DISCUSSION PAPER SERIES

No. 3439

ASSESSING THE POLITICAL SUSTAINABILITY OF PARAMETRIC SOCIAL SECURITY REFORMS: THE CASE OF ITALY

Marcello D'Amato and Vincenzo Galasso

PUBLIC POLICY

Centre for Economic Policy Research

www.cepr.org

Available online at: **www.cepr.org/pubs/dps/DP3439.asp**

ISSN 0265-8003

ASSESSING THE POLITICAL SUSTAINABILITY OF PARAMETRIC SOCIAL SECURITY REFORMS: THE CASE OF ITALY

Marcello D'Amato, Università di Salerno
Vincenzo Galasso, IGIER, Università Bocconi and CEPR

Discussion Paper No. 3439
June 2002

Centre for Economic Policy Research
90–98 Goswell Rd, London EC1V 7RR, UK
Tel: (44 20) 7878 2900, Fax: (44 20) 7878 2999
Email: cepr@cepr.org, Website: www.cepr.org

CEPR Discussion Paper No. 3439

June 2002

ABSTRACT

Assessing the Political Sustainability of Parametric Social Security Reforms: The Case of Italy*

Recent reforms of the Italian social security system (Amato-Dini reforms) aimed at reversing the upward trend in Government pension spending. The main provisions of these reforms are: i) the adoption of a (unfunded) defined contribution system as a basis for computing pensions benefits, ii) a sharp reduction in the incentives to retire early, iii) an increase in the statutory retirement age, and iv) the indexation of pensions to price inflation rather than to wage growth. This Paper evaluates the long-run political sustainability of this new pension system. We use a general equilibrium model calibrated to reproduce the main Italian demographic, economic and political aspects as well as the social security system before and after the reforms. We simulate our model to compute the equilibrium tax rate that is preferred by a majority of voters at steady state, i.e., in the year 2050, given the structural characteristics of the Italian economy and for different retirement ages. To evaluate the effectiveness of the reforms, we compare the equilibrium tax rate under the new regime with the equilibrium tax rate that would have prevailed in the absence of reforms. Two main aspects of the aging process are relevant to our analysis: i) the increase in the dependency ratio, which reduces the profitability of the (unfunded) social security system and ii) the increased political influence of the elderly voters. Our simulation suggests that, to retain its political sustainability under the Amato-Dini regime, the equilibrium social security tax rate has to increase from 38% in 1992 to 48.9% in 2050. At steady state, the most effective provision of the reform in reducing pension spending is an increase in the retirement age. The switch to a (unfunded) defined contribution system has mainly redistributive implications, while eliminating the indexation of pension benefits to wage growth induces a majority of voters to increase the replacement rate at retirement.

JEL Classification: D72, E17 and H55
Keywords: defined benefits, demographic dynamics and political equilibria

Marcello D'Amato
CSEF
Dipartimento di Scienze Economiche
Università di Salerno
84084 Fisciano (SA)
ITALY
Tel: (39 089) 96 2074
Fax: (39 089) 96 3169
Email: damato@diima.unisa.it

Vincenzo Galasso
IGIER
Università Bocconi
Instituto di Economia Politica
Via Gobbi 5
20136 Milano
ITALY
Tel: (39 02) 5836 5319
Fax: (39 02) 5836 5343
Email: vincenzo.galasso@uni-bocconi.it

For further Discussion Papers by this author see:
www.cepr.org/pubs/new-dps/dplist.asp?authorid=145445

For further Discussion Papers by this author see:
www.cepr.org/pubs/new-dps/dplist.asp?authorid=137398

* We thank Giampaolo Arachi, Roberto Artoni, Giuseppe Bertola, Paola Casavola, Giuliano Cazzola, Elsa Fornero, Marco Maffezzoli, Franco Peracchi, Paola Profeta, Guido Tabellini and participants at the workshop 'Pensioni. Davvero una verifica?' at the Ministero dell' Economia e delle Finanze, Rome, and at a IGIER-Università Bocconi seminar for useful comments. Giuseppe Maraffino provided excellent research assistance and Fondazione Rodolfo De Benedetti partially financed this project. Any remaining errors are ours.

Submitted 06 June 2002

1. Introduction

In the early 90s, the evolution of the Italian pension system had created great concern among experts and politicians. In 1990, pension expenditure amounted to 14.4% of GDP compared to an average of 9.2% among Oecd countries. The upward trend has been mainly due to the aging process, the system generosity and the strong incentives to retire early. Figures on future demographic dynamics were far less than soothing for the expected financial sustainability of the public system in the long run.

The Amato reform passed in 1992 as a measure to cope with the financial distress of the government budget and the Dini reform in 1995 have introduced many provisions aimed at eliminating the long run financial unbalances of the public pension system. The main aspects of the reforms are: i) the switch from a (unfunded) defined benefits to a (unfunded) defined contributions system as a basis for computing pensions benefits (Dini), ii) a sharp reduction in the incentives to retire early (Dini), iii) an increase in the statutory retirement age (Amato), and iv) the indexation of pensions to price inflation rather than to wage growth (Amato).

Despite the consensus obtained not only – as necessary – in the Italian Parliament but also among scholars (among others see Castellino, 1995, and Peracchi and Rossi, 1996), some aspects of the reforms have also been criticized (see Gronchi and Aprile, 1998, and Giarda, 1998). These critical aspects are related to the long run financial sustainability of the system in the new regime and to its excessively slow transition. In particular, the crucial question is: will the Amato and Dini reforms be able to reduce the size of the pension system given the forecasted further aging of the population?

In this work, we analyze the political sustainability of the Italian social security reform in the year 2050. We introduce a political economics model, in which individuals play the double role of economic agents and of voters in the elections that determine the size of the social security system. With this framework, we provide a quantitative analysis of the size of the pension system – measured by the equilibrium tax rate – chosen by a majority of voters given the institutional framework introduced by the reforms – i.e., defined contributions system, retirement age, and price indexation – and the demographic structure expected for the next 50 years.

In particular, we focus on the possible destabilizing implications of future revisions of the conversion coefficient used to calculate the pension benefits. In fact, chapter 11 of the Dini reform allows such coefficients to be modified every ten years. As the Italian population ages, there will be growing political pressure to increase them. Hence, the difference between the simulated conversion coefficients – or analogously the social security tax rate – obtained in our politico-economic model and those provided by other agencies, such as the Bank of Italy, the Treasury Ministry or INPS, should be viewed as a measure of the political pressure – due to the aging process – that the policymakers will face to increase pension benefits in 2050.*

Two main aspects of the demographic dynamics are crucial in our analysis. First, in unfunded (PAYG) systems, the aging of the population reduces the profitability of the system – measured for example by the internal rate of return – since it increases the dependency ratio, i.e., the ratio between the number of beneficiaries – the retirees – and of contributors to the system – the workers. If the labor productivity does not increase enough to offset this effect, the overall profitability of the system decreases. In this light, the figures

provided by ISTAT on future demographic dynamics are gloomy, since they forecast a substantial increase in the elderly dependency ratio – the ratio of the population older than 60 to the population between 18 and 59 years old –from the 29% in 2000 to 47% in 2050. Second, aging implies a larger share of elderly voters in the population. This is relevant in a politico-economic analysis of the pension system. Since elderly voters, coeteris paribus, tend to prefer a larger and more generous system, aging will increase the relevance of pension spending on the agenda of the policymakers. An indicator of the political importance of elderly voters is given by the median age among voters. In 1992, this median age was 44. In 2050 – when the reform is expected to cover the entire population – estimates by ISTAT suggest that the median age will be around 57.

Two elements are crucial to evaluate the political sustainability of these reforms[1]: the intergenerational and the intragenerational redistributive effects built in the system. To appreciate how relevant these intergenerational redistributive aspects have been in shaping social security design in Italy, Beltrametti (1995) and Peracchi and Rossi (1996) estimate that the Dini reform in 1995 has reduced the pension wealth of workers who were less than 40 years old, while leaving the pension wealth of those who were older than 40 years untouched. In other words, the cost of the reforming the social security system has mainly be born by a minority – the young workers – in order to preserve the claims of the political majority. As for the intragenerational redistribution aspect, Castellino (1995), Gronchi (1998) and Gronchi and Aprile (1998) suggested that the adoption of a defined contribution system has increased the intragenerational equity, thereby raising the political support in favor of the Dini reform.

Our overlapping generations general equilibrium model is calibrated to match the main Italian demographic (population structure and age conditional surviving probabilities), economic (wage and productivity growth) and political aspects (participation rate at election by age and education) as well as the most relevant institutional features of the Italian social security system before and after the reforms. Our model incorporates both the intragenerational and the intergenerational redistributive component of social security and allows us to evaluate the political sustainability of the reforms in the year 2050, i.e., when all workers and retirees will be covered by the provisions introduced by the reforms. In particular, we simulate the model to quantify the equilibrium tax rate of the social security system as preferred by a majority of voters in 2050 under the rules established by the Amato-Dini reforms, and for different retirement ages. This equilibrium tax rate will be compared to the one that would have prevailed in absence of reforms, in order to obtain a measure of the incidence of the reforms on the size of the system.

It is important to stress that, for a given dependency ratio, in our model the equilibrium tax rate determines the overall generosity of the system. After the Dini reform, the link between the tax rate, and thus the collected revenues, and the benefits is given by the conversion coefficients, which, at retirement, transform the capitalized contributions of a worker during her working life into a stream of pension benefits. The Dini reform fixed these conversion coefficients, which vary according to the retirement age, and suggested that they should be changed – every 10 years – to account for any longevity gain. In our model, since the social security budget is balanced every period, voting over the equilibrium tax rate is equivalent to vote over these conversion coefficients. In other words, we are assuming that current reforms can not commit future voters' decisions over social

[1] For a survey on the political economics of social security reforms, see Galasso and Profeta, 2002.

security. Gronchi and Aprile (1998), Peracchi and Rossi (1996) and, albeit from a different perspective, Giarda (1998) have also argued that this system of coefficients constitutes a weakness of the reform, since they can easily be modified by future policy-makers under electoral pressure. In this respect, our simulations provide a quantitative evaluation of the effects of the political pressure on the generosity of the system.

To address the main redistributive aspects of the reforms we calibrate two versions of our model to the Italian economy, and in particular to the pension system for private employee (Fondo Pensioni Lavoratori Dipendenti, FPLD). Our economy is populated by overlapping generations of workers and retirees. In the basic version of the model, agents are only heterogeneous with respect to age. In the second version, they also differ with respect to education level, income, survival probabilities and retirement age. In every period, agents decide how much to save. Workers contribute a fraction of their labor income to the system, and, at retirement age, they receive an annuity – the pension benefit – whose amount depends upon the specific regime under analysis.

The pension system we consider – the FPLD – is an unfunded system, which in the last few decades has been partially financed through general taxation. In our model, we concentrate instead on the FPLD equilibrium tax rate, which would allow total benefits to equal total revenues, and we disregard any redistributive implications due to the general taxation financing. In any period, this tax rate is determined by majority voting. To characterize the economy and the social security system before the reform, we calibrate the parameters of the model so that in the initial steady state a majority of the voters chooses the average equilibrium tax rate prevailing in the decade previous to the reforms.

The two versions of the model, with the values of the parameters pinned down in the initial steady state, are then fed with the demographic and economic scenarios expected for the year 2050. We simulate the size of the system as preferred by future voters for two alternative institutional scenarios: a) the regime prevailing before the reforms and b) the Amato-Dini regime, which features an increase in the retirement age, the adoption of the contributory system, and the price indexation rather than wage indexation.

The results obtained in the basic version of the model suggest that, in absence of the Amato-Dini reforms, the aging process would have driven the equilibrium tax rate supported by majority voting from 38% in 1992 to 58,1% in 2050. The provisions in the Amato Dini reforms are able to limit the increase in the size of the system only partially. The equilibrium tax rate chosen under majority voting in the new regime would be equal to 51%, for an average retirement age of 62 years, and to 46.8% if retirement age is 65. Notice, however, that a raise in the retirement age would induce voters to increase the generosity of the system, i.e., the replacement rate, through a change in the conversion coefficients.

The results of the second version of the model, in which heterogeneity in education, income, electoral participation, surviving probabilities and retirement age is also considered, confirm that the new regime is only partially able to reduce the upward trend in the size of the social security system. With this model, we are able to identify some important intragenerational redistributive effect of the reform in favor of less educated, or lower income, agents. The bottom line of the analysis is that, given the expected demographic scenario, the only feature of the new regime that appears to have a relevant impact on the equilibrium tax rate, and consequently on the size of the system, is an increase in the retirement age.

The remaining of the paper is organized as follows: in section 2 we describe some institutional details of the social security reform in Italy. In section 3 and 4 the politico – economic model is introduced, demographic data are discussed and the calibration is presented. Section 5 reports the results and section 6 concludes.

2. The Italian Social Security System: Amato-Dini-Prodi Reforms

The reforms of the social security took place in the 90s, through a series of legislative actions: the Amato Reform (Dlgs n.593 1992), the Dini reform (Legge 335, 1995), and the Prodi reform (art. 59, Legge 449, 1997). The general principles inspiring the whole legislative process are stated in the Dini reform (Art.1). The main objective is the stabilization of the government expenditure for pensions over the GDP to be obtained through new criteria for computing pension benefits, new eligibility criteria, the progressive harmonization of the different systems prevailing in the different sectors of the labor markets and the provision of incentives for private pensions funds to complement the public system.

Contributors to the literature on the reform process in Italy – see, to quote a few, Brugiavini and Fornero (2001), Castellino (1995), Castellino and Fornero (1997), Diamond (1999), Franco (2000), Giarda (1998), Gronchi (1998), Gronchi and Aprile (1998), Peracchi and Rossi (1996) and Tumbarello (2000) – share the common view that these reforms were aimed at ensuring the financial balance and at establishing some equity criteria for redistributive concerns. As such, they represent an important breakthrough with respect to the past legislation.

The Italian social security system before the reforms was an unfunded, defined benefits system. Benefits were computed on the basis of the average wage received by the employee in the last five years of his working career. To complement the unfunded pillar of the previous system there existed a – quantitatively less important – funded pillar called "trattamento di fine rapporto" (TFR), which essentially represented a form of severance payment. Contributions to this funded pillar were retained by the firm in a special account (from which the name TFR originates) as a debt towards the worker to be paid at the extinction of the labor contract. Contributions to the fund yielded a fixed interest rate – administratively set – which was typically much lower than the interest rate available on the financial markets. Another characteristic of the previous regime was the large heterogeneity in the coverage of the workforce according to the different sectors of the economy they belonged to. Such regime emerged as the sequence of – often overlapping – legislative actions, which had defined a set of characteristics, in terms of contribution rate, eligibility criteria, retirement age and benefits formula, that could greatly differ across the sectors of the labor market[2]. This lack of a unitarian design is among the reasons leading to the excessive generosity of the system.

The Amato reform introduced a gradual increase in the retirement age and in the minimum contribution requirements to be eligible for old age (pensione di vecchiaia) and seniority pensions (pensione d'anzianità), a common discipline regarding the entitlement to

[2] See Gronchi (1995) for a study of the different rate of returns in different sectors and its perverse redistributive effects across income classes.

pension benefits while still working as an employee or a self employed, the indexation of pension benefits to inflation (rather than wage growth) and regulations about the transition.

