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Demographic trends and pension systems equilibrium:
the Italian case

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Introduction

In the last few years the international scientific community and policymakers have paid increasing attention to the consequences of population ageing on the financial equilibria of social institutions. Leading international organizations such as the OECD, the IMF, the EMI (now ECB) and the European Commission have reported worrying structural tendencies in most of the industrial countries (OECD, 1996) and, most notably, a rapid rise in the financial cost of pension systems, which in just a few decades would reach a level in relation to GDP that would be clearly unsustainable in macroeconomic and social terms. The forecasts were made, however, on the basis of models that, while they adequately capture the effects of demographic changes, use a highly simplified representation of the legal-institutional framework. In Italy’s case they do not take account of the effects of the far-reaching changes to the rules made in the reforms enacted between 1992 and 1997. The need to capture the effects of both demographic and legal-institutional factors has led the Italian Treasury Ministry’s State Accounting Office (Ragioneria Generale dello Stato — RGS) to construct a new forecasting model, known as the “demographic model”, which is able to satisfy both requirements. The initial results of the project were published in 1996 (Ministero del Tesoro-RGS, Conti Pubblici e Congiuntura Economica, Quaderno Monografico no. 9). The research was subsequently developed further, in particular by replacing the population estimates made by the RGS with those produced by Istat on the basis of the latest census (Ministero del Tesoro-RGS, “Sanità, scuola e pensioni: le nuove previsioni basate sugli scenari demografici Istat”, Conti Pubblici e Congiuntura Economica, Quaderno Monografico no. 13, 1997). Major methodological improvements were made in order to bring the calculation of retirements and related average pensions more closely into line with the statutory rules. At present the most up-to-date forecast concerning the pension system is that reported in graphical form in “Italy’s convergence towards EMU”, published by the Treasury Ministry in January 1998.

The aim of this paper is to describe and analyze in more detail the results of that forecasting exercise, the assumptions underlying the scenarios and the characteristics of the model (see §§2-5 and the appendix). The paper also presents some simulations that permit an evaluation of the sensitivity of the results with respect to the main assumptions (see §.6).
1. Summary and conclusions

The model exogenously adopts the population forecasts recently produced by Istat on the basis of three different scenarios called the “main variant”, the “high variant” and the “low variant”. The main variant envisages a small increase in the total fertility rate in the early years of the forecasting period, a further small decrease in the mortality and domestic and international migratory flows in line with the present levels. The two alternative scenarios delimit a range within which it is highly probable that Italy’s demographic evolution will fall. The low variant, marked by less pronounced dynamics, envisages a further reduction in fertility, a smaller decrease in mortality and smaller migratory flows; the high variant, marked by more pronounced dynamics, envisages a recovery in fertility, a larger decrease in mortality and larger migratory flows (Figures 1 and 2).

The macroeconomic framework for the first three years is that envisaged in the Economic and Financial Planning Document for 1998-2000. Subsequently it is assumed: that participation rates by age and sex vary with the rise in school attendance rates and the average age of retirement; that unemployment rates by age and sex remain constant at the levels reached in 2000; that the average per employed person productivity of labour increases at an annual rate of 1.5% between 2001 and 2006, 1.8% between 2007 and 2015, 2.2% between 2016 and 2025, and 2.6% in the following 20 years. With the main demographic scenario, the assumptions concerning labour productivity, participation and unemployment rates result in real GDP growing at an average annual rate of 1.8% between 2001 and 2007, and 1.5% in the subsequent period, with an annual fluctuation of not more than 0.3 percentage points.

As regards the legal-institutional framework, the model takes account of the legal framework established by Laws 335/1995 and 449/1997, both in the transitional phase and when their provisions are fully phased in. In view of the large number of pension funds, most of which are of negligible size, it was necessary to group them into three main segments, covering private-sector employees, public-sector employees and the self-employed. Each grouping was considered to be subject to the rules of the most representative fund within the segment. The legal framework was also interpreted as implying the indexation of pensions exclusively to prices and the revision of the conversion coefficients1 every 10 years on the basis of the assumptions concerning life expectancy incorporated in the demographic forecasts. Two alternative hypotheses were also considered in relation to their financial effects: under the first the conversion coefficients are not revised but pensions continue to be indexed exclusively to prices, while under the second the conversion coefficients are revised every 10 years and pensions are indexed in real terms. (see §.4).

1 The conversion coefficients, linked to the average life expectancy, are included in the benefit calculation formula.
Combining the main demographic scenario and the macroeconomic scenario described above gives the baseline scenario, in which the ratio of pension expenditure to GDP rises from 14.5% in 1997 to 15.8% in 2032 and then falls back to the initial level at the end of the forecasting period (Figure 8.1). This outcome reflects two diametrically opposed trends: that of the “demographic ratio” (pensions/employed persons) and the “legal-institutional ratio” (average pension/productivity). In the early part of the forecasting period, the demographic ratio declines slightly as a result of the measures enacted to raise the retirement age (increases in the minimum age and contribution period requirements), while the legal-institutional ratio rises as a consequence of the predominance of the earnings-based regime relative to the contributions-based regime. In the central and last part of the period, the two trends reverse and become much more pronounced (Figures 8.2 and 8.3). In particular, in the last 10 years the number of direct pensions equals the number of employed persons (Figure 9.1). Over the same period the legal-institutional ratio falls just as fast owing to three legal factors: the application of the new method of calculating pensions, the 10-year revision of the conversion coefficients and the absence of indexation in real terms.

Considering the alternative demographic scenarios (Figure 8), the ratio of pension expenditure to GDP at the end of the forecasting period is around 1.4 percentage points higher for the demographic low variant and one point lower for the high variant. By contrast, in the first half of the forecasting period the differences between the ratios of pension expenditure to GDP are not significant since the evolution of the demographic structure is essentially the same for all three scenarios.

The changes in pension expenditure are entirely attributable to direct pensions (Figure 11.1). This is due both to the quantitative predominance of this category and to the fact that the ratio of survivors’ pensions to GDP remains essentially unchanged at around 2%. The breakdown of the overall ratio by sex is of greater interest since it shows the ratios for females and males drawing closer towards the end of the forecasting period after diverging significantly in the intermediate phase (Figure 11.2). The divergence is due to the tightening of the minimum retirement requirements, which has a more pronounced curbing effect for females than for males, while the difference between the average pensions paid to men and women remains essentially unchanged. The subsequent narrowing of the gap is due, instead, to the combined effect of two factors: the larger increase in the number of pensions paid to women and the more pronounced decline in the average pension paid to men.

The analysis of the ratio of pension expenditure by segment is reported in Figure 11.3. The component attributable to private-sector employees shows an increase of 12% in 2035 and 4% in 2045. By contrast, the component attributable to public-sector employees is essentially stable, since the effects of the trends in the demographic ratio and the legal-institutional ratio
cancel out. In particular, there is a significant increase in the number of pensions in this segment, accompanied by a drastic reduction in the average pension, in relation to both labour productivity and per capita GDP. In contrast with the situation in the private-sector employee segment, the size of pensions also decreases in the early part of the forecasting period as a result of the progressive lengthening of the reference period provided for in the “Amato” reform, which remains in force for pensions that are wholly or partly earnings-based. The ratio of pension expenditure to GDP for the self-employed rises sharply in the early part of the forecasting period (by around 40% in 2015) as a result of the improvements provided for in Law 230/1990, which remain in force for pensions that continue to be wholly or partly earnings-based. The ratio returns to its initial value at the end of the forecasting period.

The sensitivity analysis carried out in §.6 makes it possible to assess the financial effects of modifying some of the assumptions underlying the demographic scenarios. In particular, increasing the net flow of immigrants by 100,000 units per year compared with the forecast adopted for Istat’s main hypothesis reduces the ratio of pension expenditure to GDP by around one percentage point at the end of the forecasting period and results in real GDP growing at an average annual rate of around 1.8%. When average labour productivity is assumed to decline so as to leave the GDP growth rate unchanged with this increase in immigration, the savings are almost completely annulled because the smaller increase in the demographic ratio is largely offset by the larger increase in the legal-institutional ratio. Increasing the female participation rates by 10 percentage points from the 25-30 age bracket onwards produces a significant improvement in the ratio of pension expenditure to GDP only in the central part of the forecasting period, in which there is a saving of more than half a percentage point. The saving produced by assuming a fall in the unemployment rate to 6% is smaller. In addition, an increase (decrease) of 0.5 percentage points in the growth of average labour productivity rate produces a reduction (increase) in the ratio of pension expenditure to GDP of nearly one percentage point at the end of the forecasting period. By contrast, assuming a constant rate of increase in productivity equal to the average rate of the baseline scenario produces savings in the first part of the forecasting period and additional costs from 2030 onwards.

The results of the research highlight the following points:

a) the sharp fall in the birth rate in the last two decades is now at an “embryonic” stage as regards its effects on the “demographic” equilibrium of the various pension systems (ratio of pensioners to insureds). The forecasts based on Istat’s demographic scenarios show that the effects in question will be significant in the next millennium, when the ratio of the pensioner population to the working population will steadily deteriorate. The rise will be particularly
pronounced in the last part of the forecasting period. One factor contributing to the
deterioration is the assumption, common to all three scenarios, of a decline in the mortality;

b) the reforms enacted make an effective contribution to curbing the ratio of pension expenditure
to GDP in the medium and long term. Achieving this result depends, however, on the
conversion coefficients being revised every 10 years (according to the evolution of life
expectancy) and the non-indexation of pensions in real terms;

c) the breakdown of the ratio of pension expenditure to GDP shows the explosive effect of
demographic factors and the curbing effect of legal-institutional factors. The negative
demographic trends affect both the numerator of the GDP ratio (increase in the number of
pensioners) and the denominator (decrease in the number of employed persons). The curbing
effect of the legal framework is primarily due to the absence of indexation in real terms and,
in the second part of the forecasting period, to the introduction of the contributions-based
method of calculation in place of the earnings-related method;

d) the analysis by category of pensioner leads to some results that were already known, such as
those concerning private-sector employees (insured almost exclusively with the Employee
Pension Fund) and others that are completely new, such as those concerning public-sector
employees. The latter bring out the scale of the demographic disequilibria in the public sector
and the effective countervailing effect produced by the rapid reduction in the average pension.
For the self-employed, instead, there is a sizable increase in the ratio of pension expenditure
to GDP in the central part of the forecasting period. This can be attributed to the effects of the
more favourable calculation rules enacted in Law 233/1990, which are partly offset by the
reduction in the size of the fund for farmers. The decline in the ratio in the last part of the
forecasting period is due to the introduction of the calculation based on contribution rate (for
determining pensions) lower than that for employees (19% as against 32.7%)2;

e) the analysis of the redistributive effects shows an improvement in the position of pensioners
compared with the active population in the first part of the forecasting period. In the central
and last part, there is a pronounced reversal of this tendency, to the extent that from 2020
onwards pensions grow in real terms by less than 1% per year, compared with an average
annual rate of increase in labour productivity and per capita GDP of respectively 2.5% and
2.1% ;

f) in conclusion, the sensitivity analysis shows that the financial equilibria of the pension system
are positively correlated with the rate of growth of the economy, regardless of the
combination of assumptions underlying the scenarios. By contrast, the choice of scenario,

2 In the benefit formula there is the so called “computation rate”, instead of the contribution rate.
The computation rate is 20% for self employed workers and 33% for public and private employees.
among those compatible with a given rate of growth in GDP, influences the individual components of the ratio of pension expenditure to GDP and produces redistributive effects that are extremely important for the social and political sustainability of the system.

