Reform of the Italian Pension System:  
Increase in the Retirement Age  
Vs.  
Immigration Policy.  
An Overlapping Generations General Equilibrium Model  
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Abstract  
The reforms of the Italian pension system introduced during the Nineties were commonly judged not sufficient to adequately face the population ageing problem. The Berlusconi government has recently introduced a new reform that increases the retirement age. Using an overlapping-generations general equilibrium model, we will analyse the impacts of this reform on the macroeconomic system and in particular on the pension system. Then, we will compare these results with those obtained by considering an alternative reform: the introduction of an immigration policy.  

JEL Classification: D58, H55, J10.  
KEYWORDS: pension system, overlapping generations, applied general equilibrium, immigration, human capital.  

1 Introduction  
It is well known that many industrialised countries will live a phase of significant demographic changes over the next 50 years. The increase in the life expectancy, the reduction of the fertility rate, and mainly the baby-boom produced during the Fifties and Sixties have determined a population ageing  

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which will cause an important problem about the financing of the social security system. With regard to Italy, the demographic projections based on the central hypothesis presented by Istat\(^1\), show that the active population (figure 1), i.e. the number of people from 15 to 64 years old, will drop by 30% between 2000 and 2050 and the dependency ratio (figure 2), i.e. the ratio between the number of people aged 65 or more and the active population, will pass from 26.6% in 2000 to 63.5% in 2050.

\[\text{Figure 1: total active population}\]
\[\text{Figure 2: old dependency ratio}\]

During the Nineties, two pension system reforms were introduced: the Amato reform in 1992 and Dini reform in 1995. Even if the two reforms predict a significant reduction of the value of the pensions, they are considered to be insufficient in the short run as well as in the long run. The presence of a very long transition phase will produce important deficits in the pension system and, even when the Dini reform will be completely applied, the reduction of the value of the pensions will not be sufficient to reach the financial equilibrium of the pension system. The impacts on the macroeconomic system will also be negative: the reduction of the value of the pension and especially the increase in the tax level necessary to finance the pension system deficits, will involve a fall of the national savings. Moreover, the reduction of the capital accumulation will reduce the economic growth. As a consequence, a new pension system reform seems inevitable and, in this light, the Berlusconi government has recently introduced a reform which increases the retirement age starting on 2008.

The first objective of this paper is then to evaluate the impacts of this reform on the macroeconomic system and in particular on the pension system. The second object is to compare this reform with an alternative one: the introduction of an immigration policy.

In our analysis we will use an overlapping-generations general equilibrium model of the type Auerbach and Kotlikoff (1987). The general equilibrium approach is a very useful tool in order to evaluate the impacts of population ageing not only on the macroeconomic system (impacts on the national consumption, national saving, GDP, wages, interest rates...), but also the effects on the pension system. In

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\(^1\)Istat (2001), Previsioni della popolazione residente per sesso, età e regione. Base 1.1.2001.
fact, population ageing will significantly affect the evolution of labour supply (and thus the evolution of wages) and the evolution of capital supply (and thus the evolution of investments, interest rates and GDP). The evolution of wages directly affects the evolution of the social security contributions whereas the evolution of the GDP growth rate affects the evolution of the value of pensions since, with the Dini reform, pensions are calculated on the basis of the contributions that are paid during the whole working life and that are capitalised at the GDP growth rate.

We introduced into the model immigration and human capital accumulation. The introduction of immigration permits us to reproduce more precisely the demographic projections of Istat and to simulate the effects of the introduction of an immigration policy. The introduction of human capital permits us to introduce an endogenous growth mechanism based on the average level of knowledge present in the economy. The human capital is modelled by considering that young people (20-24 years) decide the quantity of time to invest in education. This seems important because the decision to invest or not in human capital will depend on the relative prices of the factors that will vary considerably in the presence of population ageing.

The paper is organised in the following way: in the next section, we describe the characteristics of the Italian pension system and the reforms introduced during the Nineties. In sections 3 and 4, we describe the structure of the overlapping-generations model and its “out of steady state” calibration. Sections 5 and 6, present the results of the simulations concerning the increase in retirement age and the immigration policies. We draw our conclusions in the last section.

2 The Italian pension system after the Amato and Dini reforms

The Italian pension system is almost entirely composed of a compulsory public system that is financed as a Pay-As-You-Go system. An important anomaly of the Italian pension system is that there is not a clear separation between the pension system in the strict sense and a system of social aid, which is not related to a system of contributions. In particular, the Italian pension system includes pensions related to the work activity (old-age pensions, disability pensions, pensions paid in the case of occupational diseases and industrial injuries), survivor pensions, and welfare benefits for persons over 65 lacking adequate means of support. Moreover, until 1992, the Italian pension system was characterised by a very large number of funds and schemes, in which contributions and benefits rules varied according to the sector (private or public sector, or self employment).
During the Nineties two reforms were introduced in order to reduce the total pension expenditure and to harmonise the different pension regimes: the Amato reform (1992) and the Dini reform (1995). The principal innovation of the Amato reform was the indexing of the pensions: pensions are now indexed on the basis of the inflation rate and not on the basis of the real wages. On the other side, the Dini reform (1995) introduced a new rule for the calculation of the pension, which also replaces the calculation rule for pensions introduced by the Amato reform. In particular:

- for those who started working after 1995, the pension is calculated according to the contribution based method: the contributions paid during the whole working life are virtually capitalised at the average rate of growth of nominal GDP; the value of the pension is equal to the capitalised value of the contributions multiplied by a transformation coefficient which depends on the retirement age;\(^2\);

- for those who in 1995 had more than 18 years of contributions, the pension is calculated according to the earning based method, i.e. on the basis of the average of the labour incomes obtained during the 10 last years;

- for those who in 1995 had less than 18 years of contributions, the pension is then calculated according to pro-rata method: the pension is equal to a weighted average between the pension which would have been obtained with the earning based method and the contribution based method.

