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Optimal Design of Social Security Reforms

(Preliminary Version)

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ABSTRACT

We argue that a privatization of the social security system, going from a Pay-As-You-Go to a Fully Funded system, can be interpreted as the explicit recognition of an implicit debt and there is no efficiency gain in doing so. As a consequence, potential efficiency gains upon reforming the system come from the elimination of distortions and the optimal management of that implicit debt. Based on that argument, this paper studies the optimal design of a social security privatization in a Pareto improving way. The government decides endogenously how to finance the transition and the welfare of the initial generations alive becomes policy constraint. We find that the government can design a Pareto efficient reform that exhibits sizeable welfare gains. Our approach explicitly provides quantitative policy prescriptions towards the policy design of future and maybe unavoidable social security reforms.

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1. Introduction

Demographic imbalances together with efficiency considerations have often been used as arguments for reforming public Social Security systems, usually of a Pay-As-You-Go (PAYG) nature, in favor of Fully Funded systems (FF). As a consequence, research on the quantitative evaluation of social security reforms to assess the efficiency gains has been one of the main topics in this area.[1] In the spirit of Rangel (1997), we argue that changing the nature of social security (moving from a PAYG to a FF system) does not itself generate any efficiency gain. The social security administration has an implicit debt with those individuals who have contributed in the past to a PAYG social security system and are therefore entitled to future pensions. Moving towards a FF system just amounts to an explicit recognition of this implicit debt and does not generate any efficiency gain. Therefore, efficiency enhancing social security reforms call for fundamental fiscal reforms eliminating distortions and allowing the management of the implicit debt generated by the social security system. We use Optimal Fiscal Policy tools in order to provide a quantitative evaluation of that type of fiscal reforms.

The relevant aspect in reforming the social security system is how to use the surplus generated with alternative tax policies. More importantly, in the presence of additional distortions, i.e. mandatory retirement rules, or capital income taxes, it is possible to generate even larger efficiency gains by eliminating these distortionary wedges. This point is especially important, because even if the contribution-benefit rules of the social security system are optimal, it is possible to generate Pareto improving reforms by reducing the tax burden. This margin, i.e. the elimination of distortions, allows to implement social security reforms in which everybody is made better off. Our contribution is to provide precise quantitative policy prescriptions of how to conduct such fundamental reforms in a Pareto improving way.

Notice that if there were no distortions and the economy was dynamically efficient it is not feasible to redistribute resources across generations in a Pareto improving way. This classic result goes back to Diamond (1965) and Gale (1973), who studied the "Classical case" as compared to the "Samuelson case" of dynamic inefficiency. The presence of distortions in our environment is what allows us to design reforms in a Pareto improving way even though our economy is dynamically efficient.

[1] Feldstein and Liebman (2001) summarizes the discussion on transition to investment-based systems, analyzing the welfare effects and the risks associated to such systems.

The analysis of standard overlapping generations models predicts that changing the PAYG nature of public social security systems towards a FF system might generate substantial efficiency and welfare gains in the long run. However, these long run efficiency and welfare gains come at the cost of substantial welfare losses for initial generations, casting doubts on the political viability of such a fundamental tax reform. However, most of the reforms considered implied a complete or partial default on the implicit debt. Notice that the approach in this paper is completely different, entitlements to future payments are honored and everybody is made better off.

Building on the seminal work of Auerbach and Kotlikoff (1987), there are several papers that study the transition associated to a social security privatization and find substantial efficiency and welfare gains in the long run. [2] In particular Huang, Imrohoroglu and Sargent (1997) show that a complete or a partial privatization implies large short-run welfare losses, that cannot be compensated with the long-run gains. Conesa and Krueger (1999) show that in the presence of uninsurable labor income uncertainty the welfare losses of the initial cohorts are larger, because the unfunded social social security system provides partial insurance to individuals. Kotlikoff, Smetters and Walliser (1999) analyze different types of transitions and find that transition generations experience a 1 to 3 percent welfare decline, while future generations experience gains that are close to 20 percent. Using a different approach, Feldstein and Samwick (1998) find smaller transition costs. Conesa and Garriga (2003) show that eliminating compulsory retirement rules with the privatization can substantially reduce the welfare losses of the initial generations alive. However, most of these reforms imply a complete or partial default on the implicit debt on the implicit debt of the social security system, casting doubts on the political viability of such a fundamental reform.