2. Istat’s demographic scenarios

The evolution of the population in the medium and long run depends on its initial structure and the assumptions concerning fertility, mortality and migratory flows. Accordingly, it was deemed desirable to consider different scenarios and recourse was made to the population forecasts recently produced by Istat. These consist of three different demographic scenarios, known respectively as the “main variant”, the “high variant” and the “low variant”. Each scenario was constructed assuming different evolutions of fertility, mortality and migration in the period from 1996 to 2020. From 2020 to 2046, instead, the demographic parameters are kept constant for each region.³

The main variant is the “real” forecast since it is based on the “most likely” evolution of each demographic factor in the light of the trends observed in recent years. In particular, it is assumed that the total fertility rate⁴ (the number of children a woman can be expected to have during her reproductive years) will rise slightly in the early years of the forecasting period and remain essentially stable in the subsequent period⁵, that the mortality will decrease further and that domestic and international migration will continue at their present levels. In 2020 the total fertility rate is expected to be 1.45, compared with 1.22 today, and life expectancy will have increased by 5 years (to 78.3 for men and 84.7 for women), while interregional migration will be equal to 264,000 units and the net inflow of immigrants from abroad to 56,000 units. The increase in the total fertility rate is due exclusively to the shift in child-bearing towards higher ages. In fact the fertility rate by generation, which is the average number of children that a woman bears during the fertile period, is estimated to be essentially stable at a level that is actually higher than 1.45. This explains why the increase in the total fertility rate peters out in the early years of the forecasting period and determines the value towards which it tends once the postponement of child-bearing has come to an end.

The two alternative scenarios delimit a range within which it is highly probable that Italy’s demographic evolution will fall. The “low variant” is based on assumptions concerning demographic variables that are consistent with a low rate of economic growth and limited attention

³ Istat’s demographic forecasts were produced using a multiregional model. For more details on the specification of the scenarios, see Istat (1997c).

⁴ This indicator is measured on a calendar year basis. Consequently, changes in birth timing can significantly modify its trend.
to the welfare state. In fact, it is assumed that the rate of increase in life expectancy will slow down, that there will be a further decrease in the total fertility rate (to 1.2), and that there will be smaller flows of interregional migration and net immigration (respectively 232,000 and 35,000 units). By contrast, in the “high variant”, which is consistent with a high rate of economic growth and greater attention to the welfare state, it is assumed that the total fertility rate will increase significantly (to 1.76), that life expectancy will rise (to 80.1 years for men and 86.3 years for women), and that there will be larger flows of interregional migration and net immigration (respectively 309,000 and 76,000 units).

At the end of the forecasting period, the number of births per year is lower than now in all three scenarios (Figure 1.1). The reduction is significant in the main variant, notable in the low variant and negligible in the high variant. The contraction is not constant throughout the forecasting period: in the first 15 years and in the 10 years from 2030 to 2040 there is a temporary recovery in the number of births, the size of which depends on the assumptions regarding fertility adopted in the three scenarios. There is a similar contraction in the number of young people (0-19 years), which reflects the number of births with an average lag of 10 years. In the main variant the number of young people is down by around 4 million in 2045 (Figure 1.2).

After initially remaining almost constant, the population of working age (20-64 years) contracts significantly in all three scenarios (Figure 1.3). The corresponding curves virtually coincide in the first half of the forecasting period and only diverge significantly after 2020, when the different assumptions concerning net immigration and the fertility rate produce their full effects on this age bracket. In 2045 the forecast value of the population of working age ranges from a minimum of 19.8 million to a maximum of 27.5 million, down by respectively 15.9 and 8.2 million compared with 1996.

5 Istat’s forecasts of the total fertility rate is based on a cohort approach. “This method allows account to be taken of birth catch-ups, namely births postponed from earlier years to later stages of adult reproductive life” (Istat, 1997c, p. 83).

6 As regards migration, it should be noted that, in contrast with other demographic forecasts, those produced by Istat, take account of interregional mobility. In addition, the method used by Istat to determine net immigration takes the flow of immigrants as given exogenously, while the flow of emigrants is determined endogenously by the model in relation to the resident population. Since the evolution of the demographic structure results in the number of emigrants falling, it follows that net immigration (immigrants less emigrants) rises over time in all three Istat scenarios.

7 The evolution of births depends not only on the total fertility rate, i.e. the number of births in relation to the number of women of child-bearing age, but also on the number of such women, which in turn is a function of the number of women born between 20 and 40 years earlier. The fall in the number of births that occurred in the past tends to depress the number of births regardless of how the fertility rate evolves. This, of course, applies to both the two alternative scenarios compared here. In both cases the number of births follows a downward trend, with a fairly pronounced improvement in the first 15 years followed by a further fall and then by a second
The population of old people (65 years and over) grows rapidly (Figure 1.4). In the main variant it rises from 9.7 million in 1996 to 14.8 million in 2045. At the end of the forecasting period, the differences between the main scenario and the two alternatives are less than one and a half million units. The rapid growth in the population of old people is due not only to the decline in mortality but also to the baby-boom generations exceeding the threshold of 65 years.

The age structure of the population is analyzed in Figure 2, which shows the main demographic indicators: the youth dependency ratio (the ratio of young people to people of working age), the elderly dependency ratio (the ratio of old people to people of working age), the total dependency ratio (the ratio of young and old people to people of working age), and the ratio of old people to young people. The evolution of these indicators and the differences between the three scenarios are attributable to the evolution, described above, of the numerators and denominators of the various ratios.
Figure 1: Italy - evolution of the population by age group (residents at 1 January)*

Figure 1.1: Births

Figure 1.2: Young people (0-19)

Figure 1.3: People of working age (20-64)

Figure 1.4: Old people (65 and over)

* Interval between the high and low variants

Main variant
Figure 2: Italy - evolution of the main demographic indicators (residents at 1 January)*

Figure 2.1: Youth dependency ratio

Figure 2.2: Elderly dependency ratio

Figure 2.3: Total dependency ratio

Figure 2.4: Old to young people ratio

*Interval between the high and low variants

Main variant
3. The macroeconomic scenario

The macroeconomic variables that explain the evolution of the ratio of pension expenditure to GDP, and serve as instrumental variables of the model, are: consumer prices, the GDP deflator, employment rates, participation rates, labour costs and average labour productivity. The discussion focuses first on the assumptions concerning the participation and unemployment rates and then on those concerning the other variables.

The participation rate varies considerably according to age and sex. It is much higher for males and, for the same sex, is higher in the central age brackets. Apart from having deep cultural roots, the higher male participation rates are the result of specific social policies. In Italy’s welfare state, and more generally in those of continental Europe, family policy has been implemented by means of transfer payments to the head of the household rather than in the form of the provision of services. Consequently, there has been an incentive for women to concentrate on domestic activities (looking after the home, children and dependent elderly people) that has considerably limited their participation in the labour market. Nonetheless, in recent years the sex-based disparity has diminished, although it remains significant, especially in the countries where there has been least economic and social progress.

The structure of the participation rates is likely to change for the highest and lowest age brackets as a result of a contraction in the labour force made up of younger people and an expansion in that made up of older people. The first effect is due to the rise in school attendance rates, which, as in the past, mainly concerns the population in the 15-19 age bracket and, albeit to a lesser extent, that in the next age brackets. This “spontaneous” phenomenon will be reinforced by the lengthening of compulsory school attendance to 16, a step that appears highly probable. The second effect is due to the lag with which young people enter the world of work and the raising of the average age to qualify for a pension provided for in the recent pension reforms. Both phenomena will lead, albeit not simultaneously, to an increase in the labour force made up of people aged from 50 to 65.

8 The term “labour costs” refers to the earnings of both employees and the self-employed.
9 For a more detailed analysis of family policies within the framework of continental European welfare state policies, see Ferrera (1993, 1995) and, in particular, Esping-Andersen (1995).
10 The overall increase is due to the fact that the first effect will presumably be smaller than the second.
11 This phenomenon, which has already been under way for some time, reflects both the increase in school attendance rates and the lengthening of the average time taken to find a first job. As regards the increase in the average age to qualify for a pension, cf. §.4.
12 The reference is to the new minimum age requirements for old-age pensions (65 for men and 60 for women) provided for in the “Amato” reform (Legislative Decree 503/1992) and the
On the basis of these considerations, the evolution of the participation rates was expressed as a function of the raising of the minimum retirement requirements and school attendance rates. The calculation was made, by age and sex, by subtracting from one the share of the population entitled to a direct pension other than an old-age allowance (net of the “pensioner-contributor” component, which in any case was quite small), the share attending school or university, the share of the attributed population excluded from the labour force and, lastly, the share comprising the “residual population”. The last component but one comprises the so-called “dormant members”, i.e. persons belonging to a fund who have paid sufficient contributions in the past to acquire the right to a pension. It is particularly large for females owing to the choice made by some working women to drop out of the labour market, permanently or temporarily, after the birth of their first child.13 The residual population, instead, consists of persons who remain permanently outside the labour market for psychological, physical or family reasons or who in any case have not earned entitlement to a direct pension.

The share of the population entitled to a direct pension is determined endogenously by the model. The methods used to make the calculation are described below in connection with the analysis of the legal-institutional framework. The school attendance rates are obtained from a projection made by the RGS in order to forecast the number of teachers.14 The share of the “attributed population” not belonging to the labour force and not receiving a pension has been kept constant for each generation at the values observed in 1996. Lastly, the share of the “residual population” was determined separately for three age brackets: 15-25, 26-30 and over 30 (see the appendix). For the first bracket it was assumed that the increase in school attendance rates is at the expense of the share of the “residual population” where this is sufficiently large for this to be possible. Where this is not the case, the excess part produces a corresponding reduction in the participation rates. For the second bracket the participation rates were assumed to show an increase equivalent to that in the school attendance rates at 25. For the third bracket it was assumed that the share of the “residual population” at 30, as modified by the interventions concerning the preceding age brackets, remains constant for each generation.

The participation rates for males and females in 1996 and 2045 are shown in Figure 3. The interaction between the evolution of the participation rates and the distribution of the population by age and sex implies, with reference to the main demographic variant, an increase in the participation rate (for people aged between 15 and 64) from 57% in 1996 to 61% in 2045.

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14 The forecasts were made as part of the research on the consequences of the ageing of the population. See Ministero del Tesoro-RGS (1996b).
Both sexes contribute to the overall increase, although not to the same extent, since the female participation rate rises by 1.5 percentage points and the male participation rate by 5 points.

The forecast of the level and structure by age and sex of the unemployment rates is much more uncertain than that of the participation rates. It is difficult to determine even qualitatively the possible future trends since the evolution of the unemployment rates depends on a plurality of factors that are hard to forecast, such as: technological innovation, the degree of geographical and vocational mobility of the supply of labour, the diversification of firms’ demand for labour, and the globalization of markets. In addition, there are the effects of national and Community policies aimed at fostering employment, regulating the labour market and reducing the latter’s excessive segmentation\(^{15}\) and the precarious nature of jobs. In such an uncertain situation, in which specific unemployment rates could move either way, the hypothesis of no change compared with the initial values appeared to be the most “neutral” choice.\(^{16}\) The interaction with the distribution of the labour force by age and sex leads to a reduction in the average unemployment rate from 12% to 9%.

As regards prices, it appeared reasonable to assume the constancy, in a medium-to-long-term perspective, of the ratio of the consumer price index to the GDP deflator. The same assumption was made for labour costs and average labour productivity.\(^{17}\) These assumptions imply that the effect of the above-mentioned variables on the ratio of pension expenditure to GDP depends essentially on the indexation mechanism provided for by law. Where pensions are “fully” adjusted, i.e. so that they rise in line with the nominal increase in average labour costs, the assumptions concerning inflation and productivity have no effect at all on the ratio of pension expenditure to GDP. Where, instead, pensions are partially adjusted, there is a progressive improvement in the ratio compared with the hypothesis of full indexation. In the case of partial indexation there are two possibilities. The first is that the degree of “underindexation” compared with the rise in labour costs is established as a fixed percentage, so that the improvement in the ratio of pension expenditure to GDP is curbed by the assumptions concerning the macroeconomic framework. The indexation of pensions exclusively to prices is a special case, in which the financial equilibria of the system improve as the rate of real growth in average earnings

\(^{15}\) One possibility is that the demand for labour will be increasingly oriented towards the highest skill levels, persons who will manage technological progress, and the lowest skill levels with a large manual component that cannot be automated, or at any rate not profitably. In the process the intermediate skill levels will be squeezed. See Gesano (1997).