Moreover, with the Dini reform, in order to retire it is necessary to be 57 years old with at least 5 years of contributions, or to have paid 40 years of contributions. Workers can thus decide to retire between 57 and 65 years old. The goal of the reform is to penalise early retirement, because if an individual works less, the value of the pension will be lower since he accumulates a lower value of contributions and the transformation coefficient applied will be also lower.

\(^2\)Les coefficients de transformation sont compris entre 4.72% pour ceux qui partent à la retraite à 57 ans et 5.911% pour ceux qui partent à la retraite à 64 ans.
3 The model

3.1 The generations

3.1.1 The characteristics of the model

The model presented in this paper is an overlapping-generations model in which 13 age groups, indicated by $g(k)$ with $k = 1,...,13$, coexist at each period $t$.

<table>
<thead>
<tr>
<th>$g(1)$</th>
<th>20 - 24</th>
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<tr>
<td>$g(2)$</td>
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<td>$g(3)$</td>
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<td>$g(4)$</td>
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<td>$g(5)$</td>
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<td>70 - 74</td>
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<td>$g(12)$</td>
<td>75 - 79</td>
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<tr>
<td>$g(13)$</td>
<td>&gt; 80</td>
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</table>

Table 3: age group’s composition

The model includes immigration. We make the hypothesis that immigration is concentrated on the age group 30-34. Then, for each of the following age groups, it is necessary to distinguish two individual groups, indicated by $z$: people born in Italy ($it$) and the immigrants ($im$).

For each age group we assume that there exists a representative agent of people born in Italy and a representative agent of immigrants (intra-generation’s heterogeneity), that agents have perfect foresight and that there is no liquidity constraint. Each period consists of 5 years and all the variables are supposed to be constant during each period.

At the end of each period, people belonging to the last age group ($k = 13$) die, a fraction of people belonging to the other classes dies, and a new generation enters into the active population. Since only people over 20 are taken into account in the model, the objective is to reproduce the demographic evolution of the population over 20, and in particular the dependency ratio, i.e. the ratio between people over 65 and people from 20 to 64 years old, the structure of the population, i.e. the ratio $^3$The fertility rates and the survival rates are assumed to be identical for the people born in Italy and the immigrants. $^4$People under 20 years old are supposed completely dependent of their family.
between the number of people belonging to a given age group and the total population, and the total population.

In order to achieve these goals we have calibrated the parameters concerning the fertility rates and the survival rates. As already mentioned, we made the assumption that immigration is concentrated on the age group 30-34. We considered a migratory flow between 100,000 and 120,000 individuals per year since 1990, according to the Istat’s assumption.

The result of the procedure of reproduction in the model of the demographic evolution is summarised in the following figure, which indicates that the dependency ratio, that represents the most important demographic variable, is almost perfectly reproduced.

![Figure 4: reproduction into the model of the dependency ratio (>65 / 20-64)](image)

People who die in the last period (85 years old) decide to leave a bequest to the other generations, on the basis of a maximization process of their utility function: in this case, there are voluntary bequests. On the other hand, people belonging to the other age groups, in the case of premature death, do not program the value of their final wealth: in this case, there are involuntary bequests. Voluntary and involuntary bequests are uniformly distributed among the other generations.

The first 9 age groups work. The decision about how much to work is endogenous for the first 7 age groups. In particular, people belonging to the first age group (20-24 years old) must decide the fraction of time to devote to the human capital formation. The following age groups, until the class 50-54, must decide the fraction of time to devote to work and to leisure. With regard to the two last age groups who work (55-59 and 60-64 years old), the fraction of people which works is exogenously fixed, according the 1995 data. This permits us to simulate the impact of an increase in the retirement age.
Immigrants and people born in Italy have exactly the same structure of preferences. They must decide the intertemporal profile of consumption and leisure as well as the value of the voluntary bequest that will be left at the end of the last period of life. On the other hand, the decision about the fraction of time to devote to study concerns only people born in Italy. Moreover, immigrants differ from people born in Italy by a lower level of productivity and we assume that immigrants enter in Italy with no capital. The children of immigrants are considered identical to the children of people born in Italy. Consequently, they must decide the fraction of time to devote to studying and the difference in productivity disappears.

We assume that the economy produces only one good, according to a Cobb-Douglas production function, and the existence of competitive markets for labour and capital.

In this paper we treat into details the generations’ behaviour and the government budget. For other details of the model, see Magnani (2004).

3.1.2 Maximisation problem for the generations

People born in Italy and immigrants present the same utility function. The utility level for the generation born in $t$ is given by the sum of three elements:

1. the present value of the utility of consumption, weighted by the survival probability;
2. the present value of the utility of leisure, weighted by the survival probability;
3. the present value of the utility of the bequest left at the end of the last period of life, weighted by the survival probability.

5 Storesletten estimates for the United States that the productivity of people who immigrate at 37 years old is lower by 13% with respect to the natives.

6 $Y_t = A \cdot K_t^{\alpha} \cdot L_t^{1-\alpha}$, where $Y_t$ represents the quantity produced in the period, $A$ the constant total factor productivity, $K_t$ the physical capital demand, and $L_t$ the per unit of effective labour demand.
The utility function, which is a logarithmic function, is the following:\footnote{We use a logarithmic functional form, instead of a more flexible one (for example, a CRRA function), because the only value of the intertemporal elasticity of substitution compatible with the steady state, in the presence of economic growth, is 1. This implies that economic growth does not affect the quality of leisure.}:

\[
U^z_{t} = \sum_{k} \log \left( c^z_{g(k),t+k-1} \right) \cdot B_{g(k)} \cdot \Omega_{g(k),t+k-1} + \sum_{k} \epsilon_{g(k),t+k-1} \cdot \log \left[ \Delta \cdot \left( 1 - l^z_{g(k),t+k-1} \right) \right] \cdot B_{g(k)} \cdot \Omega_{g(k),t+k-1} + \beta_{BEQ} \cdot \log \left( BEQ_{t+12}^z \right) \cdot B_{g(13)} \cdot \Omega_{g(13),t+12}
\]

with \( k = 1, \ldots, 13 \) for people born in Italy and \( k = 3, \ldots, 13 \) for immigrants.