Notice that the approach in this paper is completely different, entitlements to future payments are honored and everybody is made better-off by construction. In contrast, we use optimal fiscal theory in order to design these reforms. The analysis of optimal fiscal policy in overlapping generations economies has been recently considered by Erosa and Gervais (2002) and Garriga (1999). In particular, Garriga (1999) characterizes the optimal fiscal policy in an environment with participation constraints as the ones used in this paper. There are two different alternatives to compensate the initial generations alive and satisfy their promised keeping or participation constraints. First, the fiscal

[2] Theoretical frameworks that introduce dynastic considerations within the life-cycle framework, such as some sort of intergenerational links as in Fuster (1999) or Fuster, Imrohoroglu and Imrohoroglu (2004), might imply that the efficiency gains are much more moderate or even in existent.

authority could compensate potential welfare losses through the use of an appropriate scheme of distortionary taxes and subsidies. Second, we could give lump-sum transfers to initial generations alive at the beginning of the reform. This second option raises the question of how to optimally finance these transfers using distortionary taxes. In particular, the size of the optimal transfer does not need to be equal to the present value of the expected social security benefits, because the optimal policy reduces or removes some pre-existing distortions that already affect households' welfare.

Feldstein (1995, 1998) showed that two conditions are required in order to increase the present value of consumption of all generations. First, the return on capital must exceed the implicit return in the unfunded system. Second, the marginal product of capital exceeds the social discount rate. Our benchmark economy satisfies both conditions.

Our main conclusions are:

1. The optimal management of the explicit debt generates substantial welfare gains. In the parameterized economy the equivalent variation of consumption for future newborns is 15-20% larger than in the economy with a PAYG social security system. Along the transition path the size of the gains depend on the relative weight that the government places between present and future generations.

2. The appropriate scheme implies substantial tax cuts and increases in public debt at the beginning of the reform, but the increase in debt needed is much smaller than the implicit debt of the PAYG benchmark. The privatization implies that the optimal level of debt increases with respect to the initial level but in the long run it roughly converges to the initial steady state value.

3. The welfare costs of using distortionary instruments are large in the short run, but relatively small in the long run.

5. If we allow the fiscal authority to rationalize the taxation of capital income, then the optimal fiscal policies change, but the additional welfare gains are relatively small.

The rest of the paper is organized as follows. Section 2 describes the economic environment under the Status Quo policies. Section 3 describes how to view PAYG social security as an implicit debt and the neutrality of making explicit this debt. Section 4 discusses how the benchmark economy is parameterized. Section 5 presents the government problem. Section 6 discusses the results. Section 7 analyzes the case in which some constraints on the set of fiscal instruments are introduced. Section 8 concludes.

2. The Status Quo Economic Environment

Households

The economy is populated by a measure of households who live for I periods. These households compulsory retire in period i_r. We denote by $m_{i,t}$ the measure of households of age i at time t. Preferences of a household born in period t depend on the stream of consumption and leisure this household will enjoy. Thus, the utility function is given by:

$$U(c^t, l^t) = \sum_{i=1}^{I} b^{i-1} u(c_{i,t+i-1}, 1 - l_{i,t+i-1})$$

Each household owns one unit of time in each period that they can use for work or leisure. One unit of time devoted to work by a household of age i translates into e_i efficiency units of labor in the market.

Technology

The Production Possibility Frontier is given by an aggregate production function $Y_t = F(K_t, L_t)$, where K_t denotes the capital stock at period t and $L_t = \sum_{i=1}^{I} m_{i,t} e_i l_{i,t}$ is the aggregate labor endowment measured in efficiency units. We assume the function F displays constant returns to scale, is monotonically increasing, strictly concave and satisfies the Inada conditions. The capital stock depreciates at a constant rate d.

Government

The government influences this economy through the Social Security and the general budget. For simplicity we assume that these two programs operate with different budgets. Then, pensions (tr_t) are financed through a payroll tax (t_t^p) and the social security budget is balanced. On the other hand, the government collects consumption taxes (t_t^c), labor income taxes (t_t^l), capital income taxes (t_t^k) and issues public debt (b_t) in order to finance an exogenously given stream of government consumption (g_t).

Thus the government budget constraints are given by:

$$t_t^p w_t \sum_{i=1}^{i_r-1} m_{i,t} e_i l_{i,t} = p_t \sum_{i=i_r}^{I} m_{i,t}$$

$$t_t^c \sum_{i=1}^{I} m_{i,t} c_{i,t} + t_t^l (1 - t_t^p) w_t \sum_{i=1}^{i_r - 1} m_{i,t} e_i l_{i,t} + t_t^k r_t \sum_{i=1}^{I} m_{i,t} a_{i,t} + b_{t+1} = g_t + (1 + r_t) b_t$$

Market arrangements

We assume there is a single representative firm that operates the aggregate technology taking factor prices as given. Households sell an endogenously chosen fraction of their time as labor ($l_{i,t}$) in exchange for a competitive wage of w_t per efficiency unit of labor. They rent their assets ($a_{i,t}$) to firms in exchange for a competitive factor price (r_t), and decide how much to consume and save out of their disposable income. The sequential budget constraint is for a household on it working age is given by:

$$c_{i,t} + a_{i+1,t+1} = (1 - \Phi)(1 - t_t^l)(1 - t_t^p) w_t e_i l_{i,t} + (1 + r_t) a_{i,t} + \Phi tr_t$$

where Φ is an indicator function equal to zero if $i < i_r$ and equal to one if $i \geq i_r$.