\(^{16}\) This is the hypothesis adopted in all the earlier forecasts produced by the RGS. See Ministero del Tesoro-RGS (1996c, 1997).

\(^{17}\) In particular, it is assumed that average labour costs rise with productivity.
increases and vice versa. Since this is the solution envisaged in Law 335/1995, the assumption concerning the real increase in labour productivity becomes of considerable importance for the forecast, while the assumption concerning inflation has virtually no effect.

Before describing the assumptions concerning the average productivity of labour, it is worth recalling the relationship that links this variable to GDP. In particular, there exists a deterministic relationship between the rates of change in the two variables that depends exclusively on the structure of the population by age and sex and the participation and unemployment rates. The relationship, based on the unemployment assumptions described above, is shown in Figure 4 for each of Istat’s three demographic variant. With the main demographic scenario there is a difference between the rates of change in GDP and average productivity per employed person that goes from 0.3 percentage points in 2001-05 to -0.9 points in 2041-45, with a minimum of -1.2 points in 2031-35. The differences in absolute value are smaller with the high variant and larger with the low variant (respectively -0.4 and -1.6 percentage points in the last five years of the forecasting period).

These results point to a clear reversal of the earlier trend. In fact, in the last forty years the growth in employment has made a significant contribution to the rate of growth in GDP. Between 1949 and 1991 the contribution was equal on average to 0.6 percentage points per year. Productivity per employed person, by contrast, has grown in line with GDP, since the reduction in hours worked per capita has offset the increase in the number of employed persons. When the observation period is divided into two parts, it can be seen that the contraction in hours worked was significantly larger than the growth in employment from 1947 to 1974, and significantly smaller from 1975 to 1991. Consequently, in the more recent period the growth in GDP was well above that in average productivity per employed person (0.4% per year) and substantially in line with the growth in hourly productivity.18 Looking ahead, instead, the demographic and employment trends will permit GDP growth rates below that of productivity per employed person and even further below that of hourly productivity if, as seems probable, the reduction in the number of hours worked continues.

Hourly productivity depends largely on technological progress and investment in training (total productivity of factors) and to a lesser extent on the increase in the per capita endowment of capital and the reconfiguration of the labour force between sectors with different levels of productivity. Innovation, which is the basis of technological progress, is by its very nature unpredictable in both qualitative and quantitative terms. Technological progress can be considered independent of the demographic and employment scenario insofar as the globalization of the economy means that innovation is easily exported. It will also result in the segment of the labour

market involving those with the highest skill levels being global, with a consequent leveling of their compensation. None of this applies, instead, to the production of goods and services sold primarily in the domestic market and inherently sheltered from international competition. This part of the economy, which will include most of the services typically provided by the public sector — assistance to old people and families, education and training services, etc. — will have a much lower productivity, owing both to the lack of incentives to innovate and to the fact that the human component in the production of such services cannot be compressed beyond a certain point. Average hourly productivity will therefore depend on the size of the (capital intensive) economy exposed to international competition compared with that of the (labour intensive) sheltered economy. Investment in human capital should foster the expansion of the economy exposed to international competition; on the other hand, increased employment, especially if it is brought about with the contribution of immigrants, should lead to the expansion of the sheltered economy. In quantitative terms it is difficult to forecast the combined effect of these two factors. In the first half of the forecasting period, in which the number of employed persons will remain essentially stable or decline slightly, hourly productivity can be expected to continue to rise in real terms at an annual rate of 2.2% until 2025, in line with the average observed in the last 20 years. In the following period, by contrast, the sharp fall in the labour force will make capital intensive technologies more advantageous, thus encouraging investment in physical and human capital. Accordingly, it was considered appropriate to raise the annual rate of change in hourly productivity in the second half of the forecasting period by 0.4 percentage points.

As regards the number of hours worked per capita, it appeared reasonable to suppose that the downward trend under way since the beginning of the century would continue. Factors that may contribute to the decline include a reduction in contractual working hours, an increase in part-time work and greater scope for leave on family grounds (to assist children or parents), together with a greater propensity on the part of citizens to take such leave. In “normal” conditions, i.e. in the absence of specific policies aimed at supporting cultural, economic and social changes encouraging the preference for free time, it appeared reasonable to expect the downward trend in hours worked per capita to peter out in the medium-to-long term. In other words, the number of hours worked on average was assumed to converge asymptotically on a limiting value. Apart from satisfying a conceptual condition (the decrease in the number of hours worked cannot continue infinitely), this assumption is consistent with historical experience: in the last 20 years the average annual rate of decrease in hours worked per employed person was around 0.4%, or half the rate of around 0.8% observed in the preceding 20 years. Accordingly, it was assumed that the average

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number of hours worked would decline at an annual rate of 0.7% from 2001 to 2006\textsuperscript{20} and 0.4% from 2007 to 2015; subsequently, it was expected to remain unchanged.

On the basis of the assumptions described above, the rate of change in average productivity per employed person in real terms is equal to 1.5% from 2001 to 2006, 1.8% from 2007 to 2015, 2.2% from 2016 to 2025, and 2.6% in the following 20 years. In combination with Istat’s main demographic scenario, this results in average annual GDP growth in real terms of around 1.8% from 2001 to 2007 (i.e. close to the average for the 1990s) and of 1.5% subsequently, with an annual fluctuation of not more than 0.3 percentage points (Figure 5).

\textsuperscript{20} The 0.7% reduction assumed in the early years of the forecasting period takes account of the structural trends observed and of a probable reduction in the working hours provided for in labour contracts, in line with the indications that have emerged recently in political fora.
Figure 3: Participation rates in 1996 and 2045

Figure 3.1: males

Figure 3.2: females
Figure 4: Gap between the average annual rates of change in GDP and average labour productivity on the basis of different demographic scenarios

Figure 5: Real GDP growth
4. The legal and institutional framework

This section describes the criteria used to group Italy’s manifold pension plans into a limited number of segments that are sufficiently homogeneous from the standpoint of rules and explains the assumptions made concerning the reproduction over the entire forecasting period of the key aspects of the provisions currently governing pensions.

One of the objectives of the reform is to bring the rules governing the public pension system gradually into line, so as to reduce the differences between the rates of return of the various funds. At present, the rules differ widely as regards contribution rates, pension computation algorithms and retirement requirements. Harmonization will be very slow and will only be complete when the contributions-based regime is fully phased in. Even then, however, there will still be some differences in pension parameters as the contribution rate for the self-employed will be significantly lower than that for employees (19% compared with 32.7%).21

For these reasons, it was deemed important that the forecasting model take adequate account of the main differences in plan rules, both during the long transitional period and once the reform was fully phased in. However, the Italian pension system has too many funds for each of them to be treated separately, not only because of the complexity of the operation but also owing to the lack of sufficiently detailed data.22 It was thus decided to group the pension funds into three large “segments” according to the homogeneity of their rules and the type of employment. The first segment comprises the funds and plans for private-sector employees and includes the INPS Employees Pension Fund (FPLD), the Journalists Pension Institute (INPGI), the Industrial Managers Pension Institute (INPDAI), the Entertainment Industry Employees Pension Organization (ENPALS) and the special plans for employees insured by INPS. The second comprises the funds for public-sector employees insured by the General Government Employees Pension Institute (INPDAP) pursuant to Legislative Decree 479/1994.23 The third includes the three plans for the self-employed insured by INPS (artisans, shopkeepers and owner-occupiers,

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21 In addition, Law 335/1995 provided that previously uninsured free-lance workers and quasi-employees would have an overall contribution and computation rate of 10%. Subsequently, Law 449/1997 provided a gradual increase of the contribution rate from 12% to 19% and introduced a computation rate of 20%. Moreover for the self-employed funds the Law 449/1997 defined a gradual increase of the contribution rate from 15% to 19% (the computation rate remains the same).

22 See Ministero del Lavoro e della Previdenza Sociale-NVSP (1998), vol. II.

23 In practice, it covers central government employees, the employees of the former social security institutes (the fund for local government workers’ fund, the bailiffs fund, the nursery school teachers fund, the healthcare workers fund), and the employees of the State Railways and the Post Office.
sharecroppers and tenant farmers) and the funds for the members of the professions. The costs of
the non-contributory old-age allowances superseding the welfare pensions provided for under the
legislation in force before Law 335/1995 have been treated separately. The rules of the INPS
Employees Pension Fund were applied to the first segment, those of the local government
workers’ fund (CPDEL) to the second (except for central government employees, whose own rules
were used), and those of the INPS plans for the self-employed to the third. This simplification
does not have significant effects on the overall results of the forecast, as the size of most of the
pension funds is negligible when compared with the major ones.

It is worth stressing that the evolution of the share of the population “attributed” to each
segment has a significant bearing on the forecast of overall pension expenditure as well as on the
result for the segment in question. As noted, there will be differences in benefit calculation rules
not only during the transitional period but even after the reform is fully phased in, although they
will be limited to the differentials in contribution and computation coefficients.

The non-retired attributed population was distributed among the segments on the basis
of two separate hypotheses. The first concerns the distribution between employee and self-
employed insureds, the second that between public- and private-sector insureds. With regard to the
first hypothesis, it was assumed that from the age of 30 onwards the cohorts will have the same
distribution between employees and the self-employed as in 1996 and maintain it until the total
extinction of each generation. A similar hypothesis was adopted for the distribution of
employees between the public and private sectors. Accordingly, from 2030 onwards the non-
retired attributed population will be composed as follows: 22.5% self-employed workers and
members of the professions, 60.5% private-sector employees and 17% public-sector employees (in
1996 the proportions were, respectively, 21%, 62% and 17%). Figure 6 shows the redistribution
by sex of the attributed population according to segment. It should be noted that the broad stability
of the relative size of the individual segments conceals a drastic reduction in the numbers

24 Including these funds in the same segment as the plans for self-employed workers is not
justified by homogeneity of rules, but neither would assigning them to any other segment have
been appropriate. Moreover, it seemed inadvisable to treat them separately because they are
numerous, differ considerably and their combined size is modest (around 500,000 insureds and
100,000 pensioners in 1995). See Ministero del Lavoro e della Previdenza Sociale-NVSP (1998),
vol. II.

25 This fund covers more than 95% of insured private-sector employees.

26 This share comprises insureds (current contributors and dormant members) who will accrue
entitlement to a direct pension. For the public sector, they are made to coincide with employees;
for the private sector, they are assumed, separately for employees and the self-employed, to be
equal to the number of contributors plus the share of dormant members not attributed to the other
segments.

27 The data are taken from the results of the Istat labour force surveys. See Istat (1997a).
involved; with the main demographic variant, the non-retired attributed population will fall by more than 6 million in the period 1996-2045.

With regard to the rules for calculating pensions, it needs to be emphasized that the shift from the earnings- to the contributions-based method will be very gradual as a result of a dual mechanism for safeguarding the so-called “acquired rights”. The first is the exclusion from the new system of calculation of workers who had already accrued 18 years of contributions at 31 December 1995. The second regards workers with fewer than 18 contribution years at that date, for whom the contributions-based method will be applied on a pro rata basis. In practice, the new method applies only to the contribution period following the entry into force of the reform, whereas the old (earnings-related) method will continue to apply to the contributions paid earlier. The contributions-based method applies integrally only to workers who first signed up after 1995. The method provides for the “notional” capitalization of contributions using the five-year average change in GDP. The amount obtained from capitalization is multiplied by the “conversion coefficient” associated with the age of retirement. The coefficient increases with retirement age, rising from 4.72% at 57 to 6.14% at 65. When the contributions-based regime is fully phased in, retirement will be possible from 57 onwards for workers with a contribution period of at least 5 years and contributions having a “pension value” equal to at least 1.2 times the amount of the non-contributory old-age allowance. For the 10-year revisions of the conversion coefficients mandated by Law 335/1995, it was decided to use the changes in life expectancy corresponding to the probabilities of death adopted for the forecast.

