THE FORECASTING MODEL OF THE ITALIAN PENSION SYSTEM BUILT BY THE DEPARTMENT OF GENERAL ACCOUNTS: SOME METHODOLOGICAL ISSUES

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1 The forecasting activity of the Department of General Accounts

The pension reforms enacted in 1992, 1995 and 1997 involved extremely gradual solutions that were diversified according to the pension plan and members' age and contribution period. Consequently, the forecasting model must be able to consider both a forecasting period long enough to allow the structural effects of the reforms to be fully captured and a high level of disaggregation that allows the management of information needed to simulate accurately the main features of the legal-institutional framework outcomes from reforms approved.

Besides, in the last few years there has been growing interest on the part of scholars and policy makers at international level in the consequences of the ageing of the population for the financial equilibria of welfare systems. The major demographic changes under way will have very substantial structural effects. The alarm was sounded by the leading international economic organizations (the OECD, the IMF, the EMI and the European Commission), which pointed to the worrying prospects for the Pension Systems of most of the industrial countries. The projections

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produced in this context are highly dependent on demographic developments but based on an extremely simplified representation of the legal and institutional framework.

Both these needs made it necessary for the Department of General Accounts (DGA) of Italy to build a forecasting model extended to the whole public Pension System and able to take account of the effects of demographic shifts and changes in the main elements of the legal and institutional framework over the entire forecasting period that should have been not less than 50 years (Treasury - Department of General Accounts 1996, 1997 and 1998).

The last update of the model (Treasury - Department of General Accounts, 1999) mainly concerned the introduction of some important algorithms designed to improve the reproduction of features peculiar to the legal-institutional framework of the Italian Pension System. Compared with the earlier forecasts, the model incorporates the algorithms based on Markov processes. For the moment, this application is restricted, for the private sector, to the INPS Employees Pension Fund (FPLD) and the three pension funds for self-employed workers and, for the public sector, to the former social security institutions for local government and health service workers and to the systems for schools, government departments and universities. Taken together, these account for about 85% of the total expenditure of the entire compulsory Pension System and more than 90% of the number of pensions paid. The remaining part of the compulsory system is treated as a residual with a higher degree of aggregation. Specific models based on Markovian process are being prepared also for this residual component for inclusion in the next update.

The changes made allow much more detailed results to be obtained for almost the entire Pension System compared with earlier versions of the model. At the same time, the basic data have to be much more disaggregated than before. In particular, the level of disaggregation coincides both with the basic data of the model and with the results of the forecasts with the definition of the states involved in the Markov process. In addition, for most of the monetary variables (pensions, contributions and earnings), which are also distributed according to the structure of the states considered, the model dynamically constructs specific probability distributions that permit a more faithful reproduction of certain features of the Italian Pension System. The greater analytical detail allows the effects of hypothetical changes in the law to be quantified or quantified more accurately. The greatest improvements concern the handling of the eligibility requirements for retirement during the transition from the earning-based regime to the contribution-based regime.

The aim of this paper is to discuss some methodological aspects of the latest version of the model constructed by the DGA. Special attention is paid to the description of the forecast of the members and to how the interrelationship with demographic an macroeconomic scenarios is captured by the model.

2 The methodological approach

In projecting a forecasting pension model, the choice of method must be made on the basis of the ability to handle the information available efficiently[1]. In very general term there are two possible choices: the microsimulation model or the multistate model[2].

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1 The problem can be summarized as follows. Let $x_1, x_2, \ldots, x_n$ be the n variables that describe the attributes (ID, work-related, earnings-related and pension-related) of a member of the plan and let $k_1, k_2, \ldots, k_n$ be the states of the foregoing variables. We will thus have $\prod_{i=1}^{n} K_i$ different insurance positions (each of which identifies the possible combinations of the states of the n variables). Often, the value of k_i is very high (infinity under the hypothesis that the variable is continuous), so that it is not possible to treat such a large number of positions distinctly. From a methodological point of view, there are two possible solutions: either to eliminate the possible positions with a null frequency and repeat those with a frequency of more than one as many times as they occur or to renounce part of the information available according to its importance for forecasting purposes (*e.g.*. by reducing the number of variables, rendering discrete those that are continuous, and reducing the states of the discrete variables, etc.).