\( \Delta \) indicates the number of years that constitute one period (5 years), \( c^z_{g(k),t} \) represents consumption of the age group \( g(k) \) for one period, \( B_{g(k)} \) represents the actualisation factor, with \( B_{g(k)} = \prod_{s=1}^{k} \frac{1}{1 + \rho_{g(s)}} \) where \( \rho_{g(k)} \) represents the intertemporal preference rate belonging to the class \( g(k) \), \( \epsilon_{g(k),t} \) measures the intensity of the preference for leisure with respect to consumption, \( \beta_{BEQ} \) measures the intensity of the preference for bequests, and \( BEQ_{t}^z \) indicates the voluntary bequest left at the end of the last period.

\( 1 - l^z_{g(k),t} \) with \( k > 1 \) indicates the fraction of time that the class \( g(k) \) devotes to leisure, whereas with \( k = 1 \), i.e. for the first age group, it indicates the fraction of time devoted to study.

\( \Omega_{g(k),t} \) indicates the probability that a person that belong to the age group \( g(k) \) is alive in \( t \).

Clearly, \( \Omega_{g(1),t} = 1 \). Since \( \gamma_{g(k),t} \) is the probability that an individual belonging to the age group \( g(k-1) \) in \( t-1 \) joins in \( t \) the age group \( g(k) \), \( \Omega_{g(k),t} \) can be expressed in the following way:

\[
\Omega_{g(k),t} = \prod_{w=1}^{k} \gamma_{g(w),t-k+w}
\]

Each agent maximises the intertemporal utility function given the intertemporal budget constraint, according to which the final wealth of each individual is left as a bequest: voluntary, for people who live until the last age group (85 years) and involuntary in the case of premature death. In both cases, the actual value of the final wealth is given by the difference between the present value of future incomes and the present value of future consumption, where incomes are given by the net labour incomes, net pensions and the voluntary and involuntary bequests.
3.1.3 Individual productivity

The labour income is given by the wage per unit of effective labour and by the productivity level. The productivity level depends on three elements:

i) the productivity related to the age of the individual, and thus on his experience, indicated by $EP_g(k)$. This component is described by a quadratic function:

$$EP_g(k) = \theta + \theta_1 k + \theta_2 k^2$$

with $k = 1, \ldots, 9$, since only the first 9 age groups work;

ii) the productivity related to the decision to study, indicated by $HC_g(k,t)$. This component is described by a concave function:

$$HC_g(1), t = \Delta \cdot (1 - l_{g(1),t})$$

where $l_{g(1),t}$ indicates the fraction of young people born in Italy that belong to the age group 20-24 years old which works, or the fraction of time, during the first period of life, an individual spends working. The stock of human capital accumulated by the individuals that belong to the first age group depends on the number of years devoted to studying $\Delta \cdot (1 - l_{g(1),t})$. Thereafter, the human capital accumulated by the individual depreciates, according to a depreciation rate.

iii) the productivity related to the average level of knowledge present in the economy, indicated by $H_t$; the average level of knowledge present in the economy is measured, for each period, by the weighted average of the stocks of human capital accumulated by each class which coexists at the same period, indicated by $\overline{H}_t$, with $\overline{H}_t = \frac{\sum_k HC_g(k), t \cdot l_{g(k),t} \cdot POP_{g(k),t}}{\sum_k l_{g(k),t} \cdot POP_{g(k),t}}$; the rate of growth of this index ($g_{H_t}$), which represents the economic growth rate in the steady state, is supposed endogenous and proportional to the average level of knowledge:

$$g_{H_t} = \frac{H_{t+1} - H_t}{H_t} = g_{exo} \cdot \overline{H}_t$$

where $g_{exo}$ is an exogenous parameter. No individual can influence, by his decision to study, the value of this index. Consequently, there exists a positive externality.
The total productivity, indicated by \( A_{g(k),t} \), for an individual that belongs to the age group \( g(k) \), is given by the product of these three types of productivity. Therefore, we have:

\[
A_{g(k),t}^z = EP_{g(k)} \cdot HC_{g(k),t} \cdot H_t \cdot \theta^z
\]

with \( \theta^{it}=1 \) and \( \theta^{im}=0.87 \), because the total productivity of the immigrants is supposed to be lower by 13% (Storesletten, 2000).

### 3.1.4 Optimal individual choices

In order to maximise the intertemporal utility function given the intertemporal budget constraint, each individual born in \( t \) must decide:

- **i)** the fraction of time to devote to studying, when he belongs to the first age group, \( g(1) \);
- **ii)** the fraction of time to devote to leisure, when he belongs to the classes \( g(2), g(3), g(4), g(5), g(6), g(7) \);
- **iii)** the intertemporal consumption profile;
- **iv)** the value of the voluntary bequest to leave at the end of the last period of life.

The first order conditions are the following:

**i)** The decision of studying (which only concerns people born in Italy):

\[
(1 - \tau_t - \tau_{cs}) \cdot \frac{w_t \cdot A_{it}^t}{\Delta} = \sum_{k=1}^{9} R_{t+k-1} \cdot (1 - \tau_{t+k-1} - \tau_{cs}) \cdot w_{lab,(t+k-1)} \cdot \frac{\partial A_{g(k),t+k-1}}{\partial \left[ \Delta \cdot \left( 1 - l_{it}^g(1),t \right) \right]}
\]

where \( R_t \) represents the factor of capitalisation, with \( R_{t+k-1} = \prod_{s=t+1}^{t+k-1} \left( \frac{1}{1 + r_{net,s}} \right) \).