The Dini reform – despite being based on the same principle of budgetary discipline – completely redesigned the architecture of the system. It introduced the defined contribution principle for the computation of the pension benefits, eliminated the seniority pensions and devised a new set of rules to govern the transition. Other norms completed the harmonization process of making the system more homogeneous across sectors and stated the commitment by the Government to provide incentives to the private pension pillar to complement the unfunded pillar.

The Prodi reform further extended the share of the workforce covered by the new regime, restated the principle of indexation of pension benefits to inflation and reduced the length of the transition period.[3]

For convenience, we hereby report the aspects of the reforms that are more relevant for our analysis. With the Amato reform:

i) the retirement age increased from 55 to 60 for women and from 60 to 65 for men;

ii) the minimum number of years to be eligible for an old age pension increased from 10 to 15, and then to 20 along the transition;

iii) pension benefits have been indexed to inflation rather than to wage growth (with the possibility for the Government to further intervene in the context of the annual Budgetary Law in cases of financial distress);

With the Dini reform:

iv) the defined contribution principle has been introduced in the computation of pension benefits. This computation has been applied pro quota to workers with seniority below 18 years in 1995, while workers with higher seniority have their benefits computed according to the old regime. The new contributive system is only figurative tough. Each worker has a personal figurative fund where her contributions (33% of her wage) are accrued during her working career. The interest rate is computed as a five years moving average of the nominal GDP growth. At retirement, the accumulated asset value is transformed into an annuity by applying a conversion coefficient, which is a function of the expected life at retirement and is increasing in the actual retirement age;

v) seniority pensions are abolished and criteria for eligibility to old age pension are redefined. In particular the new system introduces for private employees between 57 and 65 the right to choose retirement age under a minimum of 5 years seniority.

The main critical aspects of these reforms, as discussed in the literature, are two: the length of transition from the old to the new regime and the financial sustainability of the new regime at steady state. A shared opinion among experts – see Franco (2000) and references therein – is that the transition from the old to the new regime will be too slow and gradual. At the core of the problem is the decision to guarantee the claims to workers with seniority higher than 18 years in 1995. This decision will induce an extremely slow improvement in the financial unbalance of the social security budget and furthermore violates a notion of intergenerational equity by placing most of the burden of the transition on the younger generations. Both issues – the speed of transition and which claims on pension benefits to guarantee and how to allocate the costs of transition among generations – belong to the realm of politics. We do not explicitly deal with the political sustainability of the transition process. However, the work by Beltrametti (1995, 1996) and Castellino

[3] For a critical evaluation see Giarda (1998).

(1994) may be suggestive of the restrictions that political sustainability has imposed upon the design of the transition process in the Amato and Dini reforms and in the reform attempt by the Berlusconi government (See box D).

Some doubts may also be cast on the long run financial sustainability of the system in the new regime. As argued in Peracchi and Rossi (1998), Giarda (1998), Gronchi and Aprile (1998) some existing rules are not necessarily in line with the aim of the reforms to build a two pillars social security system, in which the public PAYG pillar is budget balanced, provides a defined rate of return, and does not crowd the development of a complementary funded pillar out. These studies have argued that the reformed system is not robust to manipulation – for electoral reason – of the criteria for computing pension benefits. For instance, annuity pension benefits are computed by using a conversion coefficient, which depends on the retirement age and on the expected life at retirement. These coefficients, which are reported in Table A of an Annex to the Dini law, have been computed according to actuarial principle in order to provide, given the retirement age and the expected life at retirement, an annual real internal rate of return of 1.5% on the contributions accumulated during the working period. Annuity pension benefits are then indexed at the price inflation. The lack of indexation to any real measure of economic growth – for example, to wage growth – generates the so called "pensioni d'annata". In real terms, the pension annuity will differ according to the year of retirement, and the ratio between average pension and average wage will be decreasing over time during the retirement period (Gronchi, 1998). According to Gronchi (1998) and Gronchi and Aprile (1998), the lack of indexation of the pension benefits to a real measure of economic growth and the absence of an intergenerational sharing of the productivity growth may introduce redistributive pressures. In a world in which the percentage of elderly in the population is expected to increase, the electoral pressure to pass laws that re-establish a link between pension benefits and wages may be strong[4].

Moreover, chapter 11 in the Dini reform gives the Ministry of Welfare (in agreement with the Ministry of the Economy and with the Ministerial Committee for Public Spending on Social Security, the Trade Unions and the Parliamentary Committee concerned with the specific issue) the power to modify every 10 years such coefficients "on the basis of current demographic forecasts and of the comparison between the actual dynamics of the GDP growth rate and the growth rate of wage income that is subject to contribution to the system". This rule does not describe in details how to revise these coefficients, thereby leaving a large discretionary power to the policy-makers in setting the actual size of the pension benefits in terms of the overall dynamics of the economy. Such discretionality may well be used, as argued in the literature, to respond to political pressures from the elderly who represent a growing component of the political constituency. Our model focuses on these aspects by examining the political implications of aging and quantifying the size of the public pillar in the reformed system which is consistent with these demographic and political processes.

[4] For an average retirement period of two decades, the reduction of the ratio between average pension and average wage may turn out to be quite significant. Gronchi (1998) suggests that in the history of social security institutions – in Italy and worldwide – there has been no PAYG system in which the dynamics of pension benefits was completely unrelated to the wage growth. Similar arguments are in Pizzuti (1998).

BOX A: A FUNDED PILLAR: IL TRATTAMENTO DI FINE RAPPORTO

The unfunded component of the Italian social security system is complemented by a funded pillar, called "trattamento di fine rapporto" (TFR), which represents a form of severance payment. Chapter 2120 in the Civil Code, as reformed by Act n.297/1982, requires the employer to post, as a liability in the firm's balance sheet, 7.41% of the annual gross salary. This is a debt towards the employee to be paid at the expiration of the labor contract, typically – but not necessarily – at retirement. This fund pays a regulated interest rate equal to 1.5% plus 75% of the consumption price inflation rate. From an economic standpoint, the annual contribution to the TFR fund is a part of the labor cost. However, firms effectively incur in this cost only at the expiration of the labor contract. Therefore, from the financial point of view, it represents a source of funds to finance current activities.

As reported in Castellino and Fornero (2001), the incidence of the TFR fund over the total liabilities of the firms is on average equal to 5%, both in the sample of firms covered by the Mediobanca survey and in the sample of firms covered by the Centrale dei Bilanci survey (5.880 firms over a period 1982-1997)[a]. The TFR fund therefore represents a non negligible source of funding for the firms at an artificially low interest rate. The switch of the TFR to finance the contributions to a funded pillar, such as a pension fund, would thus represent a large cost to the firms.

At the same time, the TFR fund represents an asset and a form of (forced) saving for the employees, who are however allowed to use part of – or all – the fund before retirement. Contingencies in which the employee is allowed to draw from his TFR fund are related to unemployment and liquidity risks during his working career. In this sense, the TFR fund plays also an insurance role[b].

To quantify the importance of the TFR fund regulations, notice that, in 1997, 18.500 billions liras were paid out by firms to employees on their accounts. Gross contributions to the fund amounted to 30.274 billions liras and the value of the stock was 196.000 billions (see Castellino and Fornero, 2001, for more details).

Therefore, the TFR allows firms to obtain internal funding at low cost, while it represents a form of forced savings for the workers. The main problem in reforming the TFR lies in the redistributive aspects involved in the decision to switch these contributions from the TFR to pension funds.

A possible cost of the reform for the employees is related to the role of the TFR as a buffer stock in the portfolio of the employees against liquidity shocks during their working career. This role would be lost, if the TFR were used to contribute to pension funds.

[a] In the sample considered by Palermo and Valentini (2000), the firms surveyed by Osservatorio del Gruppo Banca di Roma include 4.497 public companies with more than 11 employee. The TFR fund during the period 1995-97 was 8.8% of total liabilities, 22.3 of net equities and 50.6% of total long term debt.

[b] Current law allows workers to liquidate TFR funds before retirement for specific needs such as medical expenditures and for buying the first house.

Current reform proposals have tried to deal with this issue by subsidizing (via tax credits) the switch of these resources to the funded pillar of the social security system. Along the same lines, the reform proposal designs a smooth transition to the new regime, by ruling future contributions while leaving past contributions untouched.

The analysis of the impact of these reforms on households and firms is still in progress. According to Castellino and Fornero (2001), such reforms would increase the cost of using these resources to smooth liquidity shocks during their working career. They argue that the current legislation, due to the tight fiscal regime, penalizes the use of these resources to smooth liquidity shocks, once they have been contributed to the pension fund. For the firms, the reform of the TFR represents a cost, since it eliminates a cheap source of funding. The impact of the reform on the financial balance of the firms has been studied by Palermo and Valentini (2000). Their empirical analysis suggests that firms would substitute TFR funding with a larger demand for funds from the banks, thereby increasing the cost, especially for small firms. In particular, large firms would use long-term loans, whereas small firms would obtain short-term loans. In both cases, this would represent an additional cost of funding, estimated to be around 420 billions liras (in 1997 prices) for firms with more than 11 employees. The impact of the reform would be different depending on the sector, with firms operating in more traditional sectors bearing relatively larger costs.

3. The political economy model

To provide an analysis of the political sustainability of the Amato-Dini reforms, our model examines both the economic and the political choices of the agents, in their double role of consumers and voters. Our theoretical framework needs to capture the economic and demographic aspects, the institutional elements of the social security system before and after the reforms and the political process that aggregates the preferences of heterogeneous individuals into a policy rule.

The economic structure of the model is given by an overlapping generations general equilibrium model calibrated to the main demographic and economic features of the Italian economy. The institutional setting is given by the rules defining the system before and after the reforms. The political structure of the model is given by a voting game played by overlapping generations of voters, in which the tax rate of the social security system is determined in every period at simple majority. In what follows, we briefly describe the decisions of the individuals both as economic agents and as voters, and the Italian social security system before and after the reforms. The details of the model are in the appendix.

3.1 The Economic Environment: the Agents

In every period, corresponding to one year, our economy is populated by different generations of agents – workers and retirees – whose measure is calibrated to the Italian

demographic structure. Each agent lives at most 78 years – from 18 to 95 – and faces an age specific probability of survival.

Agents may also differ by educational level, income, longevity and working history[5]. Each agent works a fixed number of years until she reaches retirement age and is entitled to a pension benefit. The length of the working history – defined as the difference between the actual retirement age and the age of entrance in the labor market – differs according to education. Labor productivity, and hence labor income, also depends upon education and age. More educated agents tend to be more productive. Analogously, at any time, middle aged workers are more productive than young and elderly workers.

Every agent, according to her preferences and to her expected lifetime horizon, decides how much to save for future consumption. Saving is therefore endogenous in our model. As usual in these lifecycle models, agents – who are assumed to have rational expectations – tend to smooth consumption over time. The consumption profile for agents in each education group is thus relatively flat, if compared to the income profile. This saving decision is clearly affected by the coefficient of risk aversion and by the individual discount factor. To simplify the analysis, we assume the labor supply to be exogenously given both in its intensive margin (number of hours per year) and in its extensive margin (number of years in the lifetime)[6].

3.2 The Economic Environment: the Firms.

The productive structure of the economy is composed of many firms operating under perfectly competitive conditions both in the factors (capital and labor) and in the product market. This can be represented by an aggregate production function. In any period, the level of production depends on the productive factors – labor and capital – actually employed in the production. The production function is Cobb–Douglas, with constant returns to scale. Labor productivity is assumed to grow at a constant rate due to exogenous technical progress. Competitive markets entail full employment given by the amount of labor supplied by households and the amount of funds accumulated as non pension wealth in agents' portfolio. Profit maximization and market clearing define factor prices consistent with full employment.

3.3 The Institutional Environment: the Social Security System before and after the Reforms.

The Italian pension system pre and post reform is an unfunded system. In every period t every agent aged j and with an education level q contributes a fraction of her labor income

[5] We do not model the education decision explicitely. The characteristics and the relative dimension of each educational group are exogenously defined according to the Bank of Italy Household Survey data on the composition of the population by educational group.

[6] The exogeneity of the labor supply (intensive margin) does not allow to analyze the distortions introduced in the labor market by the social security tax rate. Hence, it will introduce an upward bias in our simulations. The retirement age (extensive margin) is assumed to be exogenous to analyze the political sustainability of the social security system under the different regimes.

$\tau_t w_t^{j,q}$. Total contributions in each period depends therefore upon the tax rate τ_t and upon the education specific retirement age J^q and is given by:

$$T_t(\tau_t, J^q) = \tau_t \sum_{q=1}^{Q} \sum_{j=1}^{J^{q-1}} w_t^{j,q} \mu_t^{j,q} \tag{3.1}$$

where $\mu_t^{j,q}$ represents the proportion of agents aged j and with education q.

Under budget balance the unfunded system defines a total amount of pensions to be paid to retirees, which is equal to the aggregate contributions paid by current workers. Let $P_t^{j,q}$ be the annuity paid to retiree aged j and with an education level q as pension benefit, then the balanced budget constraint of the unfunded system requires:

$$T_t(\tau_t, J^q) = \sum_{q=1}^{Q} \sum_{j=1}^{J^{q-1}} P_t^{j,q} \mu_t^{j,q} \tag{3.2}$$

In our simulations on the political sustainability of both the pre and the post reform regime, we will concentrate on the equilibrium tax rate[7] that satisfies eq. 3.2. Pre and post reform regimes differ in the computational criteria, in retirement age and in the indexation of pension annuities. In the pension system prevailing before 1992 (before the Amato reform) pension benefits at time t for an agent with education level q and retirement age J_q were computed as the product between the average wage in the last 5 years before retirement $\overline{w}_{J_q}^q$, the number of years during which the agent contributed to the system, $\nu_{J_q}^q$, and a coefficient, α, (called "coefficiente di rivalutazione degli anni di contribuzione"), which translated the number of contributions years into a replacement ratio:

$$P_{t,J_q}^q = \alpha \nu_{t,J_q}^q \overline{w}_{J_q}^q \tag{3.3}$$

Additionally, pension benefits were indexed to aggregate productivity (real wage) growth, λ. Therefore, the benefit formula we consider is:

$$P_{t+i,J_q}^q = P_{t,J_q}^q (1+\lambda_t) \tag{3.4}$$

In the post Amato-Dini reforms, pension benefits are computed on a rather different criterion, according to a defined contribution system. Contributions are only figurative, since the system remains unfunded. During their working career, agents contribute to the system a constant fraction of their labor income, $\tau_t w_t^{j,q}$, which is capitalized at an annual rate, g. At retirement age, the capitalized contributions are transformed into an annuity according to a conversion coefficient γ, which depends on the actual retirement age and on other factors such as the residual expected life at retirement. Therefore, the pension benefit under the new regime for an agent with education level q, retiring at time t with a retirement age J_q is given by:

$$P_{t,J_q}^q = \gamma \sum_{i=s^q}^{J^q-1} (1+g)^{J_q-i} w_{t-J^q-i}^{q,i} \tau_{t-J^q-i} \tag{3.5}$$

[7] In the pre-reforms case, the existence of a deficit violates this assumption, however, it greatly simplyfies our analysis. The main drawback of this assumption is that it disregards the redistributives effects that take place with the two instruments used to finance the social security deficit: general taxation and public debt.

where s^q is the initial period in the working career of an agent of education q.