2 An application of the former methodological approach, better known as MAGIS, was made by INPS (Italian Social Security) in building the preceding version of the own forecasting model to project the balance of the main funds administered (See Inps 1989,1994). However the last version of the INPS's model adopts a multistate approach (see INPS, 1999).

The first one makes it possible to conserve all the information available for each observation unit, with obvious advantages in terms of flexibility in simulating the legal framework. However it has two drawbacks. In the first place, the processing time becomes prohibitively long for large plans, so that it is necessary to make projections on the basis of a sample, thus amplifying the forecasting errors when the results are related to the universe. The second problem concerns the random drawing of people who undergo the event from among those exposed to the risk. This method results in each probabilistic event simulated not having the same incidence with respect to the possible cases as assumed for the technical basis. Indeed, the divergence increases as the size of the set to which the probability is applied decreases. It follows that the greater information content of the individual method risks being lost as a result of an inefficient probabilistic treatment. Moreover, people affected by the simulated event, even if it is neutral with respect to people affected, do not reproduce, on average, the attributes of the set from which they come, especially if their number is small. Thus, for example, the average amount of the pensions of people who remain alive could be significantly different from that of the earlier set.

The second solution, a multistate model, requires the model to simulate the redistribution of the frequencies among the different positions in a given interval of time. As a rule, the adoption of this methodology renders the model quite treatable, with processing times that are fairly short and independent of the size of the population to which it is applied. However, the loss of information present in the initial data makes it difficult to simulate some legislative hypotheses and may seriously reduce the reliability of the forecast, especially for the continuous variables, such as pensions, earnings, etc. In fact, having to render the latter discrete involves the total loss of the information concerning the distribution by amount within classes; if the latter are not sufficiently small, this procedure may produce large errors.

In the light of the foregoing considerations, the DGA opted for the multistate model, even though it was aware of the resulting greater difficulty in reproducing the key elements of the legal/institutional framework. As mentioned earlier, the problem mainly concerns the forecast of the monetary variables (earnings, pension, etc.). In fact, the division into classes of such amounts causes the loss of important information if the classes are large. Vice-versa, if the classes are small, the number of positions could exceed the number of members, even for large plans.

In order to overcome this problem, the “discriminating” variables were divided into two groups. The first group contains the state variables, *i.e.* those that identify the distinct positions within the system. For each segment of the system (fund or specific group of workers) the model distinguishes: age, sex, contribution years, pension regime, insurance status and type of benefit[3].

As regards the monetary variables, each of the possible combinations of the states of the state variables is associated with the average value of the corresponding set of people. The combination of the frequency associated with each position and the corresponding average value of the monetary variables makes it possible to calculate correctly the values of expenditure or total earnings with the level of aggregation of the state variables. Obviously, this solution does not permit the conservation of any information about the distribution by amount of the monetary variables, which results in forecasting errors whenever the distribution affects the updating of the average value. It should be noted that many of the algorithms used to update the monetary variables involve, either because prescribed by law or because required by the forecasting technique, the application of a multiplier to the amounts for individual persons. Consequently, the updating of the average value coincides exactly with the average of the updated values. There are some cases, however, in which the information on the distribution influences the updating of the average value. In these cases it is not sufficient to know the average value of the monetary variables, even where they are distributed as a function of the state variables, but it is also necessary to know the distribution by amount within each state.

This difficulty was overcome by supplementing the mean value of the monetary variables with an index of variability (variance) and a distribution function with parameters defined in relation to the average and the variance. This made it necessary to select the most appropriate

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3 For definitions, see paragraph 3.

density function and to assume a path for the evolution of the variability index. As regards the former, the lognormal function was chosen, while for the latter, the variation coefficient (the ratio between the standard deviation and the mean) was assumed to be constant for the whole of the forecasting period. In particular, the new approach makes it possible to give adequate treatment to the mechanism for topping up earnings-based and mixed pensions to the minimum level, the indexation of pensions by size bracket, and the eligibility requirement for retirement in the earnings-based regime of a pension equal to at least 1.2 times the old-age allowance.