This means that if an individual decides in \( t \) to study one year more (where \( \Delta \cdot \left( 1 - l_{it}^g(1),t \right) \) indicates the number of years devoted to studying by people belonging to the first age group), the

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8 This assumption implies that immigrants have a level of productivity related to education lower by 13% compared to natives. In fact, we can suppose that an immigrant and a native, with the same age, have the same productivity related to the experience (\( EP \)) and that they profit in equal measurement from knowledge present in the economy (\( H \)). By considering equation (4), this implies that immigrants have a stock of human capital lower by 10% compared to natives.
individual, on one side gives up one year of wage, but on the other side, he obtains a greater wage level for each next period of working. This first order condition indicates that at the optimum, the wages lost by the individual who decides to study one year more is equal to the present value of all the additional incomes obtained thanks to the increase in the productivity related to human capital.

\[ \text{ii)} \quad \text{The intertemporal profile of consumption:} \]

\[ \frac{c^z_{g(k+1),t+1}}{c^z_{g(k),t}} = \frac{\gamma_{g(k+1),t+1} \cdot (1 + r_{\text{net}_{t+1}})}{1 + \rho_{g(k+1)}} \]  

(8)

Therefore, an increase in the survival probability causes, ceteris paribus, an increase in the future consumption and in the current saving.

\[ \text{iii)} \quad \text{The decision concerning the leisure:} \]

\[ 1 - l^z_{g(k),t} = c^z_{g(k),t} \cdot \frac{c^z_{g(k),t}}{(1 - \tau_t - \tau_{cs}) \cdot w_{lab,t} \cdot A^z_{g(k)}} \]  

(9)

Then, an increase in the net wage determines an increase in the labour supply.

\[ \text{iv)} \quad \text{The voluntary bequest:} \]

\[ RBeq^z_t = \beta_{BEQ} \cdot c^z_{g(13),t} \]  

(10)

This means that the bequest that the individual decides to leave is proportional to the consumption during the last period of life.

3.2 The government

3.2.1 The pension system

As far as the government budget, first of all we consider the pension system. The Italian pension system is a Pay-As-You-Go system in which the workers pay social security contributions (on the basis of 32.7% of wages) and the retirees receive a pension calculated on the basis of the criteria fixed by the law. In the model, the value of the pension is calculated by considering the introduction of the Dini reform which determines different criteria that vary over time. Consequently, we applied the old method (earning based method) for the pensions paid until 2015, the pro-rata method for the pensions paid between 2020 and 2030, and the new method (contribution based method) for the pensions paid since 2035.
An important problem concerns the aggregation of the individuals belonging to the age groups $g(8)$ and $g(9)$, respectively 55-59 and 60-64 years old, because in these two classes a fraction of individuals works and a fraction is retired. We will consider these two cases separately.

For the retirees belonging to the class $g(8)$, the pension is calculated in the following way:

- Old method ($t < 2015$): the pension is calculated on the basis of the average income obtained in the 10 last years (which correspond to two periods in the model):

$$\text{Pens}_{g(8),t}^z = n_{g(8)} \cdot 0.02 \cdot \left( \frac{w_t \cdot A_{g(8),t}^z + w_{t-1} \cdot A_{g(7),t-1}^z}{2} \right)$$

where the replacement ratio is proportional to the number of years worked by the class $g(8)$.

- New method ($t > 2035$): the pension is calculated by multiplying the transformation coefficient ($\beta_{g(8)}$) by the value of the contributions paid during the whole working life and capitalised on the basis of average GDP growth rate:

$$\text{Pens}_{g(8),t}^z = \beta_{g(8)} \cdot \left( \sum_k \tau_{cs} \cdot w_{t+k-8} \cdot A_{g(k),t+k-8}^z \cdot \prod_{s=t+k-8}^{t} (1 + g_{GDP_s}) \right)$$

with $k = 1, ..., 8$ for people born in Italy and $k = 3, ..., 8$ and $g_{GDP_t} = \frac{Y_{t+1}}{Y_t} - 1$.

- Pro-rata method ($2020 < t < 2030$): the pension is equal to a weighted average between the pension which would have been obtained with the old method and the new method, where the weight depends on the number of years worked before and after 1995.

For the retired people aged 60-64 years old, we have to consider that only one fraction of these individuals, indicated by $\lambda$, retires between 60 and 64 years old and that the other fraction, $1-\lambda$, retires in the previous period (55-59 years old). On average, the pension obtained by the representative 60-64 years old individual is:

- Old method ($t \leq 2015$):

$$\text{Pens}_{g(9),t}^z = \lambda \cdot n_{g(9)} \cdot 0.02 \cdot \left( \frac{w_t \cdot A_{g(9),t}^z + w_{t-1} \cdot A_{g(8),t-1}^z}{2} \right) + (1 - \lambda) \cdot \text{Pens}_{g(8),t-1}^z$$

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- New method \((t \geq 2035)\):

\[
Pens_{g(9),t}^z = \lambda \cdot \left[ \beta_{g(9)} \cdot \left( \sum_{k} \tau_{cs} \cdot w_{t+k-9} \cdot A_{g(k),t+k-9} \cdot \prod_{s=t+k-9}^{t} (1 + g_{GDP}) \right) \right] + (1 - \lambda) \cdot Pens_{g(8),t-1}^z
\]

- Pro-rata method \((2020 \leq t \leq 2030)\): with regard to the fraction \(\lambda\) who retires between 60 and 64 years old, the pension is a weighted average between the pension which would have been obtained with the new and the old method, whereas the fraction \(1-\lambda\) who retires in the previous period, receives \(Pens_{g(8),t-1}^z\).

With regard to the indexation of pension benefits, the Amato reform determines that, since 1995, pensions are not indexed to real wages, but to the inflation rate. The assumption of money neutrality implies that the pensions obtained by an individual remain constant over time:

\[
Pens_{g(k),t+k-9}^z = Pens_{g(9),t}^z
\]

with \(k = 10, \ldots, 13\).