Additionally, pension benefits are only indexed to inflation. Therefore, the benefit formula we consider is:

$$P^q_{t+i,J_q} = P^q_{t,J_q} \tag{3.6}$$

This stylized representation of the two regimes – before and after the reforms – will allow us to analyze the political support in favor of the social security system, taking into account what we consider the most distinctive features of the reformed regimes: (i) the increased retirement age, (ii) the price indexation rather than wage indexation and (iii) the adoption of a defined contributions method for the computation of the pension benefits in a still unfunded system.

For a given retirement age, the equilibrium tax rate defines the total amount of contributions to the system, $T_t(\tau_t, J^q)$, and – under budget balance – the total amounts of pension to be awarded. How the aggregate resource of the systems are allocated across retirees with different age and education level depends on the rules prevailing in the pre and post reform regimes as shown at equations 3.3 to 3.6. The conversion coefficients, both in the pre reform regime, α, and in the post reforms regime, γ, determine the overall generosity of the system by implicitly defining the average replacement rate (ratio between pension benefit and wage at retirement). It is important to notice that, in our model, these conversion coefficients are endogenous. They represent the outcome of the political game. In particular, for a given retirement age, a larger tax rate will increase total contribution to the system and, through the conversion coefficients, the total pension benefits to the retirees.

Notice also that in a funded system, in which benefits depend on the value of capitalized contributions at retirement age, the conversion coefficient, γ, that transforms the individual capitalized contributions into an annuity would be a function of the expected residual life at retirement, and would guarantee that the internal rate of return of the pension plan is consistent with the market interest rate.

BOX B: THE AGENTS' VOTING BEHAVIOR

Social security systems typically play several roles. They guarantee an old age income; they force people to transfer resources from their working period into the old age; they ensure against the risk of a permanent loss of working ability; but they also redistribute income intragenerationally, across individuals of the same cohort. Furthermore, the existence of a social security system has additional – general equilibrium – effects, since it tends to reduce the accumulation of physical capital, thereby affecting the prices of the production factors.

In our baseline model, voters only consider some of these aspects in taking their voting decision on the size of the social security system. As discussed in Box C, they enter into an implicit contract among successive generations, which allows their current vote to have an impact on the future of the system as well. Therefore, even voters in their working age – and thus many years away from collecting a pension benefit – may support the system, if an economic convenience arises. We quantify this economic convenience by studying the

social security system mainly as saving instrument, which entails within cohort redistributive elements, and by considering the general equilibrium effects it gives raise to.

Let us concentrate on these general equilibrium effects first. A social security system partially crowds out private saving, and thus decreases the accumulation of physical capital in the economy. This induces an increase in the return from capital – the real interest rate – and a decrease in real wages. These general equilibrium effects may thus lead to a redistribution from the workers to the capitalists. In our simulation, though, the size of this effect is rather limited[a].

To evaluate the effectiveness of a social security system as a saving device, we use the notion of continuation internal rate of return, or CIRR[b]. Each voter, in taking her voting decision over the size of the system – that is, on the social security tax rate – considers her current and future contributions to the system and her future benefits[c]. The CIRR is the discount rate that equalizes the value of the stream of current and future contributions to the value of the stream of future benefits. It is important to notice that past contributions to the system do not enter the calculation of the CIRR, since they could not be appropriated by the voters, if the system is voted down, and thus represent a sunk cost.

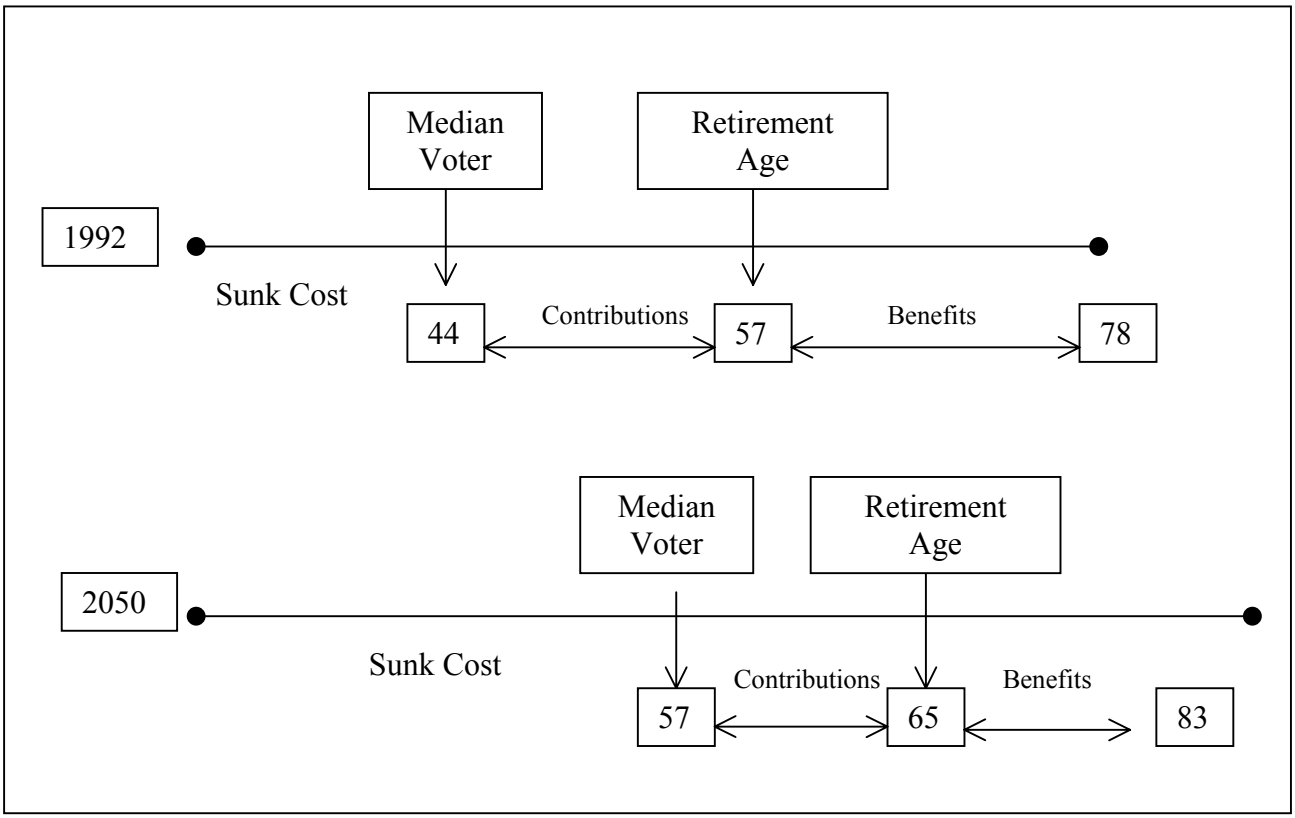
Consider now the decision of a voter with median age in 1992. Her (remaining) time horizon is displayed in the picture below. If the median retirement age is 57 years, and her life expectancy is 78 years, a 44 years old voter expects to contribute to the system for a period of 13 years, and to receive a pension benefit for the remaining 21 years. The median voter determines the amount of resources to transfer into the future through the social security system – and thus the social security tax rate – by comparing her CIRR from the system to the returns available on the capital market from assets with comparable risk, and taking into account the general equilibrium effects. In our analysis we use the average equilibrium social security tax rate from 1982 to 1991, that is, 38%.

We can now analyze the effect of population aging on this political choice about the social security system. In 2050, the demographics will be substantially different. The median age among voters is expected to be of 57 years, and life expectancy is to raise to 83 years. The retirement age should be between 62 and 65 years. Even in the case of a 65 years retirement age, though, the median voter would face a period of contributions of only 8 years, while she would be collecting pension benefits for 18 years. In this case, our simulations suggest that the social security tax rate would reach 46.8%.

[a] The change in the capital output ratio, which can be viewed as a measure of these effects, from 1992 – with a tax rate of 38% – to the year 2050 – for the tax rates associated to the different specifications of the model – is rather small: less than 2%.

[b] See Galasso (2002) for a quantitative analysis of the return from the US social security system for the median voter.

[c] See Browning (1975).



3.4. The Political Environment

Our aim is to analyze the political sustainability of the social security system in Italy after the Amato-Dini reforms and given the demographic dynamics expected for the next 50 years. By political sustainability of a specific social security regime, we mean the existence of political majority that is willing to support a given pension system in all its provisions, such as retirement age, contribution method and tax rate. In our simplified model, agents of any age and educational attainment – as voters – determine the size of the system, i.e., the tax rate τ, given the different institutional settings defined in the two different regimes and described in the previous section.

Clearly, the decision process behind any reform of a social security system is more complicated than the simple voting game considered here. Depending on the institutional context and on the historical moment, other subjects, typically trade unions and employers unions, may break the direct link between voters and politicians and play a crucial role in policy decision. Our modeling choice is to concentrate on the analysis of a simple majority voting model, since we want to stress the impact of the demographic dynamics on the political process. We thus consider the conditions under which an institution of intergenerational redistribution such as social security may arise. In this view, the social security tax rate defines the cost – to the young – and the (pension) benefit – to the elderly – that arises in the intergenerational voting game, which takes place among successive generation of agents. These reciprocal obligations are self enforced and do not require any monitoring or enforcement by any external authority (Government, Parliament, pressure

groups, etc.). The majoritarian voting model is the minimum institutional requirement to cast the analysis in this framework (see Box C for more details).

In our framework, the tax rate is the outcome of a voting game taking place in every period, in which agents of every age and educational level truthfully report their most preferred value. Each voter will choose the tax rate that maximizes her utility, given the institutional settings on the retirement age, the computation of pension benefits and the indexation rule. Income and age heterogeneity will induce different preferred levels of τ. The winning tax rate is the one agreed upon by a majority of voters, and is denoted as the politico economic equilibrium tax rate.

To understand to what extent the outcome of this stylized political system can be interpreted as a self enforcing intergenerational implicit contract, notice that – in taking her voting decision – every agent considers the impact that her choice will have on future voters' decisions. A young voter will be willing to support a specific social security regime, and thus to pay the contribution to the system, if she expects her decision to induce future workers to sustain the system until she has reached her retirement age, and can thus enjoy her pension. In this case, a social security system will emerge as an intergenerational transfer from current workers to current retirees. Such a system is not based on a constitutional right defined once and for all by some planner. Retirees' claims to a pension are rather the equilibrium outcome of a political game played by successive generations of voters according to the majority rule and could potentially be amended in the future.

BOX C: POLITICAL SUSTAINABILITY AND SOCIAL CONTRACT

The current Italian social security system is the product of a long sequence of – often overlapping – legislative actions, which have defined over time its main features. During all these processes of legislative revision, the system has – by definition – always enjoyed a "political sustainability": a parliamentary majority has always existed to support the system, often requiring amendments to its set of rules.

The relevance of these political constraints in shaping the policy decisions – particularly regarding social security issues – has been widely analyzed in the "political economics" literature, by the use of theoretical models that provide a stylized representation of these rather complex political decisions. In models of lobbying, veto power and direct democracy, economic policy decisions are respectively the outcome of the political actions of the lobbies, of the veto-power holders, or of a majority of the voters[a].

We consider a model of direct democracy. Policy decisions on social security issues depend on the voters' individual decisions (see Box B), and are aggregated by the political system at simple majority. This is clearly a rather simplified representation of the reality, since these decisions are taken by the voters' representatives, who are often under the political pressure of lobbying groups. However, this stylized model provides some empirical implications, which are supported by the data (see Box B), and represents a good framework to examine the future political sustainability of the social security system given the expected demographic dynamics.

[a] See Galasso e Profeta (2002) for a survey of the literature on the political economics of social security.

In Italy, despite the aging process and the low retirement age, the retirees do not constitute – at least yet – a majority of the voters. The political sustainability of the system thus requires the support of voters who are still in their working years. To these individuals, the support to the system comes with a direct cost: if the system is in place, they have to contribute a percentage of their (current) labor income. The future benefits associated to these contributions are instead uncertain, since the system may change before the agents reach retirement age. Thus, even if social security is an efficient saving device (see Box B), why should a current worker vote in favor of the system, and thus face a sure cost – the current contribution – while the future benefit – the pension – is uncertain? Would this agent not be better off by waiting for few year and then supporting the system only after she has reached retirement age? What induces agents to trust the system with their future pension payments?

The answer – according to Hammond (1975) – lies in the implicit social contract that arises among successive generations of individuals and that defines a set of punishments and awards for every generation. Sjoblom (1985), and later Cooley and Soares (1998), Galasso (1999), and Boldrin and Rustichini (2000) among others, identify the hypothetical signer of this intergenerational contract with the majority of the voters at each election – and thus with the median voter. Every such contract is based on self interest. At every election, a majority of the voters has to benefit from the existence of a social security system more than it would benefit from its absence (the reasons of such economic convenience are explored in Box B). What does this implicit contract, which links living generations with generations yet to be born, establish?

Consider the case of an existing system. Then the contract will require the majority of the voters to support the current system, if it is in their self-interest, i.e., if it is economically convenient to them. To improve on their current condition, the majority of the voters may even modify the existing system, as long as they do not worsen the conditions of the elderly and of the future generations so much as to induce them to dismantle the system. In fact, the contract also requires the majority of the voters to punish the voters who have previously and "inappropriately" modified the system – for instance, worsening the position of the elderly – by not providing them with a transfer.

It is easy to see that successive majorities of voters have an incentive to cope with the contract. What would have happened if they did not? If they decide not to pay the pension benefits to the current retirees, they would be punished by future voters and would not obtain their pension. In this case, they would thus live in an economy with no social security, which violates their economic convenience. If, on the other hand, a majority of voters would decide not to punish those voters who have inappropriately modified the system, they would be in turn punished by future voters for this behavior. In this case, they would have sustained the cost of contributing without receiving a pension. A strategy definitely to be avoided.

Consider now that no social security exists. A majority of voters may chose to institute one. This would give raise to an implicit contract which, as previously discussed, would be accepted by future generations of electors[b].

[b] Notice that the initial voters to institute the system may rip off more convenient economic conditions than future generations of voters.

From this brief overview of the features of these intergenerational implicit contracts, one may conclude that – once introduced – unfunded social security systems are always politically sustainable, the contract on which they rely being always honored. In fact, if today's voters expect the contract not to be complied with in the future, they would have no incentive to sign it today. However, this is not necessarily the case. As shown by Boldrin and Rustichini (2000), if there exists a stochastic element in the economy, such as the population aging, voters at a given date may be willing to sustain a social security system that will certainly be abandoned in the future, if the expected benefits from the system overcome the benefits without it. Later on, as the population aging has passed a certain threshold, voters will abandon the system, since the economic convenience has disappeared, and thus the system loses its political sustainability [c].

[c] See Galasso e Profeta, 2002, for a survey of the existing literature on the political sustainability of social security reforms

4. Data and Calibration

In this section, we analyze the Italian demographic and economic dynamics of the last decades and present the forecasts for the next 50 years. The aim is to characterize some relevant measures of the main Italian demographic, economic and political aspects during the 90s to calibrate our model to. Then, in the simulation exercises, we can use our calibrated economy to study the economic and political decisions of the agents for the different scenarios.

The long run profitability of an unfunded system, i.e., at steady state, is determined by demographics – growth rate of population and survival probabilities – and by the productivity growth rate. For example, for a given value of the tax rate, aging reduces the pension benefits by increasing the elderly dependency ratio (the ratio of agents more than 60 year old to population between 18 and 59 years old). A larger productivity growth rate, on the other hand, increases labor income, pension benefits and, as a consequence, the profitability of the unfunded system.