The alternative interpretation of a mandatory retirement rule is to consider different labor income tax rates for individuals of ages above and below i_r. In particular, a confiscatory tax on labor income beyond age i_r is equivalent to compulsory retirement. Both formulations yield the same results. However, when we study the optimal debt management problem we prefer this alternative interpretation since it considers compulsory retirement as just one more distortionary tax that the planner can optimize over.

Definition 1: A market equilibrium in the status quo economy is a sequence of prices and allocations such that: i) consumers maximize utility subject to their corresponding budget constraints given the equilibrium prices, ii) firms maximize profits, iii) the government and the social security budgets are balanced, and iv) markets clear.

3. PAYG Social Security as Implicit Debt [To be Completed]

An unfunded social security system is an intergenerational redistribution scheme, or equivalently an implicit debt scheme. The young provide resources through contributions that are used to finance the benefits of the retired. Contributions made by

the young generate an entitlement to a future benefit upon retirement, which constitutes an implicit debt of the social security administration towards them. Upon retirement, these new retirees sell their claims to social security to the new cohorts of workers.

Next, we show that the efficiency gains accruing from social security reform come from a rationalization of the fiscal system as a whole, but not from the nature of the social security system itself. These ideas were also made explicit in Rangel (1997), and most of the discussion in this section follows the same approach. In particular, Rangel (1997) uses a two period overlapping generation model with linear technology to show that there exists Pareto neutral privatizations where the welfare of all generations remains unchanged. Consequently, Pareto improving movements are feasible if and only if there exist distortions in the way the social security system is financed or in the rest of the fiscal system.

Just to illustrate the argument let me redefine a Steady State equilibrium for an economy with a social security system as a Steady State equilibrium of an economy without social security and implicit debt.

Theorem: Let $(\hat{t}, \hat{p}, \hat{B})$ be a fiscal policy, and let $\left\{(\hat{c}_j, \hat{l}_j)_{j=1}^{J}, \hat{K}\right\}$ be the associated St.St. allocation. Then, there exists a fiscal policy $(\hat{t}, 0, \tilde{B})$ and a distribution of assets $(\tilde{a}_j)_{j=1}^{J}$ such that $\left\{(\hat{c}_j, \hat{l}_j)_{j=1}^{J}, \hat{K}\right\}$ is the St.St. allocation corresponding to $(\hat{t}, 0, \tilde{B})$.

Proof: Fix prices and tax rates. Construct assets recursively from consumer budget constraints. Clearly, consumers FOC's are satisfied. The allocation is feasible. Thus, Walras' Law guarantees that the Government Budget Constraint holds.

Notice that following this view a PAYG social security system is just a way of decentralizing a particular allocation, but there are alternative ways of decentralizing the same allocation. In particular, one could choose an alternative where pensions are zero.

In the next sections, we consider a large scale overlapping generation model in order to determine the quantitative implications of a social security reform that respects the utility entitlements of the initial old. As we have been discussing, this is equivalent to the optimal management of the implicit debt and a rationalization of the whole fiscal system. We do so within the framework of the Ramsey approach to optimal fiscal policy.