28 Obviously, the modification of the computation method does not alter the pay-as-you-go nature of the pension system. Hence, the capitalization of contributions does not imply an actual accumulation of reserves but only serves for the purpose of calculating benefits.

29 The conversion coefficients are defined as the reciprocal of the so-called “divisor”, which in turn is calculated as the sum of the periodic benefits (paid to the pensioner and his or her survivor) expressed as a ratio of the pension award and discounted on the basis of the rate of change in GDP. For the purposes of the calculation, the periodic benefit was indexed at a rate equal to the percentage change in GDP reduced by 1.5 percentage points (actually, the law assumes a GDP growth rate of 1.5% and nil real indexation. The same coefficients could be obtained, however, with any other rate of change in GDP provided the difference with respect to the rate of real indexation is equal to 1.5 percentage points). This reduction made it possible to increase the income replacement ratio (the ratio of the initial pension award to final earnings) by more than would have otherwise been possible. The parameters involved in the calculation are life expectancy, the probability of leaving eligible survivors, the age difference between spouses, the rate of revertibility to survivors, and the adjustments to that rate introduced by Law 335/1995 in relation to the income of the beneficiary (see the introductory report to Law 335/1995). In addition, pursuant to Article 1 of Law 335/1995, the conversion coefficients are to be redetermined every ten years on the basis of demographic trends and the actual long-term rate of change in GDP compared with that in the incomes subject to social security contributions.

30 The revision only takes account of demographic changes since the shares of GDP were assumed to be constant.
Regarding the earnings-related method in effect during the transitional period, the computation formulae used are those established by Legislative Decree 503/1992 (the Amato Law). Since the object of the forecast is pension expenditure in relation to GDP and not the equilibrium of the individual pension segments, the model does not include the contribution rates among the normative parameters but it does include the computation rates, since these are needed to calculate pensions under the contributions-based method.31

Law 335/1995 retains the arrangement for topping up pensions to the minimum level for the whole of the transitional period. However, the number of such pensions and the average amount of the subsidy will fall drastically in the coming years for the following reasons: a) the increase from 15 to 20 years in the minimum contribution period for pension entitlement reduces the likelihood that the amounts calculated at the time of pension award will be less than the minimum benefit; b) the absence of indexation in real terms implies a gradual reduction in the value of the minimum benefit relative to computed benefits; c) the introduction of means-testing for entitlement to topping up will reduce the number of potential beneficiaries. The effect of these rules on the average benefit is hard to quantify, but in qualitative terms the following considerations are possible. The first factor should be basically neutral on total pension expenditure in the extent it involves substitution between the amount of the subsidy and the computed benefit, whereas the other two are likely to curb the number of subsidized pensions and the average amount of the subsidy. On the other hand, the pro-rata mechanism and the 10-year revision of the conversion coefficients should result in a steady reduction in the computed benefits awarded under the mixed (earnings and contributions-based) regime. Since it was impossible to formulate quantitative hypotheses regarding the above-mentioned effects, it was deemed appropriate to assume they would basically cancel each other out.

Turning to the indexation mechanism, the reforms of the pension system enacted since 1992 call for benefits to be adjusted annually on the basis of the inflation rate32 and provide for the possibility of additional adjustments in real terms as compatible with financial resources. From 2009 onwards, these adjustments could be granted for the share of each pension less than 10 million lire a year up to the limit of one percentage point of the whole contribution base. Since

31 The contribution (or financing) rates indicate the contribution, per lira of base, actually paid into each fund, whereas the computation coefficient indicates the contribution, per lira of base, credited for the purpose of calculating the pension award.

32 The Law 335/95 (the so called “Dini” reform) actually maintains the earlier differentiated indexation of pensions according to their amount (100% of the inflation rate for pensions up to two time the minimum, 90% for those between two and three times the minimum, and 75% for those above three times the minimum). Consequently the price elasticity of pensions is less than one (for the INPS Employees Pension Fund it is around 98%), so that ceteris paribus, the ratio of pension expenditure to GDP improves as the inflation rate increases. For the purposes of the
real adjustment is not automatic, it could be systematically denied in view of the fact that the demographic trends will not allow improvements in the financial equilibria of the pension system. In fact, this is the hypothesis adopted in the Government’s technical report on the medium and long-term forecasts of the effects of the reform. In order to highlight the financial effects of the adjustment of pensions to the change in nominal GDP instead of their indexation to prices alone there is a simulation in §. 6.

Since 1996 welfare pensions and the increases thereto have been replaced by an old-age allowance for persons older than 65 without means of their own. The number of new allowances payable each year was determined by assuming the ratio of beneficiaries to the “residual population” aged 65 remained constant at its value in 1996. It will be recalled that on the basis of the assumptions made for labour force participation rates, the “residual” component of the population diminishes in percentage terms while increasing in absolute terms owing to the change in the age structure of the population. Although not expressly provided for by law, the old-age allowance was indexed to the growth in GDP. This assumption was dictated by the fact that indexation to prices alone would soon erode the welfare function that Parliament intended to attribute to this institution.

As regards the probabilities of drawing a pension, account was taken of the evolution of the eligibility requirements provided for by law. In particular, for persons already insured at 31 December 1995, the retirement age was set at 60 for women and 65 for men. For these workers early retirement continues to be governed by the rules for long-service pensions, which have been made more restrictive by increasing the minimum contribution period and introducing an age requirement.

The changes in the eligibility requirements during the transitional period, together with the delay in entering and exiting the labour market, justified the use of “dynamic” retirement probabilities. These were projected separately for each segment on the basis of the propensities to retire that would have prevailed under unchanged rules. It was assumed that each insured person

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33 See Ministero del Tesoro - RGS (1996a).
34 With real GDP growth of 1.5 % a year, indexation to prices alone would result in the value of the allowance declining in relation to GDP by around 35% in 20 years.
35 For employees, the age requirement (with 35 years of contributions) increases from age 52 in 1996 to 57 in 2002 for the private sector and in 2004 for the public sector. Apart from the age requirement, early retirement continues to be governed by the rules for long-service pensions, which have been made more restrictive by increasing the minimum contribution period and introducing an age requirement.
36 The technique of projecting the probabilities of retirement was completely revised with respect to the previous versions of the model. The new method allows adequate simulation of the effects
would seek to minimize the divergence between the choices possible under the current age and
contribution requirements and the choice he or she would have made under the previous
legislation. The propensities to retire determined in this way were also used for the persons
subject exclusively to the contributions-based regime, most of whom will begin to retire in the last
10 years of the forecasting period.

As regards the reduction in retirement age to 60 for female central government
employees, it was assumed that the workers concerned (those who under the previous rules would
have retired at ages somewhere between the old and the new requirement) would not change their
propensity to retire. In particular, continuation in employment beyond 60 was deemed to be due to
reasons other than the reaching of retirement age since the early retirement mechanism could
easily have been utilized in the past in view of the low minimum contribution requirement.

Figure 7 shows, for each age, the share of the population receiving a direct pension in
relation to the total population attributed to the pension system in 1996 and in the final year of the
forecasting period.

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37 In practice, it was assumed that workers unable to retire owing to the change in the eligibility
requirements would postpone retirement for the time strictly necessary to satisfy the new
requirements.

38 In reality, before Law 724/1994 old-age pensions were calculated using pensioners’ special
supplementary compensation in full and not in proportion to the number of contribution years
accrued, as in the case of early retirement. This could have been an effective incentive for workers
to wait until age 65 to retire. In the absence of any quantitative evidence, this aspect has been
disregarded.
Figure 6: Attributed population by pension segment in 1996

Figure 6.1: males

Figure 6.2: females
Figure 7: share of the attributed population receiving a direct pension in 1996 and 2045

Figure 7.1: males

Figure 7.2: females
5. The forecasts

Figure 8 shows the forecast of the ratio of pension expenditure to GDP obtained by combining the main demographic variant and the macroeconomic assumptions described in §. 3 (henceforth the “baseline scenario”). In this scenario the ratio is basically unchanged at the end of the forecasting period, although it increases significantly within the period, reaching a peak of 15.8% in 2032. The fluctuation band identified by the alternative demographic scenarios widens over time. This is due to the gradualness of the change in the structure of the population by age and sex as a result of the demographic assumptions. At the end of the forecasting period, the ratio of pension expenditure to GDP is 1.4 percentage points higher than the central curve at one extreme and 1 point lower at the other.

Apart from the differences in level, the three curves in Figure 8.1 present notable similarities, thus suggesting the existence of common explanatory factors, whose analysis is essential in order to understand the prospects of the Italian pension system. For the sake of simplicity, discussion of the results will focus mainly on the forecasts obtained with the main demographic variant (baseline scenario).

The ratio of pension expenditure to GDP rises and falls. After basically holding steady for the first five years, it increases until 2032 and then turns downwards in the final forecasting years. To understand the reasons for this behaviour, it is useful to decompose the ratio of pension expenditure to GDP into the product of two factors: the “legal-institutional” ratio (average pension to productivity per employed person) and the “demographic” ratio (number of pensions to number of employed persons). The two components move in opposite directions (Figures 8.2 and 8.3), with the demographic ratio rising considerably (from 90% to 131%) and the average pension falling in relation to productivity (from 16% to 11%). The fluctuation band is explained almost entirely by the demographic ratio. The fluctuation in the legal-institutional ratio is instead very modest and is due essentially to the difference in the assumptions concerning mortality, which is reflected in both the revision of the conversion coefficients and the turnover of the stock of pensions.

The increase in the demographic ratio is due to the absolute and relative ageing of the population. The decrease in the legal-institutional ratio stems from the introduction of the contributions-based method, which is less generous on average than the earnings-based method (especially with the 10-year revision of the conversion coefficients), and from the absence of indexation in real terms throughout the forecasting period. So, the drop in the ratio of the average pension to productivity, is considerable (at around 32%), and large enough to offset, at the end of the forecasting period, all of the effect of the increase in the number of pensioners.
As an aid to describing the results, the forecasting period can be divided into four sub-periods: from 1996 to 2007, when the new rules on long-service pensions will be fully phased in; from 2008 to 2015, when the flow of new pensions calculated exclusively with the earnings-based method will cease; from 2016 to 2034, when the earnings-based method will presumably cease to be used for new direct pensions; and from 2035 to 2045, the end of the forecasting period.

The ratio of pension expenditure to GDP rises slightly in the first sub-period (from 14.4% to 14.8%). The breakdown of the ratio shows the legal-institutional factor rising from 16% to 16.4% and the demographic factor remaining basically stable at around 90%. These results reflect the provisions of Legislative Decree 503/1992, Law 335/1995 and Law 449/97, which are effective in containing the number of new pensions in this sub-period (by increasing the retirement age and reducing the possibility of qualifying for a long-service pension) but do not substantially modify the benefit calculation parameters. The increase in the average pension in relation to productivity, notwithstanding the “braking” effect of the absence of indexation in real terms, is due to the difference between the contribution periods of new pensions and those of the stock (“turnover effect”). The difference is particularly large in the private sector and is amplified by the shift in the composition of pensions towards categories with generally longer contribution periods (old-age and long-service pensions increase while disability pensions decrease).