The last problem concerns the determination of the transformation coefficient. These coefficients are fixed by law and vary according to the age of the individual. The transformation coefficients used in the model for the classes \(g(8)\) and \(g(9)\) are calculated by considering the average retirement age inside these two age groups.

The deficit of the pension system \((DEF_{sst})\) is given by the difference between the pensions paid and the social contributions perceived:

\[
DEF_{sst} = \sum_{z} \sum_{k} POP_{g(k),t}^z \cdot PP_{g(k),t} \cdot \Delta \cdot Pens_{g(k),t}^z - \sum_{z} \sum_{k} \tau_{cs} \cdot POP_{g(k),t}^z \cdot l_{g(k),t}^z \cdot w_{lab,t} \cdot A_{g(k)}^z
\]

where \(PP_{g(k),t}^z\) represents the fraction of retirees for each age group, \(POP_{g(k),t}^z\) represents the number of retirees, while \(POP_{g(k),t}^z \cdot l_{g(k),t}^z\) represents the number of workers that belong to the age group \(g(k)\).
3.2.2 Public expenditures and government saving

In the model we considered three types of public expenditure: those which are related to the education of young people from 5 to 24 years, the health care expenditure and the other government expenditures. The introduction of the expenditure on education permits to take into account the fact that the negative impact of the reduction of the fertility rates on the macroeconomic system, caused by the deficits of the pension system and by the increase in the health care expenditure which reduces the level of saving, the accumulation of the capital and the growth, will be partially compensated by the reduction of the expenditure on education. The expenditure on education of young people from 5 to 24 years was modelled by making the assumption that this expenditure is proportional to the number of the young people who study in $t$:

$$ Gedu_t = \varphi_t \cdot \left[ \left( 1 - l_{g(1),t}^{it} \right) \cdot POP_{g(1),t} + POP_{g(1),t+1} + POP_{g(1),t+2} + POP_{g(1),t+3} \right] $$

where $\left( 1 - l_{g(1),t}^{it} \right) \cdot POP_{g(1),t}$ indicates the number of people between 20 and 24 studying in $t$, $POP_{g(1),t+1}$ indicates the number of people that in $t$ were 15-19 years old, $POP_{g(1),t+2}$ indicates the number of people that in $t$ were 10-14 years old and $POP_{g(1),t+3}$ indicates the number of people that in $t$ were 5-9 years old. This implies that all people from 5 to 19 years old are supposed to be studying.

We made the assumption that $\varphi_t$, which represents the average expenditure by student, varies over time according to the evolution of the GDP.

The health care expenditure is modelled by making the assumption that it is proportional to the number of people aged 60 years or more:

$$ Gmed_t = \phi_t \cdot \sum_{k=9}^{13} POP_{g(k),t} $$

We made the assumption that $\phi_t$, which represents the average expenditure by individual aged 60 years or more, varies over time according to the evolution of the GDP.

With regard to the other government expenditures, we made the assumption that their value, with respect to GDP, remains constant over time.

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9 This assumption could imply an overestimate of the health care expenditure, since one can expect an improvement, in the future decades, of the quality of life for old people. Nevertheless, this overestimate is compensated by the fact that this expenditure is supposed to be proportional to the number of old people, when, in the reality, it grows exponentially with the age of the individual. In any case, this simplified modelling permits a good reproduction of the evolution of the health care expenditure estimated by the Italian authorities (which should pass from 5.5% in 1995 to 7.5% in 2050, with respect to GDP).
The public saving \((S_{gov})\) is given by the difference between the revenues (direct taxation on labour and capital incomes and on pension benefits) and the expenditures (expenditures on education, on health and other, interests paid on the national debt and deficit of the pension system). We make the hypothesis that the national debt \((B_t)\) and the government expenditure with respect to the GDP are constant.

### 3.3 Equilibrium conditions

The equilibrium conditions are the following:

\[
Y_t = \sum_z \sum_k POP_{g(k),t} \cdot c_{g(k),t}^z + Gedu_t + Gmed_t + G_t + I_t \quad (19)
\]

\[
K_t + B_t = \sum_z \sum_k POP_{g(k),t} \cdot lend_{g(k),t}^z \quad (20)
\]

\[
L_t = \sum_z \sum_k POP_{g(k),t} \cdot l_{g(k),t}^z \cdot A_{g(k)}^z \quad (21)
\]

Equation (19) represents the equilibrium in the good market: the production must be equal to the aggregate demand, given by the private and public consumption and by the investments.

Equation (20) indicates that the total capital supply (where \(lend_{g(k),t}^z\) represents the level of wealth for an individual belonging to the age group \(g(k)\)) is used as physical capital in the production and to finance the national debt.

Equation (21) indicates that the total labour supply (expressed in per unit of effective labour) is used in the production activity.

### 3.4 Dynamics of the economy

The evolution of the capital stock depends on investments and on capital depreciation, while the evolution of the public debt depends on public savings:

\[
K_{t+1} = K_t \cdot (1 - \delta) + I_t \quad (22)
\]

\[
B_{t+1} = B_t - S_{gov} \quad (23)
\]

### 4 Calibration of the model

The aim of the calibration is two-fold: to reproduce the 1995 Italian macroeconomic data (in particular, the value of the GDP, the ratio between aggregate consumption and the GDP, the ratio between
the investments and the GDP, and the ratio between the public expenditure and the GDP) and to reproduce the most important aspects concerning the pension system: the ratio of the number of pensioners to the number of workers, and the ratio of the total pension expenditure to GDP.

Since our objective is to analyse the impacts on the pension system in the presence of population ageing, we have only considered the old-age pensions. In particular, the pension aggregate that we have used in our analysis is represented by the basic services paid by the public and private institutions to the pensioners over 55. These benefits are perceived by the public and private sector employees and by the self-employed workers. In order to simplify our analysis, we made the assumption that all the workers belong to the same system, i.e. they pay the same social security contribution rate and they receive the same pension benefit.