4. Parameterization of the Status Quo Economy

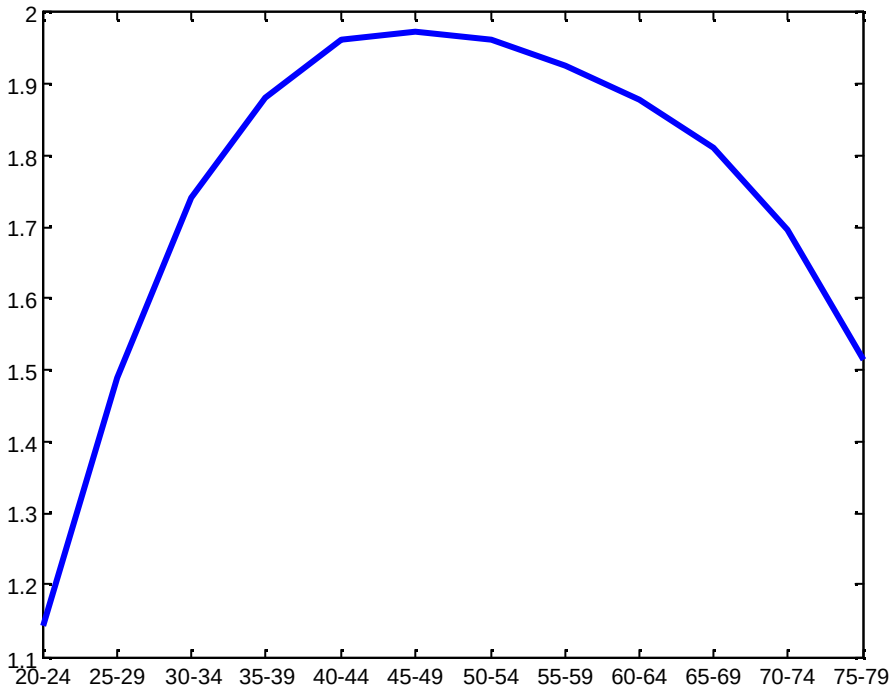
Demographics

We choose one period in the model to be the equivalent of 5 years. Given our choice of period we assume households live for 12 periods, so that the economically active life of a household starts at age 20 and we assume that households die with certainty at age 80. In the benchmark economy households retire in period 10 (equivalent to age 65). We assume the mass of households in each period is the same.

Endowments

The only endowment households have is their efficiency units of labor at each period. These are taken from the Hansen (1993) estimates, conveniently extrapolated to the entire lifetime of households.

Figure 1: Age-Profile of Efficiency Units of Labor from Hansen (1993)



Government

We assume that the government runs two completely independent budgets. One is the social security budget that operates on a balanced budget. The payroll tax is taken from the data and is equal to 12.4% (excluding Medicare). Our assumptions about the demographics together with the balanced budget condition directly determine the amount of the public retirement pension that will be 37.2% of the average gross labor income.

The level of government consumption is exogenously given. It is financed through a consumption tax, set equal to 5.2%, a marginal tax on capital income equal to 33% and a marginal tax on labor income net of social security contributions equal to 16%. These tax rates are taken from the effective tax rates estimated by Mendoza, Tesar and Razin (1995). The effective distortion of the consumption-leisure margin is given by $(1-t^{l})(1-t^{p})/(1+t^{c})=1-0.3$, yielding an effective tax of 30%.

The government issues public debt in order to satisfy its period by period budget constraint.

Calibration: Functional Forms

Households' preferences are assumed to take the form:

$$\sum_{i=1}^{I} b^{i-1} \frac{(c_i^{g}(1-l_i)^{1-g})^{1-s}}{1-s}$$

where $b > 0$ represents the discount rate, $g \in (0,1)$ denotes the share of consumption on the utility function, and $s > 0$ governs the concavity of the utility function. The implied coefficient of relative risk aversion (or the inverse of the intertemporal elasticity of substitution) is equal to $1-(1-s)g$.

Technology has constant returns to scale and takes the standard Cobb-Douglas form: $Y_t = K_t^{a} L_t^{1-a}$, where a represents the capital income share.

Calibration: Empirical Targets

Aggregate assets are taken from the Flow of Funds Accounts of the US for the year 2000. We define aggregate capital to be the sum of Non Residential Fixed Assets plus Consumer Durables. Consistently our measure of output will be GDP net of residential investment. Therefore, our calibration target will be a ratio K/Y=2 in yearly terms. Also, computing the ratio of outstanding (federal, state and local) government debt to our

measure of output we get the following ratio B/Y=0.5 in yearly terms. In order to maintain consistency with our measure of capital we measure the Depreciation of Non Residential Fixed Assets and Consumer Durables, which is a fraction of 17.25% of output. Another calibration target is an average of 1/3 of the time of households allocated to market activities. Finally, the capital income share is taken to be equal to 0.3, as measured in Gollin (2002).

Calibration Results

We have five parameters in the model to calibrate and five empirical targets: capital to output ratio, debt to output ratio, investment to output ratio, average hours worked over the life cycle, and share of labor income in the national product. The relevant targets and calibrated parameters are displayed in the following Table 1 and are all reported in yearly terms.