The adoption of this method requires that in every period each member of the set should belong to one and only one of the positions identified by the state variables. This clearly causes problems in the case of pensions paid to the survivors of pensioners (reversibility) and ensureds. In fact, people who receive such benefits may be members of the plan as contributors, dormant members or recipients of a direct pension. In the case of the largest plans, such as the Employee Pension Plan, this gives rise to considerable overlapping. The application of the multistate model would require additional state variables to be defined in order to differentiate positions according to the composition of the household and whether the individual members belong to the set of members. Such a combination would cause the number of positions to explode and render the model unworkable. In practice, for the purpose of determining pension expenditure it is usually of no importance whether a benefit is paid to the survivor of a member of the plan or to a non-member. Similarly, where the beneficiary is a member, his or her position within the plan (pensioner, contributor, etc.) is irrelevant. This made it possible to treat survivors' pensions separately[4].

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[4] In particular, the stock of indirect pensions is determined by summing up the stock of such pensions paid in the previous year to persons who are still alive in the current year and the new pensions that start in the current year. The latter in turn are determined by applying the probability of death and the probability of leaving a family to the stock of people receiving direct pensions and those who have matured the minimum requirement. Lastly, a permutation matrix is applied to the beneficiaries of indirect pensions in order to attribute an age to the survivor based on the age of the *dante causa* at the moment of death. The average indirect pension is calculated by applying the reversibility coefficient to the amounts that would have been payable to the beneficiary of the direct pension.

3 The forecast of members: legal-institutional consistency

In order for the forecast to be consistent with the Italian legal-institutional framework, as it has been reformed in the last few years, the DGA's model is able to handle the information available at the high level of disaggregation. At the first step members have been distinguished among pensioners, contributors, dormants and pensioner-contributors. Members are pensioners if they receive a direct benefit from the plan and are not simultaneously contributors, *i.e.* they do not pay any contribution in the reference year. They are contributors or dormant members depending on whether they pay contribution during the year or not. They are pensioner-contributors if they receive a direct annuity paid by the plan and simultaneously contribute to the plan.

Members also differ in terms of their sex, age, category of pension (old age, early retirement, disability) and contribution period[5]. Sex and age combine with each of the four states just mentioned, the category of pension with the states of pensioner and pensioner-contributor, and contribution period with the states of contributor, dormant member and pensioner-contributor. All the possible combinations of the variables listed above are kept distinct for the different regime provided for people with a contribution period at the end of 1995 greater or equal to 18 years, between 0 and 18 years , and equal to 0 years. This distinction was made necessary by the reform measures that provide for different treatments depending on the contribution period matured at that date[6].

At any time it is possible to identify plan members in terms of their belonging to one of the possible combinations of the state variables. The history of each member can be expressed as a sequence of positions.

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5 For age and contribution period, the aggregation is in annual classes, which corresponds to the maximum level of detail with which the raw data is available.

6 According to the Dini reform approved in 1995 the new contribution-based method will be entirely applied to new entrants after 1995. For workers ensured at the cut-off date two different regimes will take place: earning-related regime and mixed regime. The former is applied to workers with at least 18 years of contribution at the end of 1995; the second one to the remaining workers.

The sequence starts with the person joining the plan, *i.e.* with the payment of the first contribution; it ends with the death of the member. In the normally long interval between these two events, the person will transit from one state to another.

The sequence of the insurance and/or pension positions taken on within the system can be interpreted as the specification of a finite, discrete and non-homogeneous Markov random process. It 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 fundamental characteristic of a Markov random process is that the probability of transiting from one state to another depends exclusively on the origin state and not on the path followed. This limitation is acceptable if the set of states is defined appropriately[7]. Where this is the case, the specification of the origin state contains the information needed for the correct application of the probabilities of transiting to other states.