The pension expenditure ratio rises significantly in the second sub-period, from 14.8% in 2008 to 15.5% in 2015. Figures 8.2 and 8.3 show a rise in both the ratio of pensions to employed persons (over three percentage points) and the legal-institutional ratio (about one percentage point). The former is due to the restoration of “full-sized” generations of retirees, following the years in which their ranks were reduced by the changes in the eligibility requirements. The latter stems from the turnover effect mentioned above.

Between 2016 and 2034 the pension expenditure ratio rises further, but this trend is attributable to different factors from those at work in the previous sub-period. A considerable reduction in the average pension (“amount effect”) is more than offset by a very large increase in the number of pensioners in relation to the number of employed persons (“number effect”). The

39 Equal percentage changes in the demographic and legal-institutional factors have identical effects on the pension expenditure ratio, whereas equal absolute variations generally have different effects.

40 In the first sub-period the pension calculation rules are basically those in force prior to the Amato reform. Workers who qualify for retirement in these years will have accrued the bulk of their contributions before 1992, and the rules in force prior to Law 503/1992 will continue to apply to those contributions. Moreover, the new calculation rules applying to contributions accrued after 1992 are even more generous in some cases. In the private sector, where the lengthening of the earnings reference period starts from the last 5 years for employees and the last 10 years for the self-employed, the revaluation of prior-year earnings by a rate equal to inflation plus 1 percentage point allowed by the previous legislation results in more favourable replacement ratios at least until the lengthening of the reference period becomes considerable.
amount effect begins to appear when pensions calculated on a mixed (contributions and earnings) basis start being awarded and grows steadily as the pensions, or portions thereof, awarded under the contributions-based system become the majority. The number effect has a twofold explanation: on the one hand, longer life expectancy, together with the explosive growth of the flow of new pensions fueled by the baby-boom generation, leads to a sharp increase in the number of pensioners, while the fall in the fertility rate since the second half of the sixties causes a sizable drop in the active population. As a result of these trends, the pension system will come under maximum pressure in this sub-period (Figure 8.3).

Despite the further ageing of the population, in the last 10 years of the forecasting period the ratio of pension expenditure to GDP declines, falling to 14.2% in 2045, compared with the peak of 15.8% in 2032. The share of GDP allocated to financing direct pensions diminishes thanks to a further contraction in the average pension. This reflects both the elimination from the stock of pensions of long-standing benefits calculated in whole or in part with the earnings-based method and the entry of benefits that are modest in size following the downward revision of the conversion coefficients.

Figures 9.1 and 9.2 show the decomposition of the demographic ratio and the legal-institutional ratio, respectively. The analysis of the first ratio shows the effect of the demographic evolution on the pension system: in 2025 the number of employed persons falls below the total number of pensions and at the end of the forecasting period is approximately equal to the number of direct pensions. The second ratio is analyzed by comparing the dynamics of the average pension with that of labour productivity and per capita GDP. The sharp fall in the average benefit is caused by the contribution based method, the absence of indexation in real terms and the revision of the conversion coefficients.

The importance of the last two legal factors is evidenced in Figure 10, where the assumption of 10-year revision of the conversion coefficients and indexation to prices alone is compared with two alternatives: constant conversion coefficients with no indexation in real terms, and dynamic conversion coefficients with indexation to GDP. The impact is considerable: pension expenditure rises by an additional 1.3% of GDP in the first case and by an additional 3.7% in the second. The increase in expenditure is obviously due to the ratio of the average pension to productivity (Figure 10.2), which is considerably higher, especially in the second case.

Figure 11 analyzes the forecast result by type of pension, sex and segment. Figure 11.1 shows that the changes in the pension expenditure ratio are entirely explained by direct pensions. The reason is straightforward, given the predominance of this category of pensions in terms of both number and average amount. Still, it is worth pointing out that expenditure on indirect pensions decreases slightly in relation to GDP over the whole forecasting period. This is because the average benefit declines a little while the number of pensions remains broadly unchanged.
The decomposition of pension expenditure by sex (Figure 11.2) reveals a little biased toward men, albeit with a pronounced imbalance in the distribution between direct and indirect pensions.\textsuperscript{41} Starting from initial values of 7.9% of GDP for men and 6.3% for women, the two shares rise to 8.3% and 6.5% respectively in the years in which the gap is widest (2005-2010). At the end of the forecasting period the gap narrows, with shares of 7.5% for men and 6.7% for women. This result is due to the rise in retirement age, which prevalently affects women in the private sector, and the more stringent minimum requirements for drawing a long-service pension, which instead prevalently affect women in the public sector.\textsuperscript{42} While men can retire early by drawing long-service pensions, most women have to wait until they reach retirement age owing to the greater discontinuity of their careers and their shorter average contribution period compared with men the same age. The realignment of pension expenditure between the sexes is also due to the fact that the decline in the average pension for women occurs with a lag and is smaller than that for men. There are two reasons for this. First, survivors’ pensions, almost all paid to widows, are linked to the amount of the direct pensions men were awarded on average 15-20 years earlier. Second, the longer survival of women produces a smaller “turnover effect” (newly awarded pensions replacing terminated ones), and this slows down the adjustment of the average amount of existing pensions to the generally lower levels imposed by the contributions-based system.

Figure 11.3 analyzes the results of the forecast by segment. After more or less holding steady at around 8.5% of GDP in the first ten years of the forecasting period, expenditure on private-sector employees rises to a peak of 9.6% in 2032 and then falls back to an end-of-period level of 8.8%, slightly higher than the initial one. Given the size of this pension segment, the trends in the expenditure/GDP ratio, average pension and number of pensioners are very similar to those described for the pension system as a whole. The situation is appreciably different for public-sector employees and the self-employed.

Pension expenditure on public-sector employees decreases slightly in relation to GDP, from 3.7% to 3.2%. The effects of the large increase in the number of pensioners and the decrease in the average pension basically offset each other. The rise in the number of public-sector pensions, from around 2.5 to 3.5 million, reflects not only the more general phenomenon of the retirement of the baby boomers but also the massive hiring of staff between the late seventies and the mid-eighties. For this segment, the demographic ratio (i.e. the ratio of the number of pensions to the population attributed to the segment not receiving a direct pension) reaches 114.7% in 2045, 17 percentage points higher than the corresponding ratio for private-sector employees. Over the

\textsuperscript{41} In 1996 the proportion of direct pensions was 94% for men and only 62% for women.
\textsuperscript{42} Retirement on long-service pensions in public employment was greatly “facilitated”. In addition, married women with children could count on a reduction of 5 years in the minimum contribution period required.
forecasting period the ratio of the average pension to average labour productivity falls from 29.3% to 13.6%, approaching the level of 12.8% forecast for private-sector employees. In particular, in the first twenty years the curve of the average pension reflects the realignment of the calculation criteria with those established for the other segments in accordance with the Amato reform. In the second half of the forecasting period, the difference between the average pensions of public- and private-sector employees gradually tends to disappear as the contributions-based system is phased in.

For the self-employed, the expenditure ratio rises significantly in the first twenty years of the forecasting period, from 2% of GDP to 2.8% in 2016, and then gradually edges downwards over the next thirty years to return to the initial value in 2045. The initial rise is mainly due to the legal-institutional factor. In fact, while the ratio of the number of pensions to the population attributed to the sector rises by around 6%, from 81.8% in 1997 to 87.1% in 2016, the ratio of the average pension to average labour productivity rises by nearly 30%, from 9.3% to 11.8%. The large increase stems from the application of Law 233/1990, which extended the calculation rules of the INPS Employees Pension Fund to artisans, shopkeepers and farmers. This enables the self-employed to obtain much higher benefits than would have been possible under the pre-1990 rules as long as the earnings-based system remains in force. The limited growth in the demographic factor is due to the contraction of the fund for farmers, which tends to compensate the greater number of artisan and shopkeeper pensions. The pattern in the second period is determined by the halving of the legal-institutional factor, which falls from 11.9% in 2016 to 6% in 2045, only partly offset by the deterioration in the demographic factor, which rises from 81.1% to 116.3%. The fall is more marked in this segment than the others because of the smaller average pension awarded to the self-employed under the contributions-based system, which provides for a computation coefficient of 20% for the self-employed compared with 33% for other workers.

Lastly, with regard to the old-age allowance, expenditure increases slightly in relation to GDP owing to an increase in the number of beneficiaries.

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43 It should be remembered that this segment comprises pension funds with very different situations. In particular, the differences in the legal-institutional and demographic ratios, average taxable income and average pension regard artisans and shopkeepers on the one hand and farmers on the other. For a forecast of the financial situation of the Shopkeepers’ Fund and the Artisans’ Fund, see Ministero del Tesoro-RGS (1996a).

44 Law 233/1990 grants the self-employed implicit rates of return that are twice as high as those of private-sector employees. See Ministero del Tesoro-RGS (1994).
Figure 8: Pension expenditure as a percentage of GDP and its decomposition on the basis of different demographic scenarios

Figure 8.1: Ratio of expenditure to GDP

Figure 8.2: Ratio of average pension to labour productivity

Figure 8.3: Ratio of pensions to employed persons
Figure 9: Pension expenditure as a percentage of GDP - Baseline scenario

Figure 9.1: Decomposition of the "demographic" ratio

Figure 9.2: Decomposition of the "legal-institutional" ratio
Figure 10: Different hypotheses for the revision of the conversion coefficients and the indexation of pensions - Baseline scenario

Figure 10.1: Ratio of expenditure to GDP

Figure 10.2: Ratio of average pension to labour productivity

Figure 10.3: Ratio of pensions to employed persons
Figure 11: Ratio of expenditure to GDP - Baseline scenario

Figure 11.1: Decomposition by type of benefit

Figure 11.2: Decomposition by sex

Figure 11.3: Decomposition by segment
6. The sensitivity analysis

The assumptions underlying scenarios generally involve a large element of discretion, especially when they refer to the medium and long term. This means that it is extremely useful, if not indispensable, to evaluate the sensitivity of the results to alternative assumptions.

As far as the demographic forecasts are concerned, the assumption concerning the size of the migratory flow is especially important. In this respect the range of hypotheses embodied in the three Istat demographic variant is completely inadequate in comparison with the potential variability of the phenomenon in the medium and long term. It is therefore interesting to evaluate the effects on the financial equilibria of the pension system of an increase in the net flow of immigrants with respect to that already assumed in Istat’s main scenario. The additional flow was put equal to 100,000 units per year from 2015 onwards, while over the 15 preceding years it was made to rise linearly to 100,000. As can be seen in Figure 12, the additional immigration produces a gradual reduction in the ratio of pension expenditure to GDP because the increase in the number of immigrants results in an immediate rise in the number of employed persons that increases the denominator of the ratio (Figure 12.2). In the second part of the forecasting period, the improvement stabilizes at around 1% of GDP. In fact, in this period pension expenditure begins to increase as a result of the higher capitalization rates of the contributions-based regime (Figure 12.3) and the larger number of pensions payable to the immigrant population of earlier decades (Figure 12.4).

Figure 13, instead, shows the effects of a redistribution of the rate of growth in real GDP between the component attributable to employment and that attributable to average labour productivity. Specifically, it is assumed that the annual rate of increase in average labour productivity is equal to 1.5% throughout the forecasting period and, at the same time, that the growth in the number of employed persons is such that the growth in GDP remains unchanged compared with the baseline scenario. The higher employment levels are achieved by adjusting the annual net flow of immigrants. Figure 13.1 shows the ratio of pension expenditure to GDP to be essentially unchanged compared with the baseline scenario, apart from a slight improvement in the second part of the forecasting period. By contrast, the effects on the two factors into which the ratio is decomposed are significant, with major changes of opposite sign, as can be seen in Figures 13.3 and 13.4. In particular, the ratio of the number of pensions to the number of employed persons at the end of the forecasting period drops from 131% to 102%. This result is due to the larger increase in employment, the effect of which is only partly offset by the resulting increase in the number of pensions. Apart from being only partial, the offset is concentrated in the second part of the forecasting period owing to the lag between the time when immigrants enter the labour market and the time when they become entitled to a pension. On the other hand, the ratio of the
average pension to productivity at the end of the forecasting period rises from 10.8% to 13.8%. This result is due to the lower levels of productivity assumed in the macroeconomic scenario, offset only in part by the reduction in benefit amounts. Here again the fact that the offset is partial is due to the lag with which changes in the average size of new pensions, directly related to the changes in productivity, are reflected in the average size of the stock of pensions.