The recent demographic dynamics in Italy has been characterized by a steady increase in survival probabilities at any given age and by a reduced fertility rate both leading to a process of population aging. Estimates by ISTAT for the next 50 years point towards further aging. For example, the proportion of people older than 60 years over the total population is expected to increase from 29% in 2000 to 47% in 2050. A parameter measuring the effect of aging on the social security system is the elderly dependency ratio. For given retirement age and employment rate, a change in the elderly dependency ratio measures the change in the ratio between beneficiaries – the retirees – and contributors to the social security system – the workers. According to ISTAT, this ratio, which was equal to 41% in 2000, will climb to 89% in 2050: the number of retiree per worker is expected to double in fifty years.

From the point of view of our analysis, the other crucial aspect of aging is the change induced in the political representation of the different age groups. Population aging is clearly associated with the aging of the voters, which in turn increases the relevance of the

pension expenditure on the agenda of the policymakers. An indicator of the relative importance of the elderly in the electorate – and thus of the political majority supporting intergenerational transfers – is given by the median age of voters. In 1992 in Italy the median age was equal to 44. In 2050, based on ISTAT forecasts, the median age will be 57. Figure 1 shows the expected demographic dynamics from 2000 to 2050. In particular, elderly dependency ratio, the ratio of elderly over total population and the median age among the voters are reported.

4.1. Two Versions of the Political-Economic Model

In order to disentangle the two redistributive effects – intergenerational and intragenerational – associated with the reforms, we use two versions of our politico-economic model. In the first version – which we call one-dimensional – the only source of heterogeneity among agents is age. In the second version – bi-dimensional – we introduce a second element of heterogeneity: within each age cohort, agents differ by level of education and, accordingly, by retirement age, working history, income and degree of political participation.

For computational reasons, we limit the degree of horizontal heterogeneity in our bi-dimensional model. However, to avoid an ad-hoc partition in education groups, we let the data guide us in this partition. We use the 1995 Bank of Italy Survey on Consumption and Wealth. There are eight education classes in the data base, among which only five classes account for at least 5% of the total retirees. Table 1 shows the median retirement age and the frequency of these 5 groups in the Survey. The political participation rates by education, also reported in table 1, are obtained from an exit-poll at the 1999 political elections for the European Parliament, on a sample of the whole population, and refers to the turn-out rate at this round of elections.

Table 1
Agents' Characteristics by Education

Education Class	Median Retirement Age*	Frequency*	Election Participation Rate**
No education	59	8.4%	58.6%
Primary (5 yrs)	57	27.2%	75.3%
Intermediate (8 yrs)	56	26.9%	79.2%
High School (10 yrs)	57/58	26.4%	82.1%
College Degree (14 yrs)	60	6.2%	84.8%
Other	n.a.	4.8%	n.a.

*Source: Survey on Consumption and Wealth, Bank of Italy, 1995.
**Source: Exit –Poll, European Elections 1999, Abacus.

After a careful analysis of the data, we decided to aggregate agents into three education levels of similar size. The first group, low education, is made of agents with no education or with primary education. These agents exhibit an average electoral participation rate of 71.8% and retire at a median age of 57 years. The relative weight of this group in the sample is 35.6%. The second education group, intermediate education, is composed of individuals with secondary education. The average electoral participation rate is 79.2%,

agents retire at a median age of 56 and its relative weight in the sample is 31.2%. The third group, high education, consists of agents who have obtained at least a high school degree. Their electoral participation rate is 82.5%, the median retirement age is 58 and its relative weight in the sample is 33.1%.

Although in our simulations for the year 205, we retain this educational structure, a quick look at the educational attainments of today's young suggests that in 2050 only few retirees will belong to the low education group. A more realist assessment would be to consider 49% of three retirees highly educated and the remaining 51% of intermediate education. In the conclusions, we discuss the favorable effect of this generalized increase in the education level on the size of the social security system.

4.2 Calibration

The aim of this calibration exercise is to pin down the values of some key parameters of our political-economic model to match the main economic, demographic and political aspects of the Italian economy between 1982 and 1998 and the pension system in 1992 before the Amato-Dini reforms.

As previously argued, our crucial demographic indicator is given by the elderly dependency ratio. In 1992 this was equal to 36.3%. The relevant economic variables, needed to identify the long term characteristics of the economy, are the capital-output ratio and the investment-output ratio (see Cooley e Prescott, 1995). Their average value for the 1982-1998 period are respectively 3.18 and 0.2. For the political aspects of the model, we follow Galasso (1999) and calibrate the political-economic model so that, in the initial steady state, the equilibrium tax rate determined in the model is equal to the average equilibrium tax rate for the pension system for private employee (FPLD) over the period 1982-1991, i.e., 38%. These restrictions allow us to pin down the growth rate of population, which – given the survival probabilities – replicates the actual elderly dependency rate over the period in exam, the depreciation rate of the physical capital and two parameters of utility function: the subjective time discount rate and the coefficient of risk aversion. All other parameters in the model are obtained from independent empirical estimates[8].

Every period in the model corresponds to one year. Agents are born at age 18 and may live at most until age 95. Between 18 and 94, there exists an age specific probability of survival. These probabilities are obtained from ISTAT demographic tables and refer to an average by gender of the 1992 values. In our bi-dimensional model, these surviving probabilities differ by education level according to the following procedure. Survival probabilities obtained from ISTAT are assigned to agents in the intermediate education group. Survival probabilities of agents in the low education group are obtained by increasing the mortality rate by 5% at every age; while the survival probabilities of the agents in the third group – the high education level – are obtained by reducing the average mortality rate by 5%. To model the aging process, we assume that the surviving probabilities for 2050 are obtained by reducing by 20% the mortality rate of 1992 ISTAT

[8] The values of all calibrated parameters are reported in a table in the appendix.

tables[9]. Figure 2 shows the survival probabilities (average between men and women) for the intermediate group in 1992 (Istat) and 2050 (our computation).

In the production function, the parameter for the capital share is 38%, the average in our sample period 1982-98. Productivity growth rate is 1.92% per year, the average per-capita income growth rate. The number of hours dedicated to productive activities is computed considering an employment rate of 53% and a total number of hours worked equal to 40 out of a maximum[10] of 50 hours per week, and is equal to 0.423. Labor income differs by age and, in the second version of the model, by education. To estimate the labor income lifetime profile we use 1995 Bank of Italy Survey. Figure 3 shows the labor income profile by age for three education classes.

The retirement choice is exogenous. The overall median retirement age in the Bank of Italy Survey is 57. In the first version of the model, we assume a working career of 39 years: from 18 to 56. In the bi-dimensional model, both the median retirement age and the working history depend on the education level. Using the 1995 Bank of Italy Survey, we can try to reconstruct the working history for each education group. Agents in high education group have a median working history of 35 years: they start working at 23 and retires at 58. Agents in the intermediate group enter the labor market at 19 and retire at 56 (for an overall working history of 37 years), but they contribute for 35 years. To account for spells in the contributing history of agents in this group, we assume that they do not contribute to the system during their first 2 years in the labor market. Agents in the low education group have a median working history of 43 years, from 15 to 57, but contributes to the system for 30 years. This is clearly the case of individuals with discontinuous working carriers, which frequently take jobs in the unofficial labor markets. In our model, we assume that these agents work in the official sector in the period between 24 and 53. In the remaining period – between 18 and 23 and between 54 and 56 – we assume that they work in the unofficial sector. In this case, they receive a (net) wage equal to the net wage that they would obtain in the official sector but do not contribute to the system. This choice to allocate the period spent in the unofficial labor market at the very beginning and at the very end of their working history is supported by the analysis of the data on employment rate by age in the Survey on The Labor Force, Istat, 1994. There, we find that the employment rate for workers with low education is below (group) average between 15 and 19, 26, between 28 and 30 and between 54 and 65[11].

To parameterize the political system, we require the equilibrium tax rate chosen by a majority of voters to be equal to 38%, i.e., the average equilibrium tax rate between 1982 and 1991. In the one-dimensional model, the crucial political parameter is the age of the median voter, which was equal to 44 years in 1992 and is estimated to reach 57 in 2050 (see Figure 1). In the bi-dimensional version, the intragenerational redistribution elements are also relevant, and the median voter has to be identified in terms of age and education class. The data on electoral participation obtained from the Abacus at the 1999 European

[9] In our bi-dimensional model, survival probabilities for group with low (high) education are obtained by increasing (decreasing) by 5% the average mortality rate attributed to the intermediate group.

[10] The maximum number of avaliable hours to work is relatively lower than the standard values to account for the low flexibility of the Italian labor market.

[11] Notice that the profile by age of the contributions to the system does typically modify the agents' voting behavior. However, since we assume the agents to be in the unofficial sector from 15 to 23 years old, rather than from 15 to 19, at 26 and from 28 to 30, this will only have a marginal effect on the political decisions of the young electors and no effect on the elderly voters, for which they are a sunk cost.

Parliament election show that political participation is not significantly affected by age (rather differently from what is found for the US, see Galasso 2002) but differs significantly by education classes, see Table 1. Our bi-dimensional model takes this electoral heterogeneity into account in the computation of the equilibrium tax rate chosen by the median voter.

BOX D: WHO PAYS FOR THE REFORMS?

In the '90s, there have been at least three attempts to reform the Italian social security system: the Amato reform in 1992, the project of reform presented by the Berlusconi government in September 1994, and the Dini reform in 1995. Which factors have determined the political success – and thus the approval in the Parliament – of the Amato and Dini reforms? And why has the Berlusconi attempted reform failed?

To evaluate the political support in favor of the different reform proposals, we need to identify the effects of these reform packages on the net pension wealth of agents – workers and retirees – covered by the social security system. The net pension wealth represents the discounted value of the future pension benefits, which an individual is entitled to under current legislation, minus the discounted value of her future contributions to the system (Castellino, 1985). Thus, the change in the net pension wealth of an agent induced by a reform represents a measure of the costs of such reform to this individual.

Beltrametti (1995 and 1996) provided an estimate of the changes in the individual net pension wealth by age induced by the Amato and Dini reforms and those that would have been induced by the attempt of reform carried out by the Berlusconi government. These estimates may help to understand how the cost of the reforms was shared – or intended to in the case of the Berlusconi government – among workers and retirees of different age groups.

Who pays then for the reforms? As the table suggests, there is no unique answer:

- In 1992, a period characterized by a large financial imbalance of the social security system, the Amato reform represented an emergency policy action aimed at guaranteeing the financial solvency of the system in the near future, and thus the payment of the pension benefits to those who were entitled to. This reform was effective – the net pension wealth of the workers decreased by 52.9% – and both workers and retirees had to bear some of the cost of the adjustment, although in rather unequal shares. In particular, most of the cost was sustained by the young cohorts, since the net wealth of the individuals aged 30 years or less decreased by more than 100%, while the reduction was less than 5% for the workers and retirees aged 60 years or more.

- In 1994, the reform package presented by the Berlusconi government aimed at a further correction of the financial unbalance of the system. The reduction of the net pension wealth of the workers was estimated to be around 27.5%. However, unlike the Amato reform, this reduction, which was not meant to affect the retirees, was to be equally spread among workers of different age groups. In other words,

young cohorts were not to be more penalized than middle aged or elderly workers.

- In 1995, the Dini reform introduces important differences with respect to the package proposed by Berlusconi on the previous year. First, the reform is milder, as the reduction in the net pension wealth of the workers is only 11%. Second, the costs of this reform are shared very unequally among individuals – even more than in the Amato reform – since they are exclusively born by individuals with less than 40 years of age.

Thus, these estimates by Beltrametti (1995 and 1996) suggest that the political success of the Amato and Dini reforms – as opposed to the Berlusconi's attempt – may be due to the decision of placing of a larger share of the costs of the reforms on the young generations of workers. While the Amato reform was presented as an emergency package to correct the short term financial unbalance of the system, the successive reform's attempts were perceived as long term restructuring of the system – despite pursuing a milder decrease in the net pension wealth – and the decision on how to share their costs played a crucial role in their success (Dini) or failure (Berlusconi).

In fact, since the majority of the voting population in 1995 was older than 44 years, the Dini reforms was supported by a majority of voters – workers and retirees – to which the reform came at zero cost and that helped to guarantee the payment of their accrued pension benefits. It is not surprising then that the reform package proposed the year before by Berlusconi – which featured a reduction in the net pension wealth of workers elderly than 40 years – did not enjoy the same political support.

The Effects of the Reforms on the Net Pension Wealth by Age

	Amato Reform [a]				**Berlusconi Proposal[a]**		**Dini Reform[a]**	
	Before	**After**	**Δ**	**Before**	**After**	**Δ**	**After**	**Δ**
15-19	28	- 31	- 59	-48	- 52	- 4	- 56	- 8
20-24	152	- 50	- 202	-101	- 116	- 15	- 128	- 27
25-29	276	- 43	- 319	-112	- 131	- 19	- 145	- 33
30-34	347	46	- 301	-20	- 56	- 36	- 63	- 43
35-39	415	198	- 217	139	71	- 68	99	- 40
40-44	504	282	- 222	227	174	- 53	227	0
45-49	497	349	- 148	306	251	- 55	306	0
50-54	533	441	- 92	402	338	- 64	402	0
55-59	394	360	- 34	339	238	- 101	339	0
60-64	183	177	- 6	168	160	- 8	168	0
65+	79	76	- 3	74	74	0	74	0
Workers	3.407	1.802	- 1.605	1.375	997	- 378	1.225	- 151
Retirees	2.660	2.527	- 133	2.710	2.710	0	2.710	0

Source: Beltrametti (1995, 1996)
Note: [a] in billion of Italian liras in 1992

5. Results

We used the two versions of the politico-economic model described and calibrated in the previous sections to simulate the size of the Italian social security system in 2050 that a majority of the voters would choose, given the demographic dynamics and the provisions introduced by the Amato-Dini reforms. This analysis takes into account both the intergenerational and the intragenerational aspects of these reforms. In order to evaluate the incidence of these reforms, we also simulate the size of the system that the median voter would have chosen, given the demographic dynamics, in 2050 under the pre-reform regime.

5.1. The One-Dimensional Model

In the one-dimensional model, we restrict our analysis to the intergenerational redistributive effects of social security. The main focus here is on the effect of the increased political power of the elderly – due to the aging process – on the size of the unfunded pillar.

In 1992, the median voter was 44 years old and the ratio of retiree per worker – the elderly dependency ratio – was equal to 36.3%. In our calibrated economy, the preferred tax rate was 38%, with a replacement rate at retirement (average pension over average wage) equal to 78.5%. In 2050, we estimate the median voter' age to be 57 and the elderly dependency ratio to be 88.7%. We then use our model to answer two questions. What would the equilibrium tax rate be in this scenario, given the rules set in the Amato-Dini reforms? And what size would the unfunded pillar have had in absence of reforms?

Table 2 provides a first answer. Our simulated model suggests that, in absence of reforms, the equilibrium tax rate would rise to 58.1%, while the replacement rate would be equal to 52.5%. Notice that, despite the remarkable increase in the equilibrium tax rate, the generosity of the system would drop, because of the raise in the elderly dependency ratio.