Very generally, the forecast of members is calculated using the following equation (henceforth "legal institutional component" of the model)[8]:

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7 It is always possible to increase the number of states in order to take account of the specificity of some types of path. Obviously, increasing the number of states increases the data and the calculations required for the working of the model.

8 Denoting the number of ages by n, the number of contribution periods by k, and the number of categories of direct pension by z, for each fund the line vector of members will have $6n(3k+z)$ elements and, consequently, the transition matrix will be a square $(18nk+6nz)$ order matrix. Since the sex and contribution period at the end of 1995 do not change over time, it was possible to decompose the vector of entrants into 6 line vectors with $n(3k+z)$ elements and the matrix of transition probabilities into 6 square $(3nk+nz)$ order matrices. Furthermore, since age increases from year to year with a probability of one, it was possible to divide the vector of members further into n vectors with $(3k+z)$ elements. Consequently, the order of the matrix of transition probabilities decreases to $(3k+z)$. These matrices, of course, are replicated for each age, sex and contribution period at the end of 1995. In order to simplify the presentation, the latter variable has been omitted.

$$\underbrace{\mathbf{m}_{t,s,x,f}}_{members} = \underbrace{\mathbf{m}_{t-1,s,x-1,f}}_{members} \underbrace{\varphi_{t-1,s,x-1}}_{\substack{probability\\ of\ surviving}} \times \underbrace{T_{t-1,s,x-1,f}}_{\substack{transition\\ matrix}} + \underbrace{\mathbf{e}_{t,s,x,f}}_{entrants} \qquad \forall s,f,\ 15 \le a \le \omega \qquad [1]$$

where, for each sex s, age x and fund f: $\mathbf{m}_{t,s,e}$ are the ensured distributed by different states at the end of the year t ("time t"), $\varphi_{t,s,e}$ is the surviving probability at time t, $\mathbf{e}_{t,s,e}$ indicates the entrants to the plan in the year $t-1/t$ (the line vector $\mathbf{e}_{t,s,e}$ contains non-null values only in the first few elements[9]) and $\mathbf{T}_{t,s,a}$ is the matrix of transition probabilities serving to calculate the changes in the states of members in the plan at time $t-1$ and still alive at time t[10].

The general element $t_{i,j}$ of the transition matrix represents the probability that a plan member belonging to state i at time $t-1$ will transit to state j at time t. The row headings (origin state) and the column headings (destination state) follow the same order as the column headings of the state vector, $\mathbf{m}_{t,s,e}$. A helpful way to represent the transition matrix is to decompose it into 25 submatrices according to the position into the insurance status (contributor, dormant, pensioner-contributor, disability pension and old age and early retirement pension taken together).

The submatrices of the principal diagonal (*i.e.* that for which the superscript indices are the same) represent, from top to bottom, the probabilities of transition between the different contribution periods within the contributor, dormant member and pensioner-contributor states and the probabilities of transition between the two categories of pension within the pensioner state. By contrast, the submatrices with different indices represent the probabilities of transition between the contributor,

9 Because of the "shadow" contribution (for military service, illness, child care and so on). Besides, the public sector's new entrants generally take with them some contribution matured in the private sector.

10 The entrants and exits owing to death refer to an interval of one year. It is possible to eliminate the dead before applying the transition probability matrix since they constitute a *cul de sac* state, *i.e.* a state that does not permit transition to other states.

dormant member, pensioner-contributor and pensioner[11]. Since at any time a member must be in one and only one of the possible states, the sum of probabilities of each row equals 1.

Because of the number and the kind of stratification factors considered and the way how monetary variables are treated, the legal institutional components of the model handle the whole information which is necessary to reproduce accurately the features peculiar to the Italian Pension System concerning the eligibility requirements, the calculation rules an the indexation scheme. Taken together, they are able to assure the consistency with the legal-institutional framework both in transition and in the fully phased in period.