The model is calibrated in 1950 in a way such as, once the demographic shock, an annual productivity growth rate of about 2%, and the pension reforms of the Nineties are introduced into the model, the solution for the year 1995 permits to reproduce the real data. In table 5 we indicate the principal values of the parameters used in the model, whereas in table 6 we indicate the values of some endogenous variables produced by the model that are compared with the 1995 data.

---

10 In the reality, the social security contribution rate is equal to 32% for the public sector employees of the public administration (which is very close to the contribution rate applied to the private sector employees, 32.7%); on the other hand, the contribution rate applied to the self-employed workers is quite lower (15.6%).

11 The demographic changes are simulated by introducing into the model the exogenous values of the fertility rates, the mortality rates and the immigration flows, that we obtained in order to reproduce the Istat’s demographic projections.

12 We have calibrated the parameter $g_{exo}$ in order to obtain an annual productivity growth rate of about 2%.
### AGE GROUPS

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<th>Productivity related to the age</th>
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<tr>
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<td>Index of preference for bequest</td>
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</table>

### FIRMS

| Depreciation rate of physical capital | $\delta$ | 10.4 % |
| Capital remuneration in the added value | $\alpha$ | 52.2% |

### GOVERNMENT

| Contribution rate | $\tau_{cs}$ | 32.7 % |
| Public debt / GDP | 120 % |
| Public expenditure / GDP | 16 % |

Table 5: some parameters used in the model
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<thead>
<tr>
<th>Variable</th>
<th>Simulated value</th>
<th>Real value</th>
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<tr>
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<td>$s_g(11)$</td>
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<table>
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<tr>
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<td>35.9 %</td>
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<td>$l_g(2)$</td>
<td>57.8 %</td>
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<td>$l_g(3)$</td>
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<td>$l_g(4)$</td>
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<td>72.0 %</td>
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<td>71.4 %</td>
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<tr>
<td>$l_g(8)$</td>
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<td>37.7 %</td>
</tr>
<tr>
<td>$l_g(9)$</td>
<td>18.2 %</td>
<td>18.2 %</td>
</tr>
</tbody>
</table>

| National occupational rate       | 54.24 %         | 54.57 %    |

Table 6: value in 1995 of some endogenous variables
5 Effects of the increase in the retirement age

The Berlusconi pension reform increases the retirement age. Whereas with the Dini reform each worker can decide to retire between 57 and 65 years, with the Berlusconi reform the retirement age is fixed. In particular, since January 2008, people can retire either at 60 years (62 for the self-employed workers) with at least 35 years of contributions, or with 40 years of contributions independently of the age of the individual; since 2010, the retirement age will be 61 years (62 for the self-employed workers). In 2012 the government will decide whether or not increase the retirement age once more. If that is the case, from 2015 the retirement age will be 63 years.

The impact of the increase in the retirement age is analysed by two simulations: in the first (Simul A1) we simulate that the retirement age is fixed at 60 years from 2005 and at 61 years from 2010; in the second (Simul A2) we simulate that the retirement age is fixed at 60 years from 2005, at 61 years from 2010 and 63 from 2015. The results of these simulations, presented in Appendix 1, are compared with those of the base model, where only the introduction of the Amato and Dini reforms is simulated.

First of all, the increase in the retirement age will have an impact on the labour supply. Figures 10 and 11 show that, with respect to the base model, the increase in the retirement age determines an increase in the occupational rate and a reduction in the ratio of the number of pensioners to the number of workers. The increase in the labour supply causes a fall of the wages (figure 12) that pushes the individuals to devote more time to leisure and less to work. For this reason, the difference between the occupational rates obtained with the base model and the two simulations decreases from 2030 (figure 10). Consequently, from 2030, the base model presents a rate of growth of the number of workers higher with respect to the models with the increase in the retirement age (figure 13).

The evolution of the wages affects the decision concerning the fraction of time devoted to studying and, consequently, the growth rate of the productivity related to the human capital \( (g_{H_t}) \). Until 2025, the fall of the wage rate in the two simulations in which the retirement age increases, determines a reduction of the fraction of time devoted to studying (figure 14). The growth rate of the productivity related to the human capital, which depends on the weighted average of the productivity levels of each agent, will always be lower with respect to the base model (figure 15).

The macroeconomic effects of the increase in the retirement age are positive until 2035. Initially, the reform permits a more favourable evolution of the ratio of investments to GDP (figure 16). This is due to the fact that the reform, until 2040, causes a strong fall of the pension system’s deficits, which
permits to reduce the taxation level (figure 17) and, consequently, to increase the savings of the age groups. The increase in the occupational rate and the higher capital accumulation determine a better evolution of the GDP (figure 18) and of the per capita GDP (figure 19). However, from 2040, the increase in the retirement age involves a less favourable evolution of the GDP growth rate because the rate of growth of the number of workers and the rate of growth of the productivity related to the human capital are lower with respect to the base model.

With regard to the impacts on the pension system, figures 20 and 21 show that initially the increase in the retirement age has a positive impact on the financial situation of the pension system. With respect to the base model, the introduction of the reform that increases the retirement age at 60 years from 2005 and at 61 from 2010 (Simul A1) will permit a reduction of the ratio of the deficit of the pension system to the GDP of about 1% in 2010, 1.1% in 2012 and 0.4% in 2035. The introduction of the reform that increases the retirement age to 63 from 2015 (Simul A2) will permit a more important reduction: 1% in 2010, 1.7% in 2025 and 1% in 2035.