As argued in section 2, the Amato-Dini reforms have introduced several changes in the system. However, in our one-dimensional model, in which the only element of heterogeneity is age, we can only study two aspects of these reforms: the increase in the retirement age and the price indexation[12].

In our simulations – carried out for different retirement ages – the median voter – corresponding to the voter with median age – will choose her most preferred tax rate in the steady state that replicated the expected demographics for 2050. In particular, for a given retirement age, under the new regime the expected pension benefits are defined by equations 3.5 (defined contribution) and 3.6 (price indexation).

The results reported in Table 2 show the key role of the retirement age. If it remains at its 1992 level, 57 years, the political economic equilibrium tax rate would rise to 58.8%. If it increases along the transition, the equilibrium tax rate would be smaller: for a retirement age of 62 the tax rate is equal to 51% and for a retirement age of 65, it is 46.8%. Unlike the tax rate, the replacement rate is larger for higher retirement ages. This is because, by

[12] The most relevant feature of the Dini reform, i.e., the adoption of a defined contribution method, cannot be properly evaluated. The reason is simple. If agents only differ according to age, an unfunded, budget balanced, defined contribution social security system behaves in the same way as an unfunded, budget balanced defined benefits system: for a given tax rate, total contribution is equally divided among retirees.

increasing the retirement age, the steady state number of retirees decreases and the total contribution increase even in the case of a lower tax rate.

To estimate the impact of the indexation to prices, rather than to wages, we compare the regime before and after the reforms in 2050 for a retirement age of 57 (see the second and third row in table 2). Contrary to the conventional opinion that price indexation, rather than wage indexation, may contribute to reduce pension spending – and therefore the tax rate – in our model the tax rate in the absence of wage indexation is slightly larger than under the pre reform regime: 58.8% vs. 58.1%. The intuition is quite simple. In our political economic model, voters try to preserve the relative value of their pension benefits, and to appropriate future gains in productivity, by increasing the replacement rate at retirement and consequently the equilibrium tax rate. This effect is showed in figure 4, where the income profile by age for our baseline economy (1992) is compared to our simulated economy in 2050 without and with reform (retirement age is set at 65 years for both regimes). The value of the pension annuity relative to wage decreases as a function of the age of the retiree – clearly showing what in the literature has been called "pensioni d'annata", i.e., the vintage effect – in the post reform regime; whereas it is constant, though at a lower level, in the previous regime[13].

Figure 5 shows the corresponding consumption profile by age. Raising retirement age in the Amato-Dini regime increases the aggregate resources of the economy and therefore individuals enjoy larger net wealth and consumption during their life cycle.

Table 2
Simulated Political –Economic Equilibrium Tax Rate Before and After Reforms. One-Dimensional Model. 1992 e 2050.

Year	Regime	Median Retirement Age	Equilibrium Tax Rate	Substitution Rate
1992	Pre – Reform	57	38.0%	78%
2050	Pre – Reform	57	58.1%	52%
2050	Amato-Dini	57	58.8%	70%
2050	Amato-Dini	58	57.2%	73%
2050	Amato-Dini	59	55.6%	76%
2050	Amato-Dini	60	54.0%	79%
2050	Amato-Dini	61	52.5%	82%
2050	Amato-Dini	62	51.0%	86%
2050	Amato-Dini	63	49.5%	91%
2050	Amato-Dini	64	48.1%	96%
2050	Amato-Dini	65	46.8%	103%

Sources: our computations.

5.2. The Bi-Dimensional Model

The bi-dimensional model introduces an element of heterogeneity among voters of the same generation, the education level, which in our analysis can be low, intermediate and

[13] Notice that this large difference in the replacement rates is due to the different retirement ages, 57 vs. 65 years.

high. To every education level corresponds a labor income profile, a working history, a retirement age, a political participation rate and an age specific survival probability. These elements will allow a more detailed description of the effects of moving to a defined contributions method.

The baseline economy featuring the pre-reforms regime (1992), is calibrated at an equilibrium tax rate of 38% and exhibits a replacement rate equal to 59% for the low education group (in which agents contribute to the system for 30 years) and 69% for the other two groups (where agents contribute for 35 years).

What politico-economic equilibrium social security tax rate does our bi-dimensional model simulate for the year 2050, with the provisions introduced by the reforms or in absence of such reforms? The results are reported in Table 3.

In absence of reforms, and thus maintaining the retirement age at the 1992 levels – 57 years for low educated, 56 for intermediate education group, and 58 for high educated – our simulated model forecasts an equilibrium tax rate at 61%. This tax rate, however, would not allow to maintain the initial replacement rate, which, because of the increase in the elderly dependency ratio, would fall to 43% for first group and to 50% for the other two groups.

We can now analyze some intragenerational features of the system, which we disregarded in the previous version. These results are shown in Figure 6, which reports the preferred tax rates in the pre-reform system by age and education groups. A remarkable difference appears: for any given age, agents in the intermediate group chose a tax rate which is slightly higher than the one chosen by the low educated agents, but significantly higher than the one chosen by the high educated agents. This is mainly due to the different labor income profile by age faced by the agents of different education groups (see figure 3) and thus to the different contributions profile. In particular, while the contributions profile of the intermediate group is almost flat, it is steeper for high educated agents, because of their increasing labor income profile. Therefore, although the benefit computation formula in the pre-reforms regime favors steeper income age profiles, an educated worker aged – say – 44 faces the bulk of her tax burden in the late years of her working career, and thus prefers a lower tax rate than an agents of the same age that belongs to another group. Other relevant elements that account for this outcome are the lower actual retirement age and the negative general equilibrium effect on more educated workers[14].

To evaluate the effects of the Amato-Dini reforms, we simulate our bi-dimensional model under the new regime and taking into account expected demographic trends for the year 2050. Specifically, we fix a common retirement age for all groups and leave the agents choose their most preferred tax rate. Pension benefits are computed according to the defined contributions formula (eq. 3.5), where the relevant interest rate g is set equal to 1.5%. Price indexation is imposed according to equation 3.6. It is important to notice (see section 3.3) that the aggregate resources contributed to the system each year by the current workers define the total benefits to be assigned to the current retirees through the conversion coefficient γ. This conversion coefficient, γ, equalizes total contributions – which depend on τ – to total pension benefits – which depend on γ. Thus, the size of the system, and its average generosity, is determined by the voters' decisions on the equilibrium tax rate, which also define – through the balanced social security budget

[14] An increase in the social security tax rate crowds out the capital accumulation and thus reduces the average real wages. Because of their higher efficiency per unit of time, more educated agents are more affected by this reduction.

constraint – the conversion coefficient. How total resources are split among the retirees of different age and education groups depends instead on the retirement age, on the contribution history, and on the rules that determine the capitalized value of the lifetime contributions as introduced by the Amato-Dini reform.

The simulation of this model confirms the crucial importance of the retirement age in affecting the political choice on the size of the system. If everybody retires at 58, the equilibrium tax rate would be 61.1%, and reforms would thus have no impact in limiting the increase in the size of the system. By increasing retirement age to 62 (or 65), the tax rate is reduced to 53.2% (or 48.9%), while the replacement rate, and therefore the profitability of the system, increases.

These results are consistent with those obtained using the one-dimensional model and show how the adoption of a figurative defined contribution computation formula has not significant impact on the equilibrium tax rate. The intragenerational redistributive effect may however be significant. Table 3 shows that under the Amato-Dini regime the relative generosity of the system for the high educated individuals – measured by the difference in the replacement rate before and after the reform – is further reduced in favor of the less educated agents. This feature of the reform has already been stressed in the literature (see Peracchi and Rossi, 1996): the benefit formula introduced by the Amato-Dini reform penalizes the careers with steeper labor income profiles (see figure 3). Figure 7 illustrates this result: for any given age, agents with a low education level always prefer a larger tax rate than more educated agents.

Table 3
Simulated Political Economic Equilibrium Tax Rate Before and After Reforms. Bi-Dimensional Model. Years 1992 and 2050.

Year	Regime	Median Retirement Age by Education Level			Equilibrium Tax Rate	Replacement Rate by Education Level		
		Low	Intermediate	High		Low	Intermediate	High
1992	Pre-reforms	57	56	58	38.0%	59%	69%	69%
2050	Pre-reforms	57	56	58	61.0%	43%	50%	50%
2050	Amato-Dini	58	58	58	61.1%	69%	77%	61%
2050	Amato-Dini	59	59	59	59.9%	73%	81%	64%
2050	Amato-Dini	60	60	60	57.5%	76%	84%	65%
2050	Amato-Dini	61	61	61	55.3%	79%	87%	67%
2050	Amato-Dini	62	62	62	53.2%	83%	92%	69%
2050	Amato-Dini	63	63	63	51.3%	87%	98%	72%
2050	Amato-Dini	64	64	64	50.0%	92%	106%	77%
2050	Amato-Dini	65	65	65	48.9%	99%	116%	82%

Source: our computations.

As in the one-dimensional model, the effect of the switch from wage to price indexation introduced in the Amato reform can be seen in the simulated income profiles by age for the different groups of education. Figures 7, 8 and 9 show our simulated income profiles by age for the three different education classes for our baseline economy, for the 2050 economy in absence of reforms and for the 2050 economy under the Amato-Dini regime respectively. If

pension benefits are indexed to prices, the replacement rate at retirement is higher, since voters will try to appropriate productivity growth by increasing the tax rate. Notice that the equilibrium replacement rate at retirement is larger than 100% for agents in the low education group, who benefit from a comparatively larger intragenerational and intergenerational transfer.

5.3. Sensitivity Analysis

The results presented in the previous section depend crucially on how we parameterize the model. To check the robustness of these results, we thus consider alternative parameterizations and provide new simulations results. In particular, our sensitivity analysis separately studies two alternative scenarios: (1) a change in the productivity growth rate; and (2) a change in the working career of the agents with the lower education, leading to a more stable working career and to an increase in the number of years of contribution to the system.

5.3.1 Changes in the Wage Growth Rate

Wage growth is a crucial parameter to assess the profitability of an unfunded social security system. As such, it strongly affects the voters' decision about the size of the system. Specifically, a larger wage growth increases the total contribution the system and, under budget balancing, the total pensions to be paid to the retirees. Contrary to what it usually argued, an increase in the wage growth thus increases the most preferred size of the system, by raising its profitability.

Table 4 reports the simulation results for the one-dimensional model. A reduction in aggregate productivity growth from 1.92% to 1% – for a retirement age of 65 years – decreases the equilibrium tax rate from 46.8% to 38.3%, whereas an increase in the aggregate productivity growth rate to 2.5% would induce the median voter to support a tax rate of 50.6%.

Table 4
Simulated Political –Economic Equilibrium in the Post Reform Regime according three Wage Growth Rate Scenario. One-dimensional Model. Year 2050.

Median Retirement Age	Wage Growth = 1%		Wage Growth=1.5%		Wage Growth=2.5%	
	Tax Rate	Replacement Rate	Tax Rate	Replacement Rate	Tax Rate	Replacement Rate
62	42.8%	65%	47.7%	77%	54.6%	99%
63	41.2%	68%	46.2%	81%	53.2%	104%
64	39.7%	72%	44.7%	85%	51.9%	111%
65	38.3%	76%	43.3%	91%	50.6%	118%

Source: our computations.

5.3.2 Changes in the Working Career

As discussed in section 3, agents with low education levels exhibits some discontinuity in their working and contribution records: their median period spent in the labor market is 43 years, while their median contribution period is 30 years. How would their voting behavior

on the social security tax rate change if they experience more continuous contributive records, especially in the latest years of the working career? As reported in Table 5, the equilibrium tax rate would slightly increase, because of an increase in the replacement rate, due to the longer period of contributions[15].

Table 5
Simulated Politico-Economic Tax Rate in the Post Reform Regime with complete contributive records. Bi-Dimensional Model. Year 2050.*

Retirement Age	Equilibrium Tax Rate	Replacement rate by Education		
		Low	Intermediate	High
58	62.1%	77%	79%	63%
59	60.8%	81%	83%	65%
60	57.7%	83%	85%	66%
61	55.7%	86%	89%	68%
62	53.7%	90%	94%	71%
63	52.2%	94%	100%	74%
64	51.0%	100%	109%	79%
65	49.9%	107%	120%	85%

Source: our computations.

6. Conclusions

The steady increase in the government spending for social security during 80s and the dramatic forecasts about population aging called for immediate reforms of the Italian social security system. The Amato-Dini reforms, implemented during the 90s, have aimed at limiting the growth in pension spending, increasing the distributive equity of the system through specific provisions that reduced its generosity, and at stabilizing the proportion between contributors and beneficiaries (the dependency ratio). The most important features of the reforms have been: the increase in the retirement age (Amato), the reduction in the incentives to retire early (Dini); the price rather than wage indexation (Amato); and the adoption of a defined contribution formula for the computation of the pension benefits (Dini).

The main weakness of the reforms is represented by the lengthy transition to the new regime – that will be completed in 2036 – during which the treatment of successive generations of workers will be arbitrarily different, thereby creating concern about the distributive equity. Some doubts have however been cast also on the consistency of the provisions introduced by the reforms with its aims and sustainability in the long run, that is, when all workers and retirees will be under the Amato-Dini regime. The main source of concern lies in the possible manipulation of the formula that calculates the pension benefits for electoral purposes.

This work extensively analyzes the latter motive for concern. Our starting point is that in the new regime – despite the defined-contribution formula – the generosity of the system

[15] In our simulations, the negative effect on the increase in the years of contribution is underestimated, since we assume the net labor income to be equal on the official and on the unofficial labor market.

may still be easily changed by modifying the conversion coefficients. These coefficients transform – at retirement – the capitalized contribution into a pension annuity. The Dini reform – and thus its supporting majority – has set these coefficients according to actuarial principles as a function of the expected residual life at retirement. Current regulations allow these conversion coefficients to be reexamined every 10 years to take into account changes in longevity gains. These regulations – we argue – can not however prevent future majority from modifying these coefficients towards more generous pensions, as the population ages. Under budget balancing, this increase in the generosity of the system amounts to choosing a higher tax rate.

Our simulations provide a measure of the political pressure of the voters on the generosity of the system through their choice of the social security tax rate and, implicitly, of the conversion coefficient. We use a general equilibrium overlapping generations model calibrated to the main economic, political and demographic indicators of the Italian economy, for the different social security regimes – before and after the reforms. The post reforms regime is modeled as an unfunded defined contributions social security system, with higher statutory retirement age than before the reforms, and price rather than wage indexation of the pension annuity. Our stylized political system requires agents to vote on the social security tax rate.

The results of our simulations suggest that – despite the Amato-Dini reforms – the public spending for pension provision is set to grow further. The equilibrium tax rate, 38% in 1992, is estimated to increase to a remarkable 53.2% or to 48.9% for a statutory retirement age of respectively 62 and 65 years. This is mainly due to population aging, which greatly increases the political power of the elderly. As an example, the median age among the voters was equal to 44 years in 1992 and is expected to be 57 in 2050. The long run political sustainability of the Amato-Dini reform in our aging society thus implies an increase in the equilibrium tax rate.

It is important to stress that our striking political forecasts are in line with the estimates provided by INPS about the financial equilibrium tax rate in 2050. INPS forecasts that under the Amato-Dini regime, the equilibrium tax rate that will balance the budget in 2050 will be 34.5%, dropping from 48% during the transition years (2020 –2030). If we perform an analogous exercise in our model, and calculate the budget balancing equilibrium tax rate which, for the demographic structure expected to prevail in 2050, replicates the same replacement rate as in 1992, we obtain a very similar figure: 35.8%. The difference between this 35.8% and a range of 45%-55%, obtained in our political economic equilibrium depending on the statutory retirement age, represents a measure of the political pressure due to the aging process that the policymakers will face to increase pension benefits in 2050.