Table 1: Calibration Targets and Parameter Values

Empirical Targets	K/Y	B/Y	Av. l	wN/Y	Dep./Y
Empirical Values	2.0	0.5	1/3	0.7	0.1725
Parameters	b	s	g	a	d
Calibrated Values	0.983	2.5	0.32	0.3	0.1067

The given tax rates together with the government budget constraint in the calibrated economy generate in equilibrium a level of government consumption which is equivalent to 16.7% of output. This number was 15% in the 2000 data. Next section describes in detail the nature of the studied reforms.

Given this parameterization, social security payments in the benchmark economy amount to 8.7% of GDP and the social security implicit debt is equal to 147% of GDP.

Social Security as Implicit Debt: an Illustration

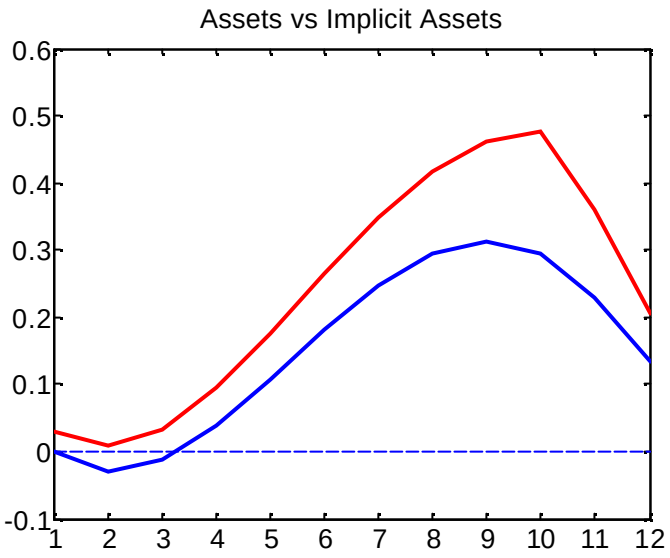
Consider an alternative decentralization for the same Steady State allocation. We construct it in the following way. Leave all tax rates and prices unchanged. Clearly, the Euler and Labor Supply conditions of the consumer's problem are satisfied.

Next, construct a sequence of assets in the following way:

$$a_J = (1+t^c)c_J / \left[1+(1-t^k)r\right]$$

$$a_j = \frac{(1+t^c)c_j + a_{j+1} - (1-t^l)we_j l_j}{1+(1-t^k)r},\ j = J-1, J-2,...,1$$

This sequence of assets has been constructed such that there is no PAYG social security system. Here are the original asset distribution and the new one.



Debt in this new decentralization is equal to the sum of all those assets minus the capital stock. Clearly debt has to be higher. How much higher? The difference is exactly equal to the implicit social security debt calculated as:

$$\sum_{j=1}^{J} m_j T_j$$

where Social Security Entitlements are defined as:

$$T_j = \frac{\sum_{s=1}^{j-1} \frac{t^p we_s l_s}{\left[1+(1-t^k)r\right]^{s-j}}}{\sum_{n=1}^{J} \frac{t^p we_n l_n}{\left[1+(1-t^k)r\right]^{n-j}}} \sum_{m=j}^{J} \frac{(1-t^l)SS_m}{\left[1+(1-t^k)r\right]^{m-j}}$$

5. Optimal Reforms

We assume that in period t=1 the economy is in a steady state with a PAYG social

security system, and no reform has been anticipated by any of the agents in the economy. The expected utility for each generation associated to remaining in an economy with an unfunded social security system is given by:

$$\bar{U}_j = \sum_{s=j}^{I} b^{s-j} u(\hat{c}_s, 1-\hat{l}_s)$$

where $\hat{c}_s, \hat{l}_s$ are steady state allocations of generation s.

At the beginning of period 2, the government implements a FF social security system and gives a one-period lump-sum transfer to all the initial generations alive who have contributed to the old PAYG system. The total amount of optimally chosen transfers is financed issuing new debt. To maximize the size of the welfare gains we let the government choose the level of debt issued and the optimal tax mix to finance the newly issued debt and the pre-existing level of government expenditure.

The government objective function is a utilitarian welfare function of all future newborn individuals, where the relative weight that the government places between present and future generations is captured by geometric discount rate $?\in(0,1)$. Formally,

$$\sum_{t=2}^{\infty} l^{t-2} U(c^t, l^t)$$

Notice that this formulation imposes some restrictions, since it rules out steady-state "golden-rule" equilibria. Also, the initial generations alive at the beginning of the reform are not part of the objective function, and only appear as a policy constraint. An equivalent formulation would include the initial s generations in the objective function with a specific weight $?_s$, where the weight is chosen to guarantee that the status quo conditions for each generation are satisfied.

In order to solve the government problem we use the primal approach to optimal taxation first proposed by Atkinson and Stiglitz (1980). This approach is based