On the other hand, from 2045, the reduction of the deficit of the pension system is negligible, i.e. in the long run the increase in the retirement age has no positive effects. In order to understand this point, we have to consider that the Dini reform, with the introduction of the contribution based method, aimed to penalise early retirement. With the old method, i.e. the earning based method, if an individual decided to work one year less (or more), the decrease (or the increase) in the value of the pension was not so important. The absence of any link between the value of the pension and the contributions paid was obviously an incentive for the earliest possible retirement. By the contrast, with the new method and the presence of an actuarial correlation between the value of the pension and the contributions paid, if an individual decides to work one year less (or more), the decrease (or the increase) in the value of the pension is more relevant. As a consequence, the increase in the retirement age causes an increase in the value of the pensions (independently of the method of calculation) but this increase is more important with the application of the new method. As we can see in table 7, from 2045 the majority of the pensioners receives a pension calculated with the new method. Then, from 2045, with respect to the base model, the increase in the value of the contributions, obtained thanks to the increase in the number of the workers, is compensated by the increase in the value of the pensions. Consequently, the positive effect of the increase in the retirement age on the financial situation of the pension system disappears.
Table 7: method applied to the age groups (old = old method, P = pro-rata method, New = new method)

Now we will consider the implicit rate of return of contributions which represents the rate that equalises the capitalised value of the contributions paid and the present value of the pensions obtained. The implicit remuneration of the contributions varies over time and according to the retirement age of the individual. As we can see in table 22, the increase in the retirement age does not affect appreciably the value of the implicit remuneration of the contributions and the differences among the three simulations mainly depend on the evolution on the GDP which represents the rate of capitalisation of the social security contributions.

To conclude, we analyse for each generation the gains and the losses related to the new reform by using the generational accounts approach introduced by Auerbach, Gokhale and Kotlikoff (1994). As we can see in table 23, the analysis begins with the generation born in 1935, which becomes active in 1955, retires in 1993 and will die in 2020 (85 years old). For each generation, we compute the ratio of the present values of the revenues (pensions and per capita government expenditure) to the present value of the payments (direct taxes and social security contributions). In the base model, we consider a representative individual who stops working at 58 years of age. In the simulation A1, we consider an individual who stops working at 58 years of age until 2003 and at 61 years of age from 2011. In simulation A2, with respect to the simulation A1, we consider an individual who stops to working at 63 years of age from 2018.

The results of this analysis are indicated in figure 24. With regard to the base model, we can note that the value of this index decreases starting from the generation born in 1960 because the introduction of the pro-rata and the new methods will determine a reduction of the value of the pensions and because of the strong increase of the taxation rate.
In particular, the increase in the retirement age at 61 years of age since 2011 (Simul A1) causes a strong fall of the index for the generation born in 1950, which is the first generation that must work until 61 years old and, consequently, to pay more contributions. With the second simulation (Simul A2) there is a strong fall of the index for the generation born in 1950 (which is obliged to work until 61 years old) and even more for the generation born in 1955 (which must work until 63 years old). For the following generations and until the generation born in 1965, the increase in the retirement age will improve the evolution of the index, with respect to the base model, thanks to the strong reduction of the taxation during the period 2010-2035. On the other hand, starting from the generation born in 1970, the positive effect of the reduction of the taxation disappears and the value of the index in the two simulations which imply the increase in the retirement age will be lower with respect to the base model.

6 Effects of immigration policies

In this section we analyse the impact on the macroeconomic system and on the pension system of the introduction of different immigration policies. In the base model, we have already introduced the immigration in order to correctly reproduce the Italian demographic trends. We supposed a migratory flow of about 100,000 – 120,000 unit per annum, according to the Istat’s assumptions. Now we will consider two scenarios:

- 100,000 immigrants per annum more that the Istat’s assumptions, from 2010 (Simul B1);

- 200,000 immigrants per annum more that the Istat’s assumptions, from 2010 (Simul B2).

Initially, we will consider the effects of these immigration policies on the demographic evolution. The increase in the migratory flows determines a strong reduction of the dependency ratio (figure 8) and an increase of the part of immigrants in the total population (figure 9). In particular, if we consider the B2 scenario, in 2045 the dependency ratio will be 51% against 68% in the basic case, i.e. without the immigration policy, and from 2045 the immigrants would represent more than 25% of the total population, against 4% in 2005.
Figure 8: dependency ratio

Figure 9: immigrants / total population

In the simulations, the two immigration policies are considered as alternatives to the Berlusconi reform. Consequently, in these two simulations the retirement age is not modified. The results of two simulations, presented in Appendix 2, are compared with the results of the model with the increase in the retirement age at 60 years of age since 2005 and 61 years of age since 2010 (Simul A1).

Figure 25 shows that the immigration policies determine an increase in the number of the workers with respect to the number of the pensioners. This involves a considerable fall of the wages with respect to the model with the increase in the retirement age (figure 26) that pushes young people to study less (figure 27). Even if in two simulations the rate of growth of the productivity related to the human capital is always lower (figure 28), the strong increase in the number of the workers permits a favourable evolution of the GDP (figure 29). On the other hand, given the assumption that the immigrants are less productive then the natives, the per capita GDP will be lower with respect to the model with the increase in the retirement age (figure 30).

With regard to the pension system, with the exception of the first period when the increase in the retirement age (Simul A1) determines a very positive effect, from 2030 the immigration policies taken into account permit a strong improvement of the financial conditions in term of deficit (figure 31) and in term of the total expenditure (figure 32). In particular, in the scenario B2 the ratio of the deficit of the pension system to the GDP will be of about 2.9% in 2040 and 0.4% in 2055 (against 4.3% in 2040 and 1.4% in the case of the increase in the retirement age).

7 Conclusions

The reforms introduced during the Nineties (Amato reform in 1992 and Dini reform in 1995) are not sufficient in the long term, because the equilibrium of the pension system will not be reached, and in
the short term, since during the transition phase the pension system will produce deficits of about 3 - 4% with respect to the GDP. For this reason, the introduction of a new reform seemed inevitable. In 2004 the Berlusconi government has introduced a reform that increases the retirement age from 2008.

The objective of this paper is to evaluate the impacts of this reform on the Italian pension system, and in general on the macroeconomic system, by using an overlapping-generations general equilibrium model.