The impact of each provision in the reforms on the size of the system is very different. At steady state, the adoption of the defined contributions formula for computing pension benefits has mainly an intragenerational impact, since it transfers resources from agents with a steep income profile to agents with a flat profile. Price indexation has virtually no effect on the size of the system, since voters anticipate future reduction of pension benefits, in terms of real wage, and vote for a larger replacement rate at retirement and therefore for a larger tax rate.

The most effective provision to limit the growth of the pension expenditure is an increase in the retirement age. On one hand, this reduces the profitability of the system to the agents by increasing the period of contribution while reducing the residual life at retirement, and

thus the period during which pension benefits are collected. On the other hand, for a given tax rate, this provision reduces the dependency ratio, i.e., the ratio of retirees to workers, and thus increases the profitability of the system. Our simulations suggest that the former effect dominates the latter, and an increase of one year of the statutory retirement age reduces the equilibrium tax rate by one percentage point.

This is – at least partially – encouraging, since the Amato-Dini reform paved the road – along the lengthy transition – for a steady rise in the effective retirement age. Such increases, however, will have to be supported by future voting majorities. Unfortunately, our model has no saying on who would support such policy. In a more complete economic environment, where the social security tax rate imposes a distortionary effect on labor supply, the forecasted large increases in the tax rate would introduce severe distortions in the economy. In that context, a rise in the retirement age may represent a politically viable measure of restoring some economic efficiency.

Finally, an element pointing to less dismal conclusions about the political implications of the aging process on the social security system is related to education: an increase in the overall education level leads to a lower equilibrium tax rate. For a statutory retirement age of 65 years, a generalized increase in educational level reduces the equilibrium tax rate from 48.9% to 45%. The reduction is due to lower pressures for intragenerational redistribution taking places through social security.

References

1. L. Beltrametti, "Le Pensioni tra Solidarietà e Sostenibilità", Il Ponte, 1995.
2. L. Beltrametti, Il Debito Pensionistico in Italia, Il Mulino, 1996.
3. M. Boldrin and A. Rustichini, "Equilibria with Social Security", *Review of Economic Dynamics*, 3, 2000, 41-78.
4. E. Browning, "Why the Social Insurance Budget is Too Large in a Democracy", *Economic Inquiry*, XIII, 1975, 373 –88.
5. A. Brugiavini and E. Fornero, "Pension Provision in Italy", in: Richard Disney and Paul Johnson, Eds., Pension systems and retirement incomes across OECD countries, Edward Elgar, London, 2001.
6. O. Castellino, "C'è un Secondo Debito Pubblico (più garnde del primo)?", *Moneta e Credito*, 38, 1985, 21-30.
7. O. Castellino, "La Riforma del sistema previdenziale ovvero il rapporto che non fu scritto", *Moneta e Credito*, 49, 1994, 515 –540.
8. O. Castellino, "Redistribution between and within generations in the Italian social security system", *Ricerche Economiche*, 49, 1995, 317 –327.
9. O. Castellino and E. Fornero, "From PAYG to funding in Italy: a feasible transition?", mimeo, Università di Torino, 1997.
10. O. Castellino and E. Fornero, La Riforma del Sistema Previdenziale Italiano, Il Mulino, 2001.
11. T.F. Cooley, and E.C. Prescott, "Economic Growth and Business Cycle", in Frontiers of Business Cycle Research, (T.F. Cooley, Ed.), pp. 1 –38, Princeton University Press, 1995.
12. T.F, Cooley, and J. Soares, "A Positive Theory of Social Security Based on Reputation", *Journal of Political Economy*, 107, 1998, 135-160.
13. D. Franco, "Italy: a Never – Ending Pension Reform", mimeo, 2000.
14. V. Galasso, "The US Social Security: What Does Political Sustainability Imply?" *Review of Economic Dynamics*, 2, 1999, 698-730.
15. V. Galasso, "The US Social Security: A Financial Appraisal for the Median Voter", *Social Security Bulletin*, June 2002.
16. V. Galasso and P. Profeta, "Politico Economic Model of Social Security: A Survey", *European Journal of Political Economy*, 18, 2002, 1-29.
17. P. Giarda, "La revisione del sistema pensionistico nel 1997: come avrebbe potuto essere", *Economia Politica*, XV, 1998, 267 –94.
18. S. Gronchi, "La sostenibilità delle nuove forme previdenziali ovvero il sistema pensionistico tra riforme fatte e da fare", *Economia Politica*, XV, 1998, 295 –315.
19. S. Gronchi and R. Aprile, "The 1995 Pension Reform: sustainability and Indexation," *Labor*, 12, 1998, 67 –100.
20. P. Hammond, "Charity: Altruism or Cooperative Egoism", in Altruism, Morality and Economic Theory (E.S. Phelps, Ed.), 1975.
21. Ministero del Tesoro, Le Tendenze di Medio – Lungo Periodo del sistema pensionistico italiano: le previsioni elaborate con il modello RGS aggiornato al 2000, Roma.
22. G., Palermo and M. Valentini, "Il Fondo di Trattamento di Fine Rapporto e la Struttura Finanziaria delle Imprese", *Economia Italiana*, 2000.

23. F. Peracchi and N. Rossi, “Nonostante tutto è una Riforma”, in Nuove Frontiere della Politica Economica, Il Sole 24 Ore Libri, 1996.
24. F.R. Pizzuti, “Pension Reforms and Economic Policy Constraints in Italy”, *Labour*, 12, 1998, 45-66.
25. K. Sjoblom, “Voting for Social Security”, *Public Choice*, 45, 1985, 225 –40.
26. P. Tumbarello, “The Italian Pension System: a Case for Notional Accounts”, mimeo, IMF, 2001.

Appendix

In this Appendix, we provide some technical details about the model. In particular, we describe the utility function and the budget constraints faced by agents, the production function and the equilibrium conditions in the factor markets.

Agents' preferences are represented by an expected utility function over lifetime consumption:

$$\sum_{j=0}^{G} \beta^{j} \left[\prod_{i=0}^{j} \pi_{t,i}^{q} \right] U\left(c_{t+j}^{t,q}\right) \qquad \forall j = 0,....,G \qquad \forall q = 1,....,Q \tag{A1}$$

where c represents consumption, t the time index, j the index for age and q the education class, β is the individual discount rate, $\pi_{t,i}^{q}$ the probability that individual of age i at time t survives until the next period and reaches age i+1, furthermore $\pi_{t,0}^{q} = 1$. Agents are assumed to exhibit a constant degree of risk aversion so that:

$$U\left(c_{t+j}^{t,q}\right) = \frac{\left(c_{t+j}^{t,q}\right)^{1-\rho} - 1}{1-\rho} \tag{A2}$$

where ρ indicates the coefficient of relative risk aversion.

The budget constraint holding in any period is defined as:

$$c_{t+j}^{t,q} + a_{t+j+1}^{t,q} = a_{t+j}^{t,q} R_{t+j} + y_{t+j}^{t,q} + H_{t+j}^{t,q} \qquad \forall j = 0,....G; \quad \forall q = 1,...,Q. \tag{A3}$$

where $a_{t+j+1}^{t,q}$ and $y_{t+j}^{t,q}$ represent the accumulated wealth measured at the end of the period and the disposable income at time t+j. $R_{t+j}^{t,q}$ is the interest factor on private wealth. $H_{t+j}^{t,q} = (1-\pi_{t+j-1}^{q})\, a_{t+j}^{t,q} R_{t+j} / \pi_{t+j-1}^{q}$ represents the amount of involuntary bequest at time t+j obtained by individuals born at t with education q left by individuals of the same age and the same education class who did not survive the previous period.

Net disposable income at time t+j for an agent born at t and of the education group q is given by:

$$\begin{aligned} y_{t+j}^{t,q} &= \varepsilon_{t+j,j}^{q} \cdot h \cdot w_{t+j}(1-\tau_{t+j}) && \forall j = s^{q},....,J-1; \quad \forall q = 1,...,Q. \\ y_{t+j}^{t,q} &= P_{t+j}^{q} && \forall j = J^{q},....G; \quad \forall q = 1,...,Q. \end{aligned} \tag{A4}$$

where w_{t+j} indicates wage per efficiency unit in the period t+j, $\varepsilon_{t+j,j}^{q}$ represents a measure of labor efficiency unit for agents of the j generation and education group q in period t+j, h represents the number of worked hours, s^{q} is the initial age at which agents in the education class q starts her working career and τ_{t+j} and P_{t+j}^{q} represent respectively the tax rate to contribute to social security and the annuity pension benefit to be paid to retirees of group q at time t+j.

The technology in the economy is represented by a Cobb Douglas production function:

$$Q_t = f\left[l_t \cdot (1+\lambda)^t, k_t\right] = b \cdot k_t^{\theta} \cdot \left[l_t \cdot (1+\lambda)^t\right]^{1-\theta} \tag{A5}$$

where λ is the growth rate of labor productivity, l is a measure of per capita unit of labor measured in efficiency units, k denotes per capita stock of capital, b denotes total factor productivity index and θ the factor share to capital.

Labor supply in efficiency units is given by the fraction of workers at any age and education level, multiplied by the correspondent human capital coefficient and by the average number of worked hours:

$$l_t = h\sum_{i=1}^{J}\sum_{q=1}^{Q}\varepsilon_{t,i}^{q}\mu_{t,i}^{q} \tag{A6}$$

Aggregate capital stock in the economy is obtained aggregating individual net saving over education classes and generations

$$k_t = \sum_{i=1}^{J}\sum_{q=1}^{Q}\frac{\mu_{t-i}^{q}a_t^{t-i,q}}{1+n} \tag{A7}$$

Optimizing conditions for agents and firms and equilibrium conditions in factor markets define the usual relationship between factor prices and employment in terms of hourly wage, w_t, and rate of return on capital, r_t:

$$\begin{aligned} w_t &= f_1\left[l_t \cdot (1+\lambda)^t, k_t\right] \\ R_t &= 1 + r_t = f_2\left[l_t \cdot (1+\lambda)^t, k_t\right] + 1 - \delta \end{aligned} \tag{A8}$$

where δ represents the parameter of the physical depreciation rate in the economy and subscripts, in the usual representation, the partial derivatives with respect to the relevant variable.

A.1 Calibration

Having described the model in some detail we now describe its calibration. Our calibration targets are: 1) capital-output ratio, set equal to 3.18; 2) the investment-output ratio, set equal to 0.20; 3) equilibrium tax rate, set equal to 38%; and 4) the dependency ratio of the elderly, set equal to 36.3%. The following table summarizes the value of the parameters in both the one-dimensional and bi-dimensional model

Table A1
Parameterization of the Politico –Economic Model

	n	m	J^q	θ	h	δ	λ	ρ	β
One-dimensional	1.35	44	57	0.38	0.423	2.99	1.92	1.33	0.992
Bi-dimensional	1.35	44	56/57/58	0.38	0.423	2.99	1.92	1.17	0.986

Figure 1: Expected Demographic Dynamics 2000 - 2050

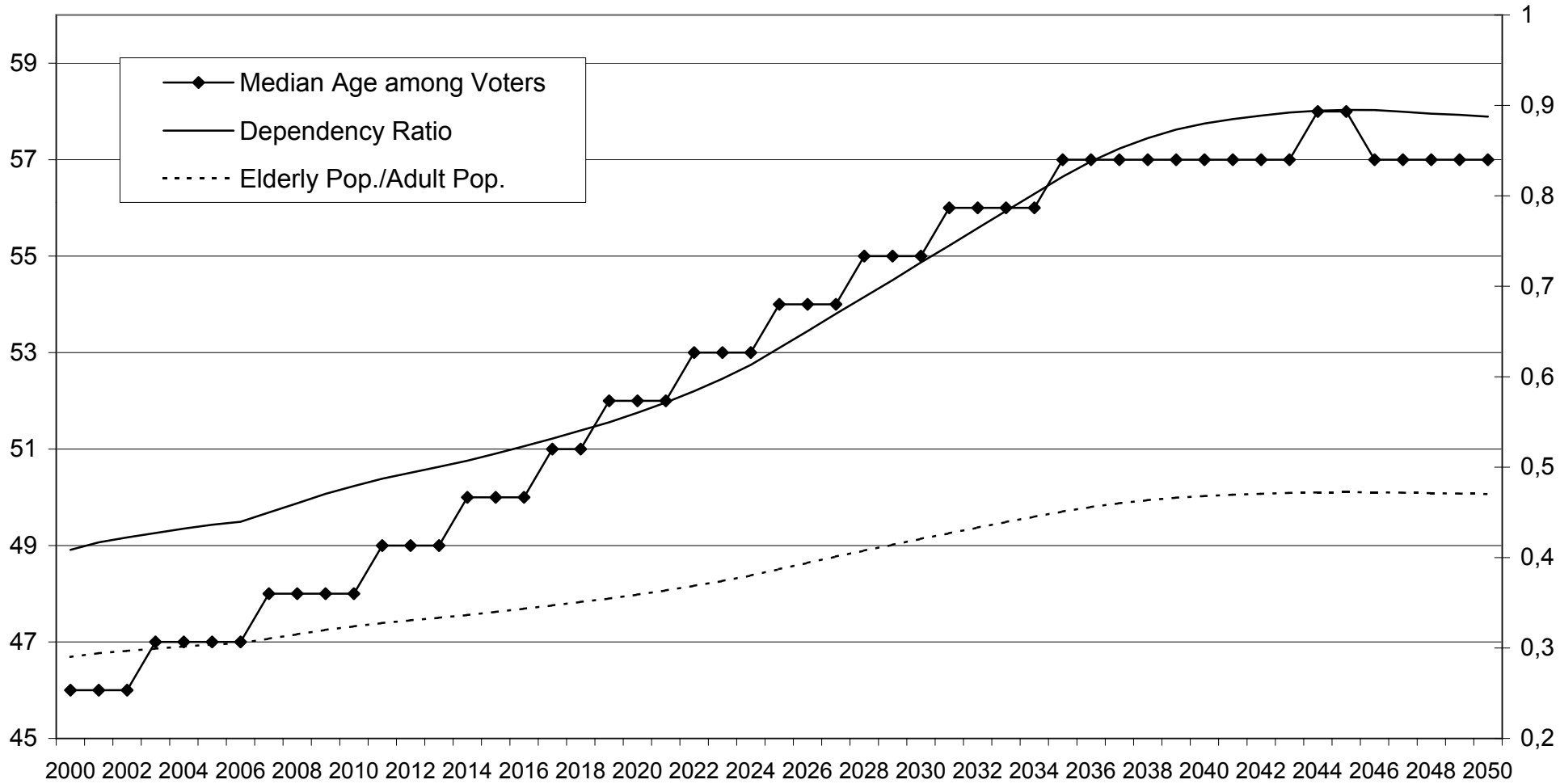


Figure 2: Intermediate Education Group's Survival Probability. Years 1992 and 2050