Therefore, the financial equilibrium of a Pension System, especially when considered in the medium and long term, depends not only on legal-institutional factors but also on demographic and occupational developments, which “determine” the size of the pensioner population (correlated with the number of old people) and the employed population (correlated with the population of working age and the employment rates). The demographic conditions become of preponderant importance where major changes occur in the structure of the population, such as those foreseeable in the coming decades. It is therefore absolutely essential that a forecasting model should be able to capture the financial effects of such changes, especially when the model “covers” a large part of the resident population. In this respect, the legal institutional component of the model suffer from some shortcomings. In particular, the equation [1] does not allow the forecast to assure the consistency with the demographic and occupational hypotheses unless it is provided with an appropriate integration concerning the calculation of the entrants into the Pension System. The solution generally adopted, especially when the model refers to only a part of the whole Pension System, fails to reach this objective as the entrants are set exogenously without any linkage with the demographic and labour market trends[12]. The reason of

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[11] Obviously, a few submatrices are nil since the transition between the states involved is impossible.

[12] Often the entrants are set equal to the difference between the number of contributors assumed at time *t* on the basis of an assumed rate of change and the number of contributors at time *t-1* still (continues)

this shortcoming and the methodological solution adopted by the DGA's model will be illustrated in the next paragraph.

4 The forecast of members: demographic and occupational consistency

The demographic developments are specified on the basis of three assumptions: the mortality rate, the fertility rate and migratory flows. The legal-institutional component of the model is able to take the assumptions concerning mortality fully into account. Indeed, the distribution of the member population on the basis of the state variables makes it possible to use specific probabilities of death (*e.g.* for disabled people) if they are available. On the other hand, the model is not able to make assumptions concerning fertility or the balance of migratory flows into account. In particular, in the case of fertility, the limitation extends to people born in past years who have not yet entered the labour market (the young). Such a drawback is due entirely to the way in which entrants into the system are handled. In fact, apart from observation errors, the structure of the existing members is bound to be consistent with that of the resident population. For these people, consistency will also be guaranteed in the forecasting phase since the model is able to incorporate assumptions concerning mortality that are homogeneous with those made for the demographic projections.

If the entrants are determined mechanically on the basis of an exogenous rate of change in the number of contributors, the complete discretion with which this rate can be fixed excludes *a priori*, the possibility of incorporating demographic constraints, which allow much less room for manoeuvre for specifying the employment assumptions. In particular, these constraints allow assumptions to be made with regard to participation and employment rates but not to the absolute level of employment, which also depends on the magnitude of generations to which they apply. Another problem arises in connection with the

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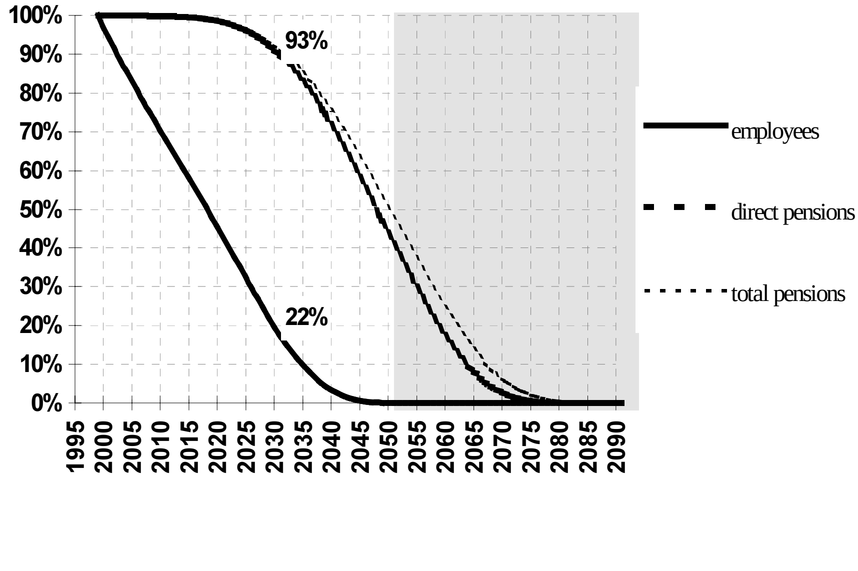
alive and not retired at time *t*. The distribution by age and sex is generally obtained using probabilities estimated on the basis of past experience.

distribution by age and sex of entrants into the Pension System, if they are obtained on the basis of exogenous probabilities that are completely unrelated to the distribution by age and sex of the generations of young people who are about to enter the labour market.