The third simulation was prompted by the fact that Italian female participation rates are lower than those of other European countries. Accordingly, there would appear, albeit with the caution required by the well-known lack of homogeneity of the data in such international comparisons, to be the conditions for female participation rates to increase more than they would endogenously according to the demographic and macroeconomic assumptions of the baseline scenario. In particular, it appeared plausible to postulate female participation rates some 10 percentage points higher from 2015 onwards. The adjustment is applied by generation starting from the age of 30 and gradually increasing from 2001 onwards. The results are shown in Figure 14. The ratio of pension expenditure to GDP is better over the whole forecasting period. The improvement is small towards the end of the period, but appreciable between 2005 and 2035, when it reaches around 0.5% of GDP. This is the combined result of an improvement in the ratio of the number of pensions to the number of employed persons (Figure 14.4) and a worsening of the ratio of the average pension to productivity in the last part of the forecasting period (Figure 14.3). The improvement is produced by the rise in female participation rates, while the worsening is due to the higher rates of growth in GDP, which lead to contributions being capitalized at higher rates under the contributions-based system.

Figure 15 shows the effects of a larger reduction in the unemployment rate than that of 3 percentage points (from 12% in 1996 to 9% in 2025) produced endogenously as a result of the changes in the population, by sex and age, and in the participation rates assumed in the baseline scenario. Specifically, it was assumed that the unemployment rates would gradually fall from 2001 onwards so as to produce an overall unemployment rate of around 6% from 2015 onwards. The adjustment was made separately by age and sex and was proportional to the unemployment rate. The results are qualitatively similar to those of the preceding exercise. It is worth noting that the improvement in the ratio of pension expenditure to GDP diminishes towards the end of the forecasting period (Figure 15.1) and that the increase in the rate of growth of GDP comes to an end in 2015, the year in which the adjustment of the unemployment rates is completed (Figure 15.2). In this case the reduction in the improvement in the ratio of expenditure to GDP is not due

45 It is worth noting that the countries with higher female participation rates are generally those where working hours are most flexible and the most recourse is made to part-time work.
to an increase in the number of pensions but, and only in part, to an increase in contribution periods and hence in the average pension.

As was noted earlier, average labour productivity is one of the scenario variables subject to the greatest discretion and at the same time one of the most influential. It is sufficient to recall that, with all the other variables unchanged, the rate of increase in productivity is reflected directly in the rate of growth in GDP and hence in the rate of return the pension system can sustain. Furthermore, in a legal framework in which pensions are not indexed in real terms, the assumption made concerning the rate of increase in productivity has a powerful effect on the ratio of pension expenditure to GDP (see §.3). This explains the desirability of quantifying the impact of a change in the rate of increase in average labour productivity with respect to the evolution assumed in the baseline scenario. Figure 16.1 shows that an increase (decrease) of 0.5 percentage points in the annual rate of increase in productivity results in a decrease (increase) in pension expenditure of around 1% of GDP. Naturally, the effect is entirely due to the change in the ratio of the average pension to productivity (Figure 16.3). It is important to note that the effect becomes less pronounced towards the end of the forecasting period as the earnings-related regime is replaced by the contributions-based regime, which offers a rate of return in line with the rate of growth in GDP.

The last simulation is designed to evaluate the importance of the assumptions concerning the rate of increase in productivity embodied in the baseline scenario compared with the assumption of a constant rate of increase. Specifically, the simulation assumes a constant annual rate of increase of 2.2%, which corresponds to the average of the rates assumed in the baseline scenario. The effect on the ratio of pension expenditure to GDP is reported in Figure 17.1, which shows a significant improvement in the first 30 years, followed by a deterioration in the last 15 years. Here again the effect is entirely due to the change in the ratio of the average pension to productivity (Figure 17.3). The lower level of this ratio in the first part of the forecasting period is due to the fact that the higher levels of productivity do not affect pension expenditure, since pensions are indexed only to prices. Only the pensions awarded each year (around 4% of the stock) are affected proportionally by the higher levels of GDP. The situation is reversed in the last part of the forecasting period, when the rate of increase in productivity assumed in the baseline scenario is higher than the average rate. In this period, however, the shift to a contributions-based regime results in the higher rates of GDP growth recorded in the first 30 years of the forecasting period being "capitalized" into larger pensions.

Two aspects of the simulations carried out appear of particular importance. In the first place, the financial sustainability of the pension system improves with higher rates of GDP growth

---

46 The reduction in the unemployment rate mainly concerns workers for whom contributions are
and vice versa. This relationship is especially pronounced in the first three quarters of the forecasting period, when all or most pensions are calculated on the basis of earnings-related method. It subsequently weakens with the shift to the contributions-based method of calculation, which uses the rate of growth in GDP to capitalize contributions.

In the second place, the forecasting scenarios compatible with a given rate of GDP growth do not produce significantly different effects on the financial equilibria of the pension system. In particular, with the same evolution of GDP growth, assuming different combinations of productivity growth, participation rates, unemployment rates and net immigration, etc. does not significantly alter the evolution of the ratio of pension expenditure to GDP. On the other hand, the choice of one combination or another significantly affects the components of the ratio and has redistributive effects that are extremely important for the social and political sustainability of the system.

imputed, so that they would in any case have become entitled to a pension.
Figure 12: Different hypotheses for immigration

**Figure 12.1: Ratio of expenditure to GDP**

**Figure 12.2: Rate of real GDP growth**

**Figure 12.3: Ratio of average pension to productivity**

**Figure 12.4: Ratio of pensions to employed persons**

---

Baseline scenario

Baseline scenario with an additional annual net inflow of 100,000 immigrants
Figure 13: Different hypotheses for immigration and average labour productivity

Figure 13.1: Ratio of expenditure to GDP

Figure 13.2: Rate of real GDP growth

Figure 13.3: Ratio of average pension to productivity

Figure 13.4: Ratio of pensions to employed persons

Baseline scenario

Baseline scenario with productivity gains of 1.5% and immigration that does not affect GDP growth
Figure 14: Different hypotheses for female participation rates

Figure 14.1: Ratio of expenditure to GDP

Figure 14.2: Rate of real GDP growth

Figure 14.3: Ratio of average pension to productivity

Figure 14.4: Ratio of pensions to employed persons

- Baseline scenario
- Baseline scenario with an increase of 10 percentage points in female participation rates
Figure 15: Different hypotheses for the unemployment rate

Figure 15.1: Ratio of expenditure to GDP

Figure 15.2: Rate of real GDP growth

Figure 15.3: Ratio of average pension to productivity

Figure 15.4: Ratio of pensions to employed persons

Baseline scenario

Baseline scenario with an unemployment rate of 6%
Figure 16: Different hypotheses for average labour productivity

Figure 16.1: Ratio of expenditure to GDP

Figure 16.2: Rate of real GDP growth

Figure 16.3: Ratio of average pension to productivity

Figure 16.4: Ratio of pensions to employed persons

Baseline scenario  Baseline scenario with productivity decreased by 0.5%  Baseline scenario with productivity increased by 0.5%
Figure 17: Different hypotheses for average labour productivity

Figure 17.1: Ratio of expenditure to GDP

Figure 17.2: Rate of real GDP growth

Figure 17.3: Ratio of average pension to productivity

Figure 17.4: Ratio of pensions to persons in employment

- Baseline scenario
- Baseline scenario with productivity gains of 2.2%
Appendix: the specification of the model

The purpose of the model is to forecast public pension expenditure \((S)^{47}\) as a ratio to gross domestic product. For the sake of simplicity, the parts concerning pension expenditure and GDP will be treated separately.

At time \(t+1^{48}\), pension expenditure can be expressed as follows:

\[
S_{t+1, \theta \leq t+1} = \sum_{f} \left( S_{t+1, \theta \leq t+1, f, d, s} + S_{t+1, \theta \leq t+1, f, r, s} \right)
\]

where \(f\) denotes the pension fund,\(^{49}\) \(d\) direct pensions\(^{50}\), \(r\) indirect pensions,\(^{51}\) \(s\) the sex and \(\theta\) the time the pension is awarded.

Direct pension expenditure, divided by fund and sex, can be determined as the product of the number of pensioners and the corresponding average pension:\(^{52}\)

\[
S_{t+1, \theta \leq t+1, f, d, s} = \left( p_{t+1, \theta \leq t+1, f, d, s} \right)^T \times \text{diag} \left( b_{t+1, s} \right) \times m_{t+1, \theta \leq t+1, f, d, s}
\]

where \(b_{t+1, s}\) and \(m_{t+1, \theta \leq t+1, f, d, s}\) are vectors of order \(n\), whose typical elements \(b_{t+1, i, s}\) and \(m_{t+1, i, \theta \leq t+1, f, d, s}\) are, respectively, the resident population and the average pension corresponding to the \(i\)th age, while \(p_{t+1, \theta \leq t+1, f, d, s}\) is a vector whose \(i\)th component indicates the percentage share

\(^{47}\) Public pension expenditure means the amounts paid by the funds belonging to the General Compulsory Insurance (Assicurazione Generale Obbligatoria; AGO). See Ministero del Lavoro e della Previdenza Sociale-NVSP (1998), vol. II.

\(^{48}\) “At time \(t\)” is taken to mean 31 December of year \(t\). Accordingly, \(t/t+1\) means the interval of time between 31 December of year \(t\) and 31 December of year \(t+1\).

\(^{49}\) For forecasting purposes pension funds are grouped into three large segments on the basis of the homogeneity of the relevant legislation and the nature of the employment. These segments comprise, respectively, private-sector employees, public-sector employees and the self-employed. The rules applied to the whole of each segment are those of the most representative fund (see §. 4).

\(^{50}\) Direct pensions comprise old-age pensions and disability pensions. The former, in turn, comprise narrowly-defined old-age pensions (paid after retirement age has been reached) and long-service pensions (early retirement), while the latter comprise narrowly-defined disability pensions and disability allowances. Since, excluding supplementary pensions, the number of direct pensions coincides with the number of pensioners, the terms “pensions” and “pensioners” will be used synonymously.

\(^{51}\) Indirect pensions comprise the survivors’ pensions paid to the survivors of insureds and those paid to the survivors of pensioners.
of pensioners in the total resident population of the same age and sex.\footnote{53} The typical element \( p_{t+1, s, i, f, d, s} \) can be interpreted as the probability of a person, of \( i \)th age and sex \( s \), receiving a direct pension from fund \( f \) at time \( t+1 \); accordingly, \( p_{t+1, s, i, f, d, s} \) can also be defined as follows:

\[
p_{t+1, s, i, f, d, s} = \text{diag}\left( z_{t+1, f, d, s} \right) \times \mathbf{y}_{t+1, f, s} \tag{3}
\]

where \( \mathbf{y}_{t+1, f, s} \) and \( z_{t+1, f, d, s} \) are vectors of order \( n \) whose \( i \)th components \( y_{t+1, f, s}^i \) and \( z_{t+1, f, d, s}^i \) are, respectively, the probability of a person of sex \( s \) and \( i \)th age being “attributed”\footnote{54} to fund \( f \) in year \( t+1 \) and the probability of a person, of \( i \)th age and sex \( s \), already attributed to fund \( f \), receiving a direct pension at time \( t+1 \).