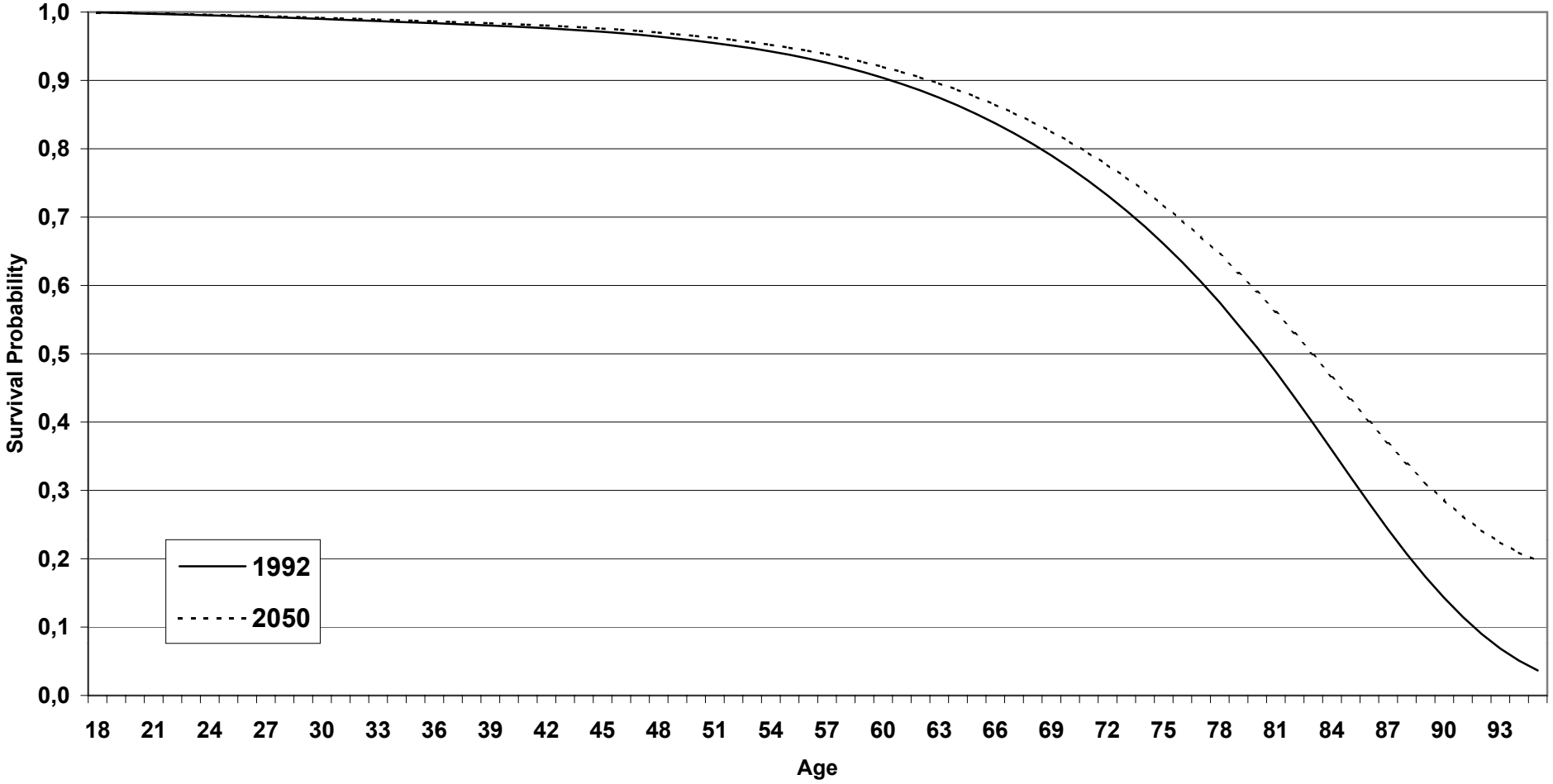


Figure 3: Efficiency Unit Profile by Age and Education

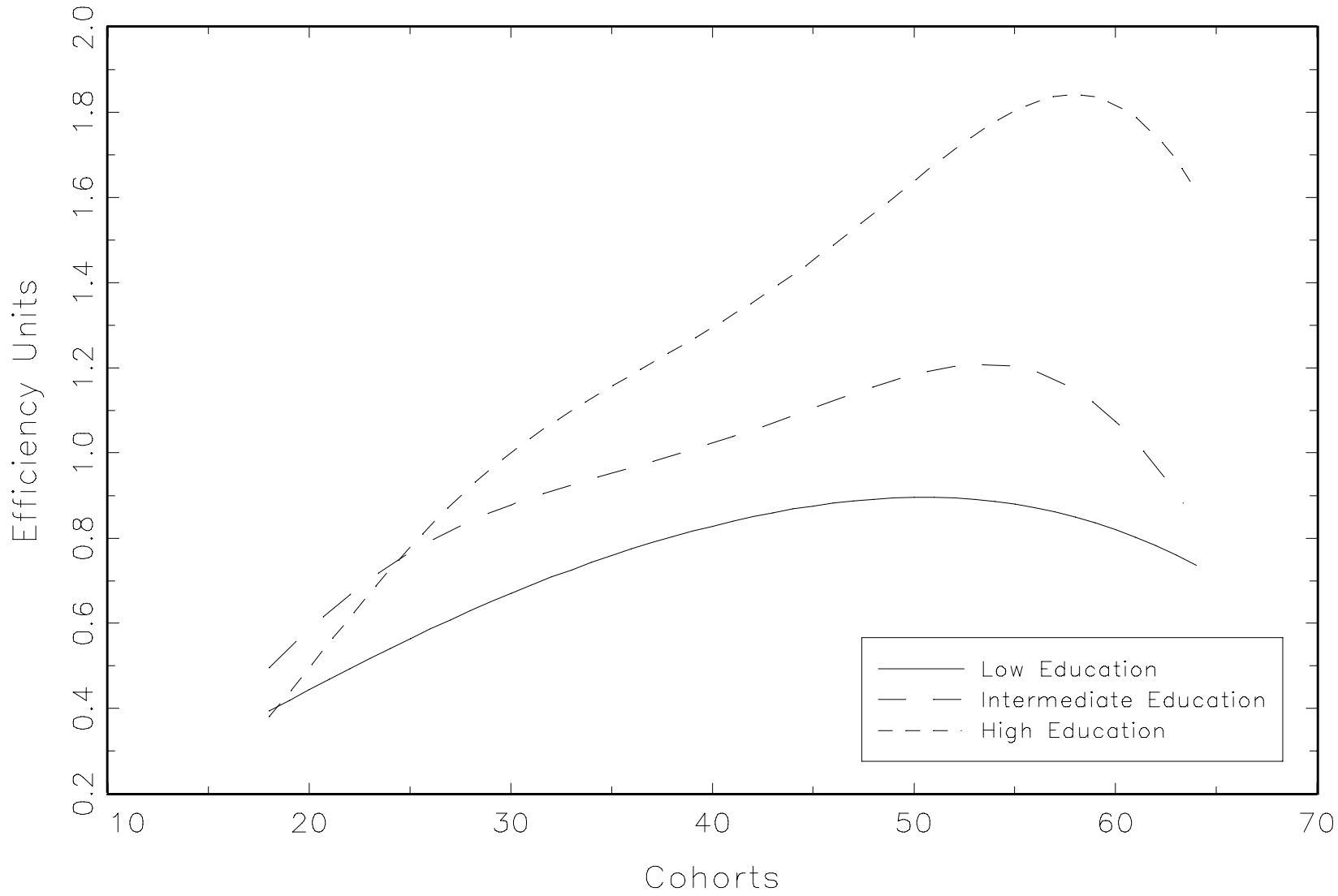


Figure 4: Income Profile by Age -- One-dimensional Model

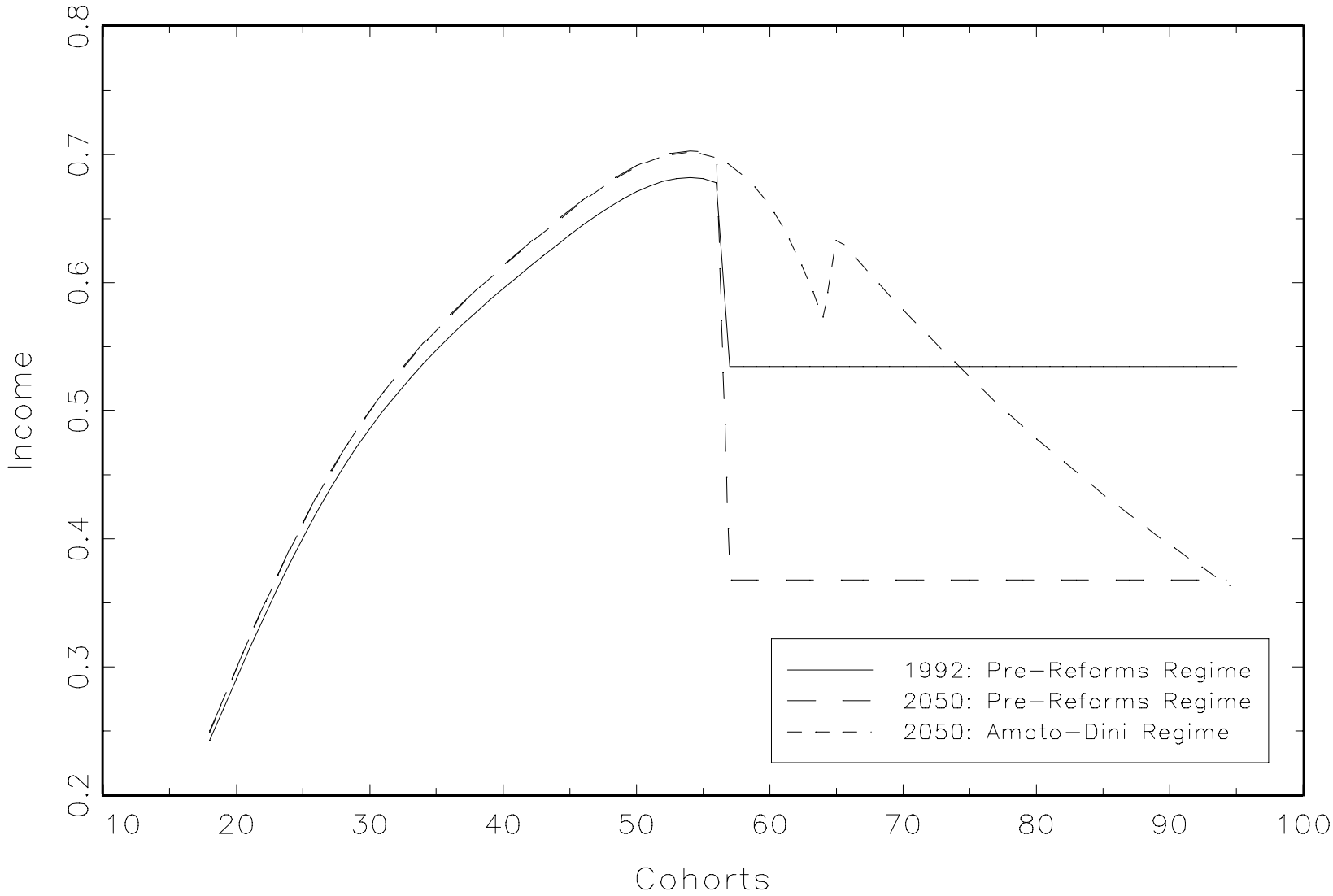


Figure 5: Consumption Profile by Age -- One-dimensional Model

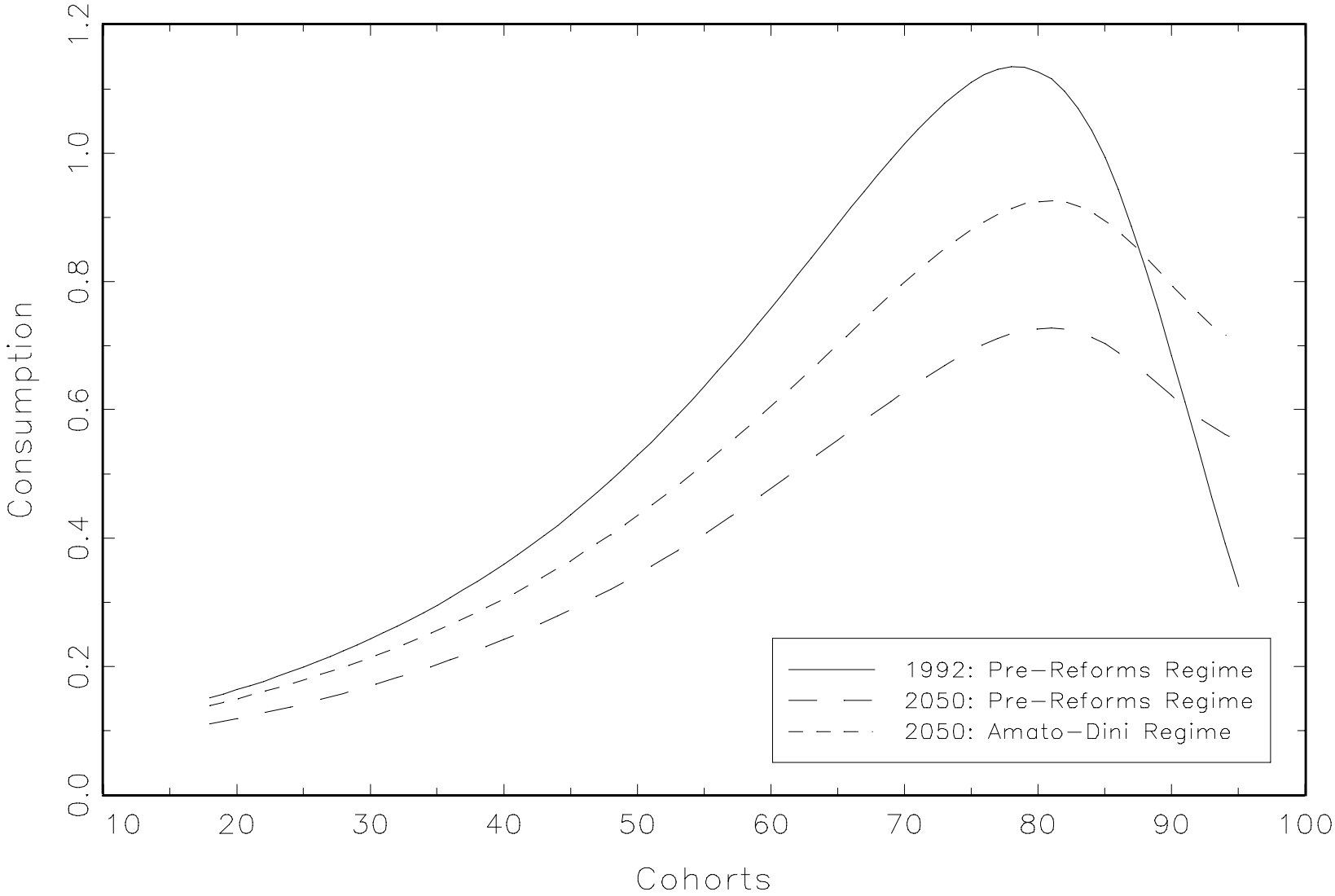


Figure 6: Simulation of the Most Preferred Tax Rate by Age and Education Level.
Pre Reforms Regime Year 2050

