College graduates**
- **Total**

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The Distributional Impact of Pension System Reforms
VI. CONCLUSIONS

Between 1992 and 1995, the Italian pension system underwent a deep reform process, and it is now moving from an earnings-related to a contribution-based scheme. The generous pre-1992 system was characterised by high replacement rates and various forms of redistribution of income from the rich to the poor. However, often redistribution operated in the opposite direction, notably because...
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the benefit formula was based on the last years of earnings, thus benefiting workers with steep earnings profiles. The new contribution-based scheme may therefore enhance equity by removing (some of) the inequities implicit in the earnings-related system.

This study has analysed the distributional impact of the change in the benefit formula on a simulated cohort of retirees. Two sets of simulations, calibrated on Italian male employees, have been performed. They differ in that artificial individuals’ retirement ages cover the minimum and maximum eligibility requirements in both the earnings-related and the contribution-based scheme.

The effect of the reforms for individuals with discontinuous careers, who are likely to experience low lifetime earnings, has not been analysed in this framework. Similarly, no attempt has been made to model workers hired with the flexible contracts recently introduced in the Italian labour market; such workers pay reduced social security contributions, so that their earned benefit may not guarantee an adequate replacement rate. Analysis of the distributional impact of the reforms on working women requires the modelling of their participation in the labour market, and is also left for future research.

The results on the simulated cohort of male employees show that the new contribution-based scheme reduces inequality in the overall population considered as well as among most of the groups of workers considered, i.e. private and public employees with different education attainments. An exception is college graduates employed in the private sector, a high-income-earning group in which the redistributive ceilings in the earnings-related scheme were mostly effective. Incorporating the benefit averages into the analysis (i.e. studying the generalised Lorenz curves) leads to mixed results. The artificial population working for 35 years (retiring between ages 57 and 60) earns a CB benefit that is too far below the EB pension to be compensated by the reduction in inequality. Conversely, workers spending 40 years in the labour market (and thus retiring at greater ages) benefit from an average CB pension that is higher than the benefit computed with the EB formula. Combined with reduced inequality, this feature makes the CB scheme preferable to the EB one. Finally, workers with steep earnings profiles retiring at a relatively young age suffer the greatest reduction in benefit level when moving from the EB to the CB scheme.

APPENDIX

The Bank of Italy SHIW records after-tax earnings; in particular, each employee is asked how much they earned during the previous year, excluding personal income tax and social security contributions. Employer and employee contributions are computed on gross earnings — gross of income tax and of social security contributions paid by the worker — and it is gross earnings that enters the computation of the pension benefit. Consequently, a procedure to calculate gross earnings has been implemented.
The Italian personal income tax (IRPEF) is computed by applying marginal progressive rates to increasing income brackets. In addition, employees benefit from tax credits, depending on both the sector of activity and the family structure of the worker. As the data-set contains detailed information on all household members, including their earnings, it is possible to define any dependent members within the household and to compute the relevant deductions for income tax purposes.

The procedure works in a few steps:

- The presence of dependent spouse and/or children in the household is detected using demographic and income information, and the relevant deductions are computed; the definition of dependent members (and in particular their threshold incomes) and the amounts of the deductions are set by law each year.
- Tax credits appropriate for the sector of activity are imputed in each year; the sample only considers employees, who all have the same tax credit. For multiple earners (for example, workers who also earn self-employment income), a separate procedure is performed, which takes into account the fact that it is not possible to qualify for more than one tax credit for the sector of activity.
- After accounting for tax credits, IRPEF is calculated according to the relevant tax rates, income brackets and year of observation. This procedure results in taxable earnings, gross of income tax but net of social security contributions.
- To obtain gross earnings, employees’ social security contributions are added to taxable earnings as a fixed percentage (8.89 per cent; see Section V).

Table A1 shows, at the individual level, net and taxable earnings for the sample used in the estimation of the earnings profiles.

**REFERENCES**

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