The first vector is determined on the basis of the following equation

\[
\mathbf{y}_{t+1, f, s} = \text{diag}\left( \mathbf{y}_{t+1, f, s} \right) \times \left( 1 - \mathbf{\delta}_{t+1, s} - \mathbf{\bar{a}}_{t+1, s} \right) \tag{4}
\]

where: \( \mathbf{I} \) is the unit vector; \( \mathbf{\delta}_{t+1, s} \) is the vector, by age, of school attendance rates; \( \mathbf{\bar{a}}_{t+1, s} \) a vector whose typical element \( \bar{a}_{t+1, s}^i \) indicates, for the \( i \)th age, the percentage of the “not attributed” population that isn’t enrolled on a regular course of studies (“residual population”; see §.3); \( \mathbf{\tilde{y}}_{t+1, f, s} \) a vector whose \( i \)th component \( \tilde{y}_{t+1, f, s}^i \) indicates the probability of a person, of sex \( s \) and \( i \)th age, already attributed to the pension system, belonging to fund \( f \).\footnote{55} Obviously:

\[\text{M} = \text{diag}\left( \mathbf{y} \right) \]

is a diagonal matrix of order \( n \) that satisfies the relationship: \( m^i, i = y^i \forall i \in \{1, 2, \ldots, n\} \).

Naturally, the elements of these vectors corresponding to the ages in which receipt of a direct pension is impossible or highly improbable are equal to zero.

Persons not enrolled on a regular course of studies are considered to be attributed to a fund where they have obtained or are in a position to obtain a direct (old-age, long-service or disability) pension from the fund. It should be noted that the reference to time reveals the change in the relative importance of each fund in the forecasting period (see §.4).

As regards the evolution of the school attendance rates for compulsory schooling and upper secondary level schooling, see Ministero del Tesoro-RGS (1996b). For university and post-university education, the continuation rates estimated for 1991 were applied to the cohorts of students with an upper secondary level school diploma. For the evolution of the variable \( \bar{a}_{t+1, s} \), see footnote 67. The share of the population attributed to each segment was calculated by assuming that, from the age of 30 onwards, it remains constant across generations (see §. 4). Finally, it was assumed that the beneficiaries of old-age allowances (social pensions until Law 335/1995) are a constant proportion of the “residual population” across generations. For the future...
The dynamics of the individual components of vector $z_{t+1,f,s}$ are described by the following system of equations:

$$
\begin{align*}
\gamma'_{t+1,f,s} + \delta'_{t+1,s} + \overline{\gamma}'_{t+1,s} &= 1 \\
\gamma'_{t+1,f,s} &= 1.
\end{align*}
$$

[5.]

The rate is defined as follows:

$$
\begin{align*}
\frac{z^i_{t+1,f,s}}{h^i_{t+1,l<0\%+1,f,d,s}} &= z^i_{t+1,f,s} + (1 - z^i_{t+1,f,s}) h^i_{t+1,l<0\%+1,f,d,s} \quad \forall k \in \{2, \ldots, n\}
\end{align*}
$$

[6.]

where $h^i_{t+1,l<0\%+1,f,d,s}$ is the retirement rate, i.e. the probability of a person belonging to a given generation, of sex $s$, already attributed to the fund and not yet retired, retiring at the $i$th age. The rate is defined as follows:

$$
\begin{align*}
\frac{\rho^i_{t+1,l<0\%+1,f,d,s}}{n} &= \frac{p^i_{t+1,l<0\%+1,f,d,s}}{j=i} \frac{p^i_{t+1+j-i,l<0\%+1,j-i,f,d,s}}{j=i}.
\end{align*}
$$

[7.]

where the numerator of the ratio is the percentage of the members of the fund of a given generation who retire at the $i$th age in year $t/t+1$, while the denominator is the percentage of the same persons who have not retired at time $t+1$. The pensions awarded during the year, which are present in [7.], are calculated dynamically for each segment, age and sex on the basis of the flows of retirements obtained, by age, sex and contribution record, using the multistate models developed by the RGS for the main pension funds. These models use forecasting techniques based on a finite, discrete and non-homogeneous Markov-type random process. The process is finite because the number of possible positions is bounded; it is discrete since it is assumed that state changes occur at intervals of one year; and it is non-homogeneous because the probability of transiting from one state to another is generally a function of time.

The Markov process concerns the following states: sex, age, the pension regime (earnings-based, contributions-based or mixed), the insurance position, (contributor, dormant member, pensioner-contributor, pensioner), the contribution record for the first three of the foregoing insurance positions (annual classes from 0 to 40) and the type of pension (invalidity or generations of 65-year olds, the proportion was put equal to the average value observed in the 65-70 age bracket in 1996.

56 The earnings-based regime applies to fund members with at least 18 years of contributions at 31 December 1995, the contributions-based regime to persons who became members for the first time after 31 December 1995 and the mixed regime (a pro rata combination of the contributions-and earnings-based regimes) to members with a contribution period of less than 18 years at 31 December 1995.

57 The dormant members of a fund are those who do not pay contributions in the reference year but who have made payments in the past.
old-age) for the insurance position of pensioner. The differentiation of members by pension regime is extremely important because it identifies different rules for the calculation of new pensions.

Using \( \mathbf{u}^R \) to denote the vector of the probability distribution by insurance status and contribution period of the members of the fund belonging to pension regime \( R \), the multistate model can be expressed as follows:

\[
\mathbf{u}^R_{t+1, f, d, s, e} = \left( \mathbf{T}^R_{t+1, f, d, s, e-1} \times \mathbf{u}^R_{t, f, d, s, e} \right)_{e \leq e^\text{max}} \]

\[
\mathbf{u}^R_{t+1, f, d, s, e} = \sum_{e=0}^{e^\text{min}} \left( \mathbf{T}^R_{t+1, f, d, s, e} \times \mathbf{u}^R_{t, f, d, s, e} \right)_{e \leq e^\text{max}}
\]

where \( \mathbf{T}^R_{t+1, f, d, s, e-1} \) is the matrix of the transition probabilities of the Markov process. These probabilities are made to evolve dynamically in relation to the raising of the average retirement age provided for by the law in force for each of the three regimes.

The vector of the average amounts of the stock of pensions being paid at time \( t+1 \) can be defined as the weighted average of the vector of the average amounts of the stock at time \( t \),

\[
\mathbf{u}^R_{t+1, f, d, s, e} = \left( \mathbf{c}, \mathbf{e}, \mathbf{p}^I, \mathbf{p}^V \right)_{t+1, f, d, s, e}
\]

where \( \mathbf{c}, \mathbf{e}, \mathbf{q} \) are \( k \)-dimensional row vectors containing the percentages, by contribution period, of the contributors, dormant members and pensioner-contributors of the fund in relation to the total membership; \( p^I \) and \( p^V \) contain, instead, the percentages for the disability pensioners (\( I \)) and old-age pensioners (\( V \)). Naturally, \( \sum_{i=1}^{3k+2} u^i = 1 \).

The matrix \( \mathbf{T}^R_{t+1, f, d, s, e-1} \) can be decomposed into 25 submatrices: those on the diagonal contain the probabilities of transition between different contribution periods within the same insurance status (for contributors, dormant members and pensioner-contributors) and the probabilities of remaining in the same state (for disability and old-age pensioners); instead, the submatrices with different indices are the probabilities of transition between different insurance states. Accordingly:

\[
\mathbf{T}^R_{t+1, f, d, s, e-1} = \begin{bmatrix}
\mathbf{T}^{CC} & \mathbf{T}^{CC} & \mathbf{T}^{CQ} & \mathbf{T}^{CI} & \mathbf{T}^{CV} \\
\mathbf{T}^{CC} & \mathbf{T}^{CC} & \mathbf{T}^{QO} & \mathbf{T}^{CI} & \mathbf{T}^{CV} \\
\mathbf{T}^{QC} & \mathbf{T}^{QC} & \mathbf{T}^{QO} & \mathbf{T}^{QI} & \mathbf{T}^{QV} \\
\mathbf{T}^{IC} & \mathbf{T}^{IC} & \mathbf{T}^{IO} & \mathbf{T}^{II} & \mathbf{T}^{IV} \\
\mathbf{T}^{VC} & \mathbf{T}^{VC} & \mathbf{T}^{VO} & \mathbf{T}^{VI} & \mathbf{T}^{VV} \\
\end{bmatrix}^{R}
\]

If \( \tau^{ij} \) is the typical element of \( \mathbf{T}^I \), \( \tau^{ij} = I \quad \forall j = 1, \ldots, 3k+2 \).
updated to time $t+1$, and the vector of the average amounts at time $t+1$ of the pensions awarded in year $t/t+1$ and outstanding at the same date. Accordingly:

$$ m_{t+1,0\le t+1,f,d,s} = G_{t+1,f,d,s} \times A \times (1 + \eta_{t+1,\omega_{t+1}}) m_{t,0\le t,f,d,s} + \left(I - G_{t+1,f,d,s}\right) \times m_{t+1,0\le t+1,f,d,s} $$

where $\sigma_{t+1}$ and $\omega_{t+1}$ are, respectively, the rate of change in prices and the rate of change in real earnings in year $t/t+1$, $\eta_{t+1,\sigma_{t+1}}$ and $\eta_{t+1,\omega_{t+1}}$ are the elasticities of the average pensions corresponding to these rates, $A$ is a permutation matrix used to shift the elements of the vector by which it is multiplied by one position and $G_{t+1,f,d,s}$ is a diagonal matrix of order $n$ defined as follows:

$$ G_{t+1,f,d,s} = \text{diag}\left\{ p_{1,t+1,0\le t+1,f,d,s}, p_{2,t+1,0\le t+1,f,d,s}, \ldots, p_{n,t+1,0\le t+1,f,d,s} \right\}. $$

The typical element of this matrix is, for the $i$th age, the ratio of the number of pensioners at time $t$ still alive at time $t+1$ to the number of pensioners at time $t+1$. It is easy to verify that the matrix $I - G_{t+1,f,d,s}$, complementary to the matrix $G_{t+1,f,d,s}$, is, for the $i$th age, the ratio of the number of pensions awarded in year $t/t+1$ still being paid at time $t+1$ to the number of pensions being paid at that date. The elements of this matrix are obtained from equations [6], [7] and [8].

The vector by age of the average amounts of pensions awarded in year $t/t+1$ can be expressed as:

$$ m_{t+1,1\le t+1,f,d,s} = \text{diag}\left\{ k_{t+1,f,d,s} \right\} \times w_{t,f,s} $$

---

60 "Updating" means the indexation of the average amounts of the pensions outstanding at time $t+1$ according to the mechanisms provided for by law, i.e. with reference exclusively to prices.

61 The matrix $A$ has the following configuration:

$$ A = \begin{bmatrix} 1 & \cdots & 0 \\ 0 & \cdots & 1 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & 1 \end{bmatrix} $$

It is an identity matrix of order $(n-1)$ topped up by an $(n-1)$-dimensional vector of elements equal to zero and, subsequently, sided on the right by an $n$-dimensional vector of elements equal to zero.
where $k_{t+1,f,d,s}$ is a vector of order $n$ whose typical element $k_{t+1,f,d,i}$ is, for the $i$th age, the ratio of the average amount of the pension awarded to the average value of the last earnings received before retirement (the average replacement ratio),\(^\text{62}\) while $w_{t,f,s}$ is the vector by age of the above-mentioned average earnings.

In addition to new rules for calculating pensions, the recent reform measures (Laws 503/1992 and 335/1995) provide for a long transitional period of 35-40 years, during which the old and the new rules will coexist on a pro rata basis, whereby the rules will be applied according to the contribution period respectively before and after the adoption of the reform measures. In particular, three separate contribution intervals are identified: up to 1992,\(^\text{63}\) from 1993 to 1995, and after 1995. The formulae for the average replacement ratio for the three pension regimes previously identified are set out below, with the proration in the transitional phase taken into account.