At this point it is necessary to assess the importance of the methodological limitations described above for medium and long-term forecasts. Since the inconsistency with the demographic and occupational developments can be attributed entirely to the size and distribution by age and sex of those entering pension plans, it appears worth dividing the forecasting results into two components: the first with reference to people who were already members in the first year of the forecast and the second with reference to people who will subsequently join the plans. This distinction can be made both for the number of pensioner (total pensions or only direct pensions) and for the employed. Figure 1 shows a completely different picture for the two variables.

Figure 1. Percentage of the number of pensions and employees accounted for by people ensured at the end of 1999



Whereas people who were members at the end of 1999 account for nearly all the number of pensions until 2025 and for more than 40% in 2050, the corresponding percentage of all the employed is much smaller: in 2015 it has already fallen to 60% and it is virtually zero in 2035. It is worth noting that in the period 2025-40, in which the structure of population vary considerably and rapidly (due to the arrival at retirement age of the baby-boom generations), the legal-institutional component of the model is able to capture the effect of the ageing of the population in absolute terms (increase in life expectancy) but completely fails to capture the effect in relative terms (reduction in the population of working age).

To avoid the shortcomings discussed above, the DGA's model has been provided with double improvements. The first one concerns the construction of legal-institutional components for the main funds, or other appropriate aggregations, aimed at covering a large part of the whole Italian Pension System. As mentioned before, seven different legal-institutional components have been built at the moment which considered together cover about 90% of the total number of pensions. Secondly, the Pension System's new entrants at time *t* by age and sex are set equal to the increase of the number of employed people *L* of each generation within a year. The former component, in turn, is calculated by applying both participation rates v[13] and unemployment rates *u* to a projected population *Pop*. In other terms, the number of new entrants are calculated according to the following equation:

$$\mathbf{e}_{t,s,x,f} = max\left[g_f\left(L_{\text{t,s,x}}\right) - g_f\left(L_{\text{t-1,s,x-1}}\right);0\right] \qquad \forall s,\ 15 \le e \le 42$$

where:

13 In the lower age bracket, participation rates by age and sex are set as exogenous variables according to the labour market middle long term hypotheses. However in the upper age bracket participation rates are carried on by cohort according to the evolution of the eligibility requirements stated by the legal framework.

$$\underbrace{L_{t,s,x}}_{\text{employed people}} = \underbrace{Pop_{t,s,x}}_{\text{population}} \underbrace{v_{t,s,x}}_{\substack{\text{partecipation}\\ \text{rate}}} \left(1 - \underbrace{u_{t,s,x}}_{\substack{\text{unemployement}\\ \text{rate}}} \right)$$

and "g_f" is a function devoted to transform the employed people into contributors belonging to each fund of the pension system.

Afterwards, the number of entrants by age and sex attributed to each fund, or other appropriate aggregation of workers, is determined on the basis of a probability vector. The elements of which indicate the share attributed to each of them.

5 Assessment of demographic and occupational consistency

The relevance of the demographic and occupational consistency depends on the magnitude and the speed of changes of population structure expected in the next decades. In fact, in the steady state, as both the level and the structure by age and sex of the entrants into the system are constant, the legal-institutional components are the only equation of the model that really matters. In this context, the ratio of pension expenditure to GDP would move towards a constant value which only depends on the legal-institutional features of the system.