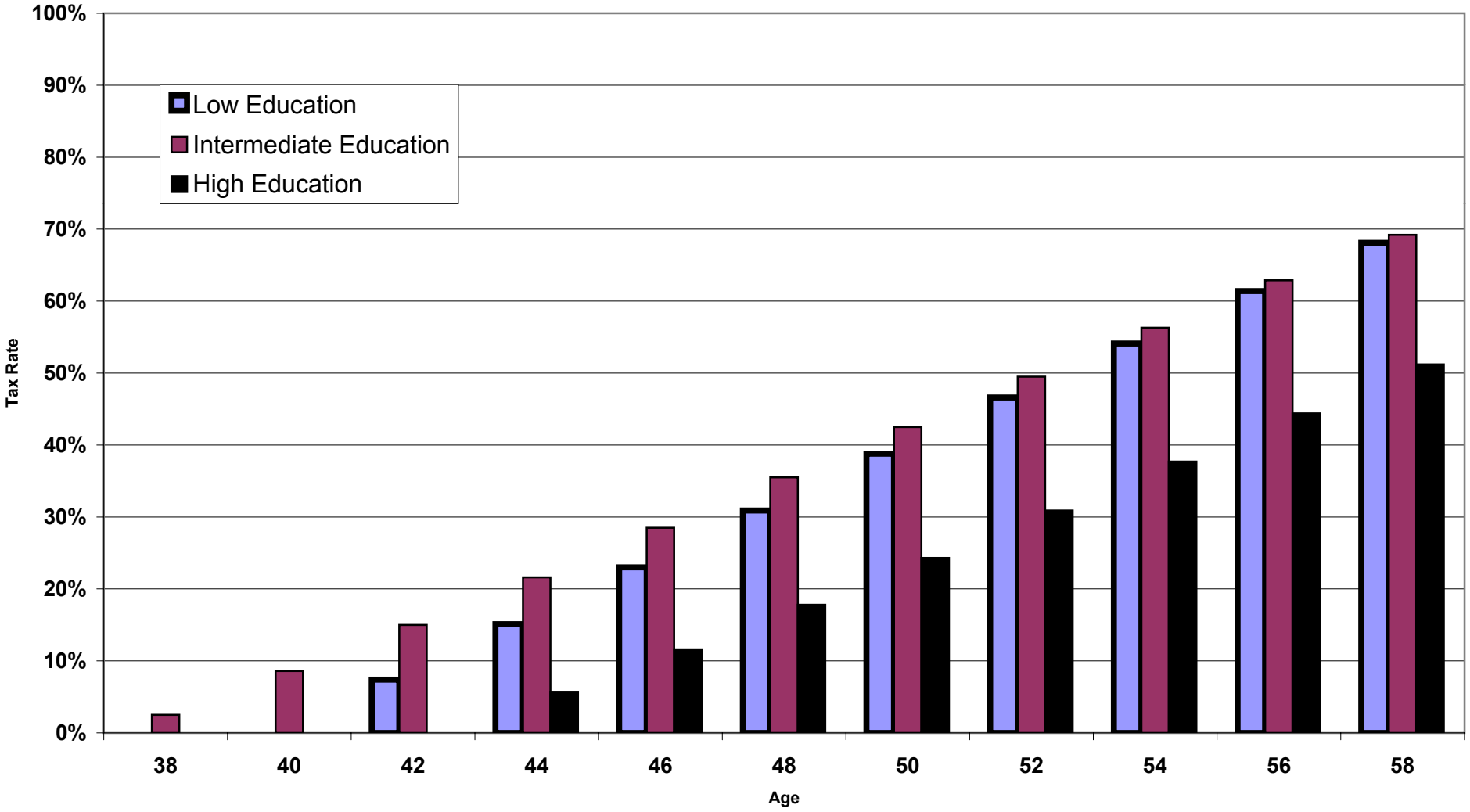


Figure 7: Simulation of the Most Preferred Tax Rate by Age and Education Level. Amato-Dini Regime Year 2050

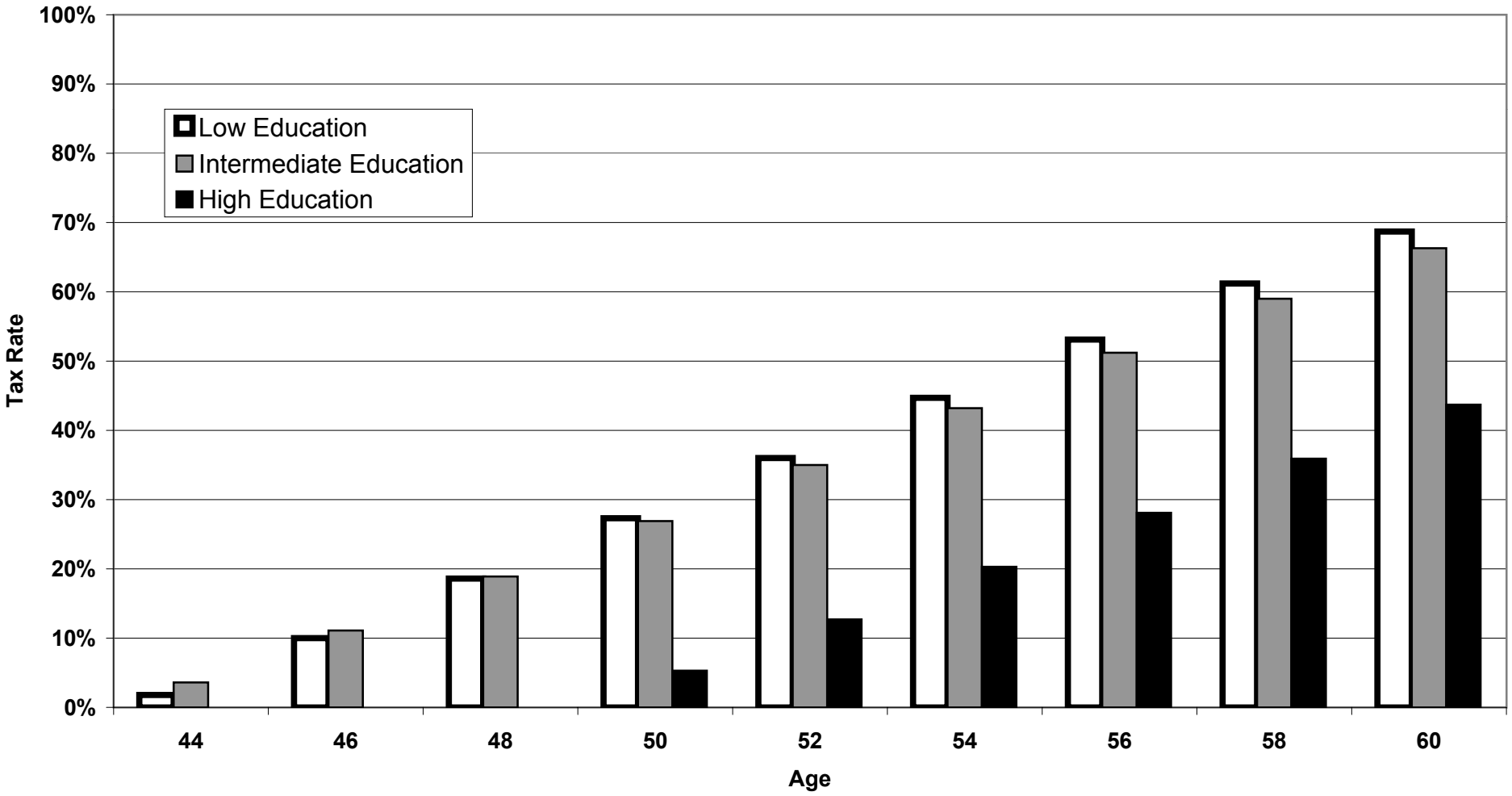


Figure 8: Income Profile by Age. Low Education Level

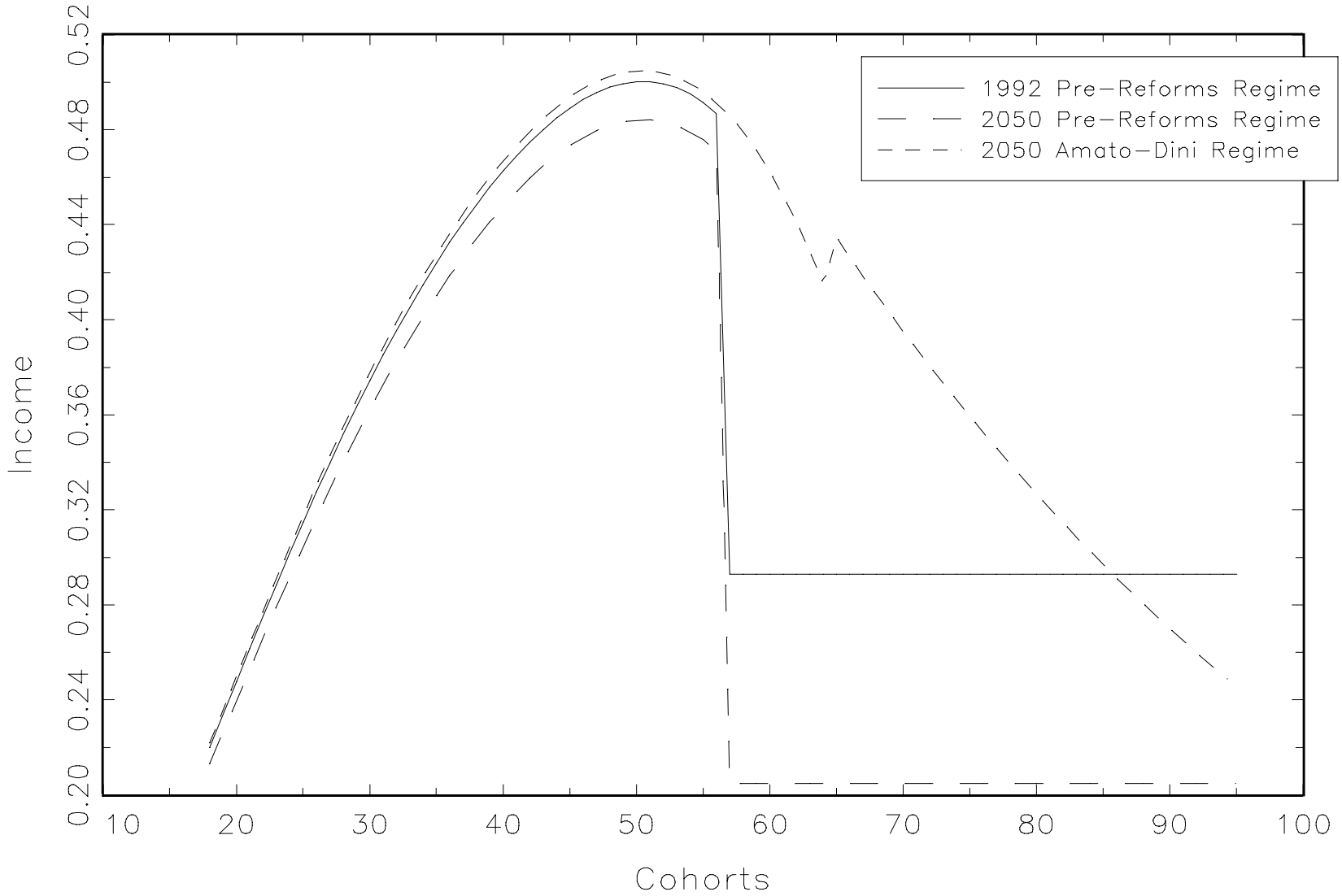


Figure 9: Income Profile by Age. Intermediate Education Level

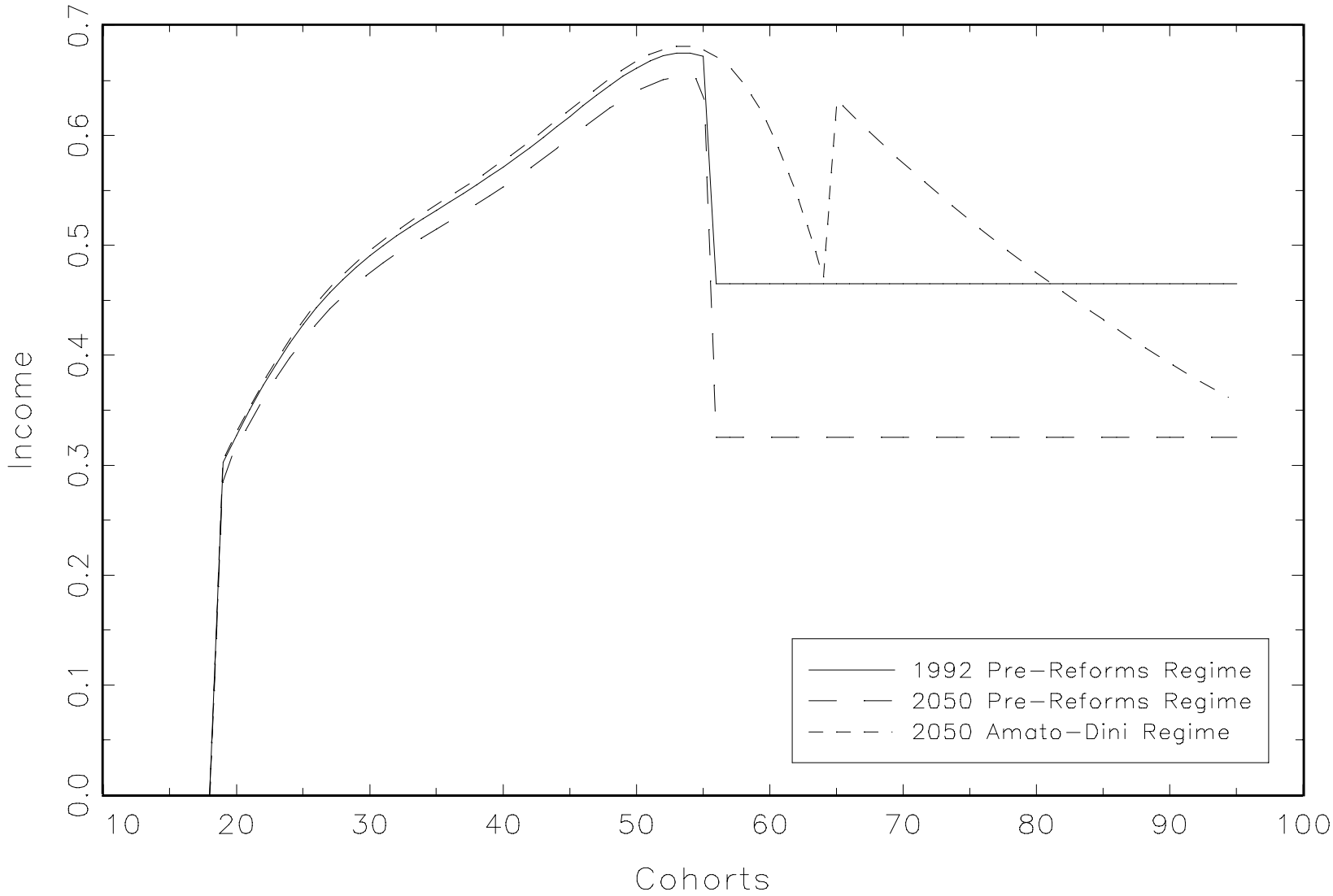


Figure 10: Income Profile by Age. High Education Level