For persons subject exclusively to the earnings-based regime (members with a contribution record of at least 18 years at 31 December 1995), the average replacement ratio is given by:

\[
\begin{align*}
  k_{t+1,f,d,s}^i &= \frac{1}{5} \left[ 1 + \prod_{j=1}^{4} \frac{1}{1 + \omega_{t,j,f}^i} \left(1 + \frac{1 + \sigma_{t-j}}{1 + \rho_{t-j,f,s}^i} \right) \right] \\
  \quad \text{where: } \lambda_{f,d} \text{ is the proportional coefficient, i.e. the ratio of the pension to pensionable earnings for each year of contributions (generally equal to 2%);} \quad \alpha_{t,f,d,s}^i \text{ is the contribution period at 31 December of year } t; \quad \sigma_t \text{ is the rate of change in average earnings imputable to promotions; } x \text{ is the number of years of contributions.}
\end{align*}
\]

\(^\text{62}\) Pensions awarded in $t/t+1$ are considered to be paid on 1 January of year $t+1$ so that the last earnings received before retirement are those of year $t$ and analogously for the last contributions accrued.

\(^\text{63}\) The proportional coefficient and the reference period for the calculation of pensions do not change over time for contributions accrued up to 1992.

\(^\text{64}\) For the $i$th age, the average contribution period at retirement is obtained as the arithmetic mean of the contribution periods of new direct pensions weighted with the corresponding frequencies.
of reference years for the calculation of pensionable earnings. The latter increases gradually over time, up to a maximum of 10 years for employees and 15 years for the self-employed.

For persons subject exclusively to the contributions-based regime (i.e. those who became members after 1995), the average replacement ratio is given by:

$$ k^{i}_{t+1,f,d,s} = \frac{v^{i}_{t+1,f,d}}{\text{conversion coefficient}} \left[ \varepsilon_{t,f,d} + \alpha^{j-1}_d \sum_{k=1}^{t} \left( 1 + g^{j}_{t-j} \right) \left( 1 + \rho^{j}_{t-j,f,s} \right) \right] $$

where

- $v^i$ is the conversion coefficient of the accrued contributions,
- $g$ is the 5-year moving average of nominal GDP and $\varepsilon$ is the computation rate.

Lastly, for persons subject to the mixed regime (those with a contribution period of between 0 and 18 years at 31 December 1995), the average replacement ratio is given by:

$$ k^{i}_{t+1,f,d,s} = k^{i}_{t+1,f,d} \left[ \frac{\alpha^{j}_{95-92,f,d,s}}{\text{contribution period up to 1992}} \left[ 1 + 4 \sum_{k=1}^{t} \left( 1 + g^{j}_{t-j} \right) \left( 1 + \rho^{j}_{t-j,f,s} \right) \right] + \text{share of pension for contribution periods up to 1992} \right] $$

$$ + \lambda^{j}_{f,d} \left[ \frac{\alpha^{j}_{95-92,f,d,s}}{\text{contribution period between 1993 and 1995}} \left[ 1 + \frac{1}{x^{t+1}} \sum_{k=1}^{t} \left( 1 + g^{j}_{t-j} \right) \left( 1 + \rho^{j}_{t-j,f,s} \right) \right] + \text{share of pension for contribution periods between 1993 and 1995} \right] $$

$$ + v^{i}_{t+1,f,d} \left[ \varepsilon_{t+1,f,d} + \alpha^{j-1}_d \sum_{k=1}^{t} \left( 1 + g^{j}_{t-j} \right) \left( 1 + \rho^{j}_{t-j,f,s} \right) \right] + \text{share of pension for contribution periods after 1995} $$

where $x_{t+1}$ is the reference period for the calculation of the average pensionable earnings to be applied to the contribution period between 1993 and 1995. It should be noted that this period grows gradually over time, at a faster rate than that envisaged for persons subject exclusively to the earnings-based regime, until it covers the entire working life. Although not shown in the equation, the calculation made by the model also takes account of the effects of the “Giugni” decree (Legislative Decree 373/1993); this provides for the exclusion from the calculation of earnings that, after revaluation, are 20% lower than the average pensionable earnings, up to 25% of the total.

In the same way as for direct pensions in [2.], indirect pension expenditure can be determined as follows:
where the evolution of the stock of indirect pensions is given by:\(^{65}\)

\[
S_{t+1,0\leq t+1, f,s} = \left( p_{t+1,0\leq t+1, f,s} \right)^T \times \text{diag} \left( b_{t+1,s} \right) \times m_{t+1,0\leq t+1, f,s}
\]

Since the method of calculation adopted is partly the same as that for direct pensions, in what follows the description is limited to the aspects that are different, which consist basically in the calculation of the number and average amount of new pensions. These are divided into those paid to the survivors of pensioners \( p_{t+1,f\leq t+1, f,s} \) and those paid to the survivors of insureds \( p_{t+1,f\leq t+1, f,s} \). The former are determined as follows:

\[
p_{t+1,f\leq t+1, f,s} = A \times p_{t+1,f\leq t+1, f,s} + p_{t+1,f\leq t+1, f,s} 
\]

where:

\[\varphi_{t,s}^{i} \text{ is a vector whose typical element, } \varphi_{t,s}^{i}, \text{ is, for the } i\text{th age, the probability of elimination by death of the potential survivor in year } t/t+1; \varphi_{t,s}^{i} \text{ is the opposite sex to } s; \varphi_{t,s}^{i} \text{ is a vector whose typical element } \chi_{t,s}^{i} \text{ is the probability of a person of } i\text{th age who died in year } t/t+1 \text{ leaving a survivor (probability of leaving a family); } \varphi_{t+1,s}^{i} \text{ is a permutation matrix introduced in order to determine the age of indirect pension beneficiaries in relation to the age of the dante causa.}^{66}\]

\[\Psi_{t+1,s}^{i} = \begin{bmatrix}
0 & 0 & 1 & 0 & \cdots & 0 \\
0 & 0 & 1 & 0 & \cdots & 0 \\
\vdots & \vdots & \vdots & \vdots & & \vdots \\
\vdots & \vdots & \vdots & \vdots & 0 & 1 \\
\vdots & \vdots & \vdots & \vdots & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0
\end{bmatrix}
\]

As for direct pensions, the stock of indirect pensions is the percentage ratio, by age, of the number of pensioners to the total resident population of the same age and sex.

The age of the dante causa and that of the survivor are assumed to differ by \( \pm j \text{ years. If, in accordance with the introductory report to the law reforming the pension system (Law 335/1995), a differential of 3 years in favour of men is assumed, the permutation matrix has the following form:}^{66}\]
The pensions awarded to the survivors of insureds in year \( t/t+1 \) are determined as follows:

\[
p_{t+1, j < \sigma_{t+1, j, s}}^{ras} = \frac{\text{diag} \left[ b_{j, t, s} \right]}{(m \times n)} \times \varphi_{j, t, s} \times \text{diag} \left[ \psi_{j, t, s} \right] \times \text{diag} \left[ \chi_{j, t, s} \right] \times \text{diag} \left[ \xi_{j, t, s} \right] \times \frac{1}{1 - \text{diag} \left[ z_{j, f, t, s} \right]} \times \text{diag} \left[ \gamma_{j, t, s} \right] \times b_{j, t, s}
\]

[18.]

where \( \xi_{j, t, s} \) is a vector whose \( i \)th component is the probability of a person insured with fund \( f \), of sex \( s \), meeting, at the time of death, the minimum contribution requirement for a survivor’s pension.

The average amounts of survivors’ pensions awarded in year \( t/t+1 \), are obtained by multiplying the vector of the average pensions received by the \( \textit{dante causa} \) by the revertibility coefficient in force in that year, while the average pensions awarded to survivors of insureds are determined in the same way as shown above for direct pensions; the only difference is that the above amounts are multiplied by the revertibility ratio.

GDP in year \( t/t+1 \), denoted by \( \text{GDP}_{t+1} \), is given by the following equation:

\[
\text{GDP}_{t+1} = \mu_{t+1} \sigma_{t+1}^{GDP} \left( I - \overline{o}_{t+1} \right)^T \times \text{diag} \left[ a_{t+1, s} \right] \times b_{t+1}
\]

[19.]

where \( \mu_{t+1} \) is average per person employed labour productivity (in real terms), \( \sigma_{t+1}^{GDP} \) the implicit GDP deflator, with reference in both cases to year \( t/t+1 \) and \( \overline{o}_{t+1} \) is the unemployment rate for the \( i \)th age.

The determination of the vector of participation rates introduced earlier is partly endogenous to the model since it is affected by the assumptions concerning the probability of retirement. In practice, the participation rate for the population of sex \( s \) and \( i \)th age can be defined as follows:

\[
a_{t+1, s} = 1 - \sum_{f} p_{t+1, f, d, s}^{i} - \overline{a}_{t+1, s}^{i} - \delta_{t+1, s}^{i} - \beta_{t+1, s}^{i}
\]

[20.]

where, for sex \( s \) and the \( i \)th age, \( \overline{a}_{t+1, s}^{i} \) is the share of the “residual population”\(^{67} \) and \( \beta_{t+1, s}^{i} \) the share of the attributed population that has not retired and is not part of the labour force (the dormant population) (see §.2.3).

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\(^{67}\) Analytically, the share of the “residual population” is calculated on the basis of the following equation:
The pension expenditure determined using the equations described above is of a “no-change” nature since it is obtained by multiplying the stock of pensions existing at 31 December by the corresponding amounts on an annual basis (the monthly amount for thirteen months). GDP, instead, is the amount of resources the country produces during the year and, accordingly, should be compared with the annual pension expenditure (the sum of the payments made during the year). This differs from the no-change expenditure because of the turnover among pensioners and the changes in the average amounts of pensions during the year. If the percentage difference between the two aggregates is assumed to be stable, which appears plausible in the medium and long run, the dynamics of annual expenditure can be approximated by that of no-change expenditure, which permits the following equivalence to be established:

\[
\frac{S_t}{GDP_t} = \frac{S_{t_0}}{GDP_{t_0}} \frac{I^{S}_{t_0/\tau}}{I^{GDP}_{t_0/\tau}} = \frac{S_{t_0}}{GDP_{t_0}} \frac{I^{S}_{t_0/\tau}}{I^{GDP}_{t_0/\tau}}
\]  \[21.\]

where \(\tau\) is the interval \(t/t+1\), \(\tau_0\) a typical interval \(t_0/t_0+1\); \(I^{S}_{t_0/\tau}\) and \(I^{GDP}_{t_0/\tau}\) are the variation factors of the variable indicated in superscript in the interval of time indicated in subscript.

\[
\bar{a}_{t,i} - \Delta \delta_{t+1,i} \quad \text{if } \bar{a}_{t,i} - \Delta \delta_{t+1,i} \geq \hat{a}^i \forall i < i^*\]

\[
\bar{a}_{t,i} - \Delta \delta^*_{t+1,i} \quad \text{if } \bar{a}_{t,i} - \Delta \delta^*_{t+1,i} \geq \hat{a}^i \forall i^* \leq i < i^{**}\]

\[
\bar{a}_{t,i} - \Delta \delta_{t+1,i} < \hat{a}^i \forall i < i^* \quad \text{and} \quad \bar{a}_{t,i} - \Delta \delta^*_{t+1,i} < \hat{a}^i \forall i^* \leq i < i^{**}\]

where: \(\Delta \delta_{t+1,i} = (\delta_{t+1,i} - \delta_{t,i})\) and \(\Delta \delta^*_{t+1,i} = (\delta^*_{t+1,i} - \delta^*_{t,i})\), while \(i^*\) and \(i^{**}\) are the elements of the vector corresponding, respectively, to the 25th and 30th year of age, while \(\hat{a}^i\) is the minimum value the above variable can have for both sexes. This has been put equal to the value of the variable \(\bar{a}_{t,i}^{**}\) for males in the 30-39 age bracket in 1994.
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