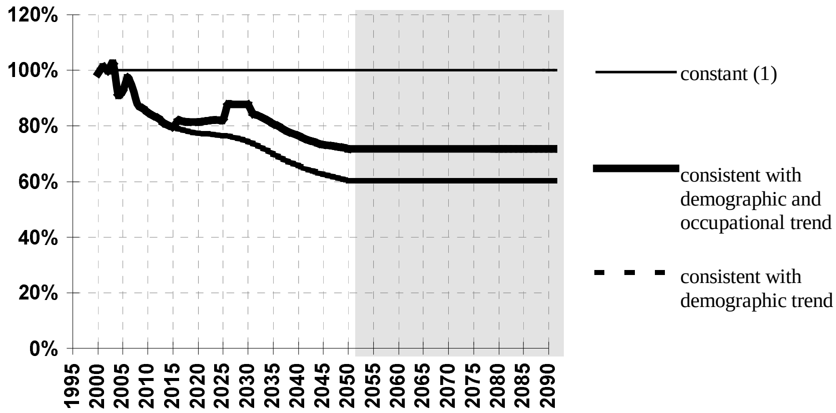
In spite of this fact, the structure of the population for the next fifty years is projected to change heavily. Apart from the decline in mortality rates that will increase the number of elderly people, it rather depends on the baby-boom generation exceeding the threshold of 65. The latter phenomenon produces simultaneously a double effect: a great decrease in working age population and a corresponding increase in the old age population. As a consequence, the elderly dependency ratio will rise dramatically and very quickly especially from 2015 to 2035. Such changes, which have never seen before, are going be relevant even under optimistic hypotheses concerning the fertility rates and the net flows of immigrants (see Istat 1997).

The fall in working age population is likely to affect the labour market. Presented at a deep shortage of labour force because of the demographic trends, there would be enough room for an increase of participation rates and a decrease of unemployment rates, especially if the starting values are respectively high or low compared with those of other developed countries. In Italy, the unemployment rate was just over 11% in 1999 and the participation rates for women are ones of the lowest.

To put in evidence the relevance of demographic and occupational changes some forecasting exercises have been made using the DGA's model described above. The demographic and labour market hypotheses are the same as assumed in the latest projection (see Treasury-DGA 1999). In particular, with regard to demographic trends, reference is made to the "main variant" population projection prepared by Istat (Istat, 1997). As regards occupational hypotheses, improvements in female participation rates and a reduction of unemployment rate are considered which only take place, in the absence of specific policies designed to foster them, in the years when employment would fall sharply.

To assess the importance of demographic and occupational constraints discussed in the previous paragraph, it is useful to show how entrants into the system are affected. The bold line of figure 2.a

Figure 2a. Entrants – Index (average 1998 - 2002 = 100)

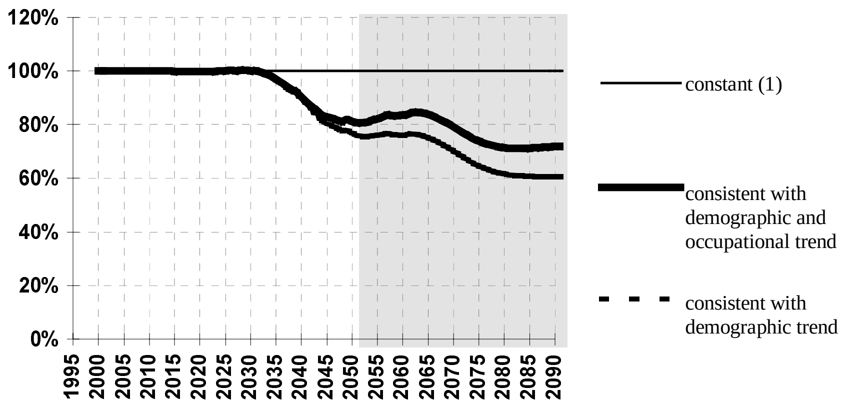


(1) The value is set equal to the average annual entrants within 1998-2002.

expresses the number of entrants consistent with the demographic and labour market trends as a percentage of the average number obtained in the first five years of the forecasting period (1998-2002). As it is shown, the number of entrants is going to be affected by a reduction of about 20% starting from 2010 and 25% starting from 2015. If no occupational hypothesis had been made (so unemployment rates would be constant and participation rates would be changing only according to the minimum requirements to be entitled of a pension) such reductions would be increased by around an additional 10-15%.