We have simulated two scenarios. In the first scenario, the retirement age is fixed at 60 years of age from 2005 and at 61 years of age from 2010; in the second scenario the retirement age is fixed at 60 years of age from 2005, at 61 years of age from 2010 and 63 years of age from 2015. The results of these simulations were compared with those of the base model, where only the introduction of the Amato and Dini reforms is simulated.

The results show that the increase in the retirement age will permit a significant improvement of the financial conditions of the pension system until 2040. By the contrast, after 2040, the positive effect related to the increase in the labour supply is compensated by the reduction of the wages and of the working participation of the age groups (that reduces the value of the contributions paid by the workers) and mainly by the increase in the value of the pensions since with the new method the value of the pension is related on the value of contributions paid and the transformation coefficient which depends on the retirement age. Consequently, from 2045, the increase in the retirement age has no positive impact on the financial conditions of the pension system.

From the point of view of equity among the generations, the generational accounts approach shows that the Amato and Dini reforms will penalise the generations born after 1965, because of the reduction of the value of the pension (related to the application of the pro-rata and the new methods) and of the increase in the level of taxation. With respect to this situation, the Berlusconi reform will cause a strong loss starting from the generation born in 1950, i.e. the first generation that must work until 61 years old. Moreover, in the long run, the index will be always lower with respect to the case where the reform is not introduced.

Then, the reform will determine a very positive impact in the short run, but it will be completely unproductive in the long run and will penalise the generations that must work more.

Then we took into account an alternative reform to the increase in the retirement age, i.e. an immigration policy that permits to increase the number of workers and to reduce the dependency ratio. We considered two scenarios: with respect to Istat’s assumptions, in the first scenario we assume an
additional migratory flow of 100,000 units per annum and, in the second, an additional migratory flow of 200,000 units per annum. We saw that the short run results of the introduction of the immigration policies on the pension system are less powerful with respect to the case of the increase in the retirement age. On the other hand, in the long run, since the retirement age does not change and, consequently, the value of the pension obtained by each pensioner does not vary considerably, the increase in the number of workers with respect to the number of pensioners will permit a clear improvement of the financial conditions of the pension system. In the long run, therefore, an immigration policy is undoubtedly more effective with respect to the increase in the retirement age.

Of course the model does not consider the problems of social nature concerning the integration of the immigrants in the Italian society. The second scenario, for example, implies a migratory flow triple with respect to the migratory flow envisaged by Istat and the ratio between the number of immigrants and the total population will be about 25% from 2045, which makes the policy migratory difficult to set up.

References


APPENDIX 1

Base model: Amato and Dini reforms.


Simul A2: retirement age: 60 years old from 2005, 61 years old from 2010 and 63 years old from 2015.

Figure 10: occupational rate

Figure 11: n. retirees / n. workers

Figure 12: wage per unit of effective labour

Figure 13: rate of growth of the number of workers

Figure 14: time devoted to schooling

Figure 15: productivity growth rate ($g_{H_i}$)
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a) Base model

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<tr>
<td>2040</td>
<td>1.65%</td>
<td>1.57%</td>
<td>1.48%</td>
<td>1.38%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2050</td>
<td>1.54%</td>
<td>1.46%</td>
<td>1.37%</td>
<td>1.28%</td>
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</table>

b) Simul A1

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<tr>
<th>retirement age</th>
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<th>58</th>
<th>59</th>
<th>60</th>
<th>61</th>
<th>62</th>
<th>63</th>
<th>64</th>
</tr>
</thead>
<tbody>
<tr>
<td>years of contributions</td>
<td>35</td>
<td>36</td>
<td>37</td>
<td>38</td>
<td>39</td>
<td>40</td>
<td>41</td>
<td>42</td>
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<tr>
<td>2000</td>
<td>2.92%</td>
<td>2.71%</td>
<td>2.48%</td>
<td>2.25%</td>
<td>2.04%</td>
<td>1.82%</td>
<td>1.59%</td>
<td>1.35%</td>
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<tr>
<td>2010</td>
<td>2.00%</td>
<td>1.77%</td>
<td>1.54%</td>
<td>1.30%</td>
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</tr>
<tr>
<td>2020</td>
<td>1.95%</td>
<td>1.78%</td>
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<td></td>
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<tr>
<td>2030</td>
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<td></td>
<td></td>
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</tr>
<tr>
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<td></td>
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<td></td>
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<tr>
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<td>1.29%</td>
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c) Simul A2

Table 22: implicit rate of return of contributions
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<th>Birth</th>
<th>Death</th>
<th>Base model</th>
<th>Simul A1</th>
<th>Simul A2</th>
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<td>1945</td>
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<td>2003 58</td>
<td>2003 58</td>
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<td>2008 58</td>
<td>2011 61</td>
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<td>1955</td>
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<td>2013 58</td>
<td>2016 61</td>
<td>2018 63</td>
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<td>1960</td>
<td>2045</td>
<td>2018 58</td>
<td>2021 61</td>
<td>2023 63</td>
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<td>1965</td>
<td>2050</td>
<td>2023 58</td>
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<td>2038 58</td>
<td>2041 61</td>
<td>2043 63</td>
</tr>
<tr>
<td>1985</td>
<td>2070</td>
<td>2043 58</td>
<td>2046 61</td>
<td>2048 63</td>
</tr>
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<td>1990</td>
<td>2075</td>
<td>2048 58</td>
<td>2051 61</td>
<td>2053 63</td>
</tr>
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</table>

Table 23: generations considered in the generational accounting analysis

Figure 24: present values of revenues / present value of payments
APPENDIX 2


Simul B1 : + 100 000 immigrants per annum from 2010
Simul B2 : + 200 000 immigrants per annum from 2010

Figure 25: n. retirees / n. workers
Figure 26: wage per unit of effective labour
Figure 27: time devoted to schooling
Figure 28: productivity growth rate ($g_{Ht}$)
Figure 29: GDP growth rate
Figure 30: per capita GDP growth rate
Figure 31: pension system deficit / GDP

Figure 32: pension expenditure / GDP