Obviously a lower number of entrants means a lower number of people who retire early as well. Yet it is worth noting that the latter effect follows the former about 35 years late as it is shown in figure 2.b. So as far as the sustainability of the Pension System is concerned, no matter how it is measured either as the equilibrium contribution rate or pension expenditure to GDP, a great effect will be produced during the next fifty years. In fact, whereas the number of employed will start to decline within the next few years, the number of pensioners will not start to decrease significantly until 2035. As matter of fact, the progressive

Figure 2b. Pensions as a percentage of those under constant entrants Index 1999 = 100

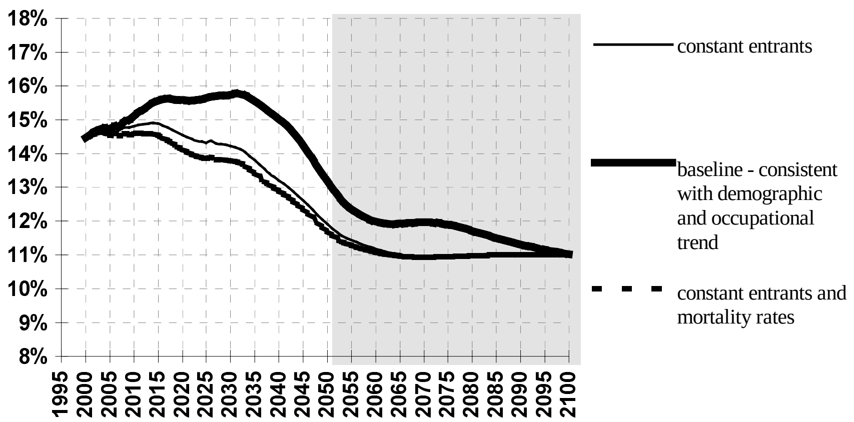


(1) The value is set equal to the average annual entrants within 1998-2002.

decline of new generations entering working age population expected for the next decades, although curbed by changes that are likely to be in the labour market, is going to worsen the Pension System sustainability until the reduction of new entrants is entirely counterbalanced by the following reduction in the number of pensions.

At this point it is quite interesting to analyse the latest forecast of the Italian Pension System produced by the DGA in light of the preceding considerations. In particular, it is worth decomposing, according to figure 3, the projected ratio of pension expenditure to GDP (the bold line) in two components. One of them (the thin line) indicates the ratio of pension expenditure to GDP that would take place assuming for the whole forecasting period a number of entrants constant respect with the initial level. So the shape of the line only depends on the legal-institutional components of the model which, in turn, reflects the legal-institutional features of the system (i.e. eligibility requirements, calculation rules and indexation scheme) and, as regards demographic variables, only the assumptions on mortality rates. If the mortality rates had set constant, the shape of the ratio would be the one indicated by the dotted line. The area between the two lines measures the demographic effect captured by the legal-institutional component.

Figure 3. Ratio of pension expenditure to GDP



Despite the fact, the difference between the bold and the thin line measures the effect on the ratio of pension expenditure to GDP only depending on the equations of the model devoted to grant the demographic and occupational consistency. In particular, such a difference expresses the deviation of the ratio of pension expenditure to GDP owing to the evolution of the entrants into the system with respect to the initial values and the corresponding effects on the annual flows of new pensions. The difference increases rapidly until 2040 and afterwards starts to decrease. As explained before, this trend depends on the average delay between the time people enter the system and which they retire. Obviously, the greater the demographic changes that affect the working age population, the greater the deviation. As the system moves to the steady state, the three lines tend to coincide. The lower lines (the thin and the dotted line) reach the steady state before the upper line (the bold line) does, since the entrants are set constant starting from 2000 instead of 2050.

Finally, it is worth noting that the steady state level of pension expenditure to GDP is independent of the hypothesis on mortality because of the revision of conversion coefficient according to the evolution of the life expectancy stated for the contribution based method[14].

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[14] For the purpose of the present forecasting exercise, the entrants after 2050 are set constant to ones in 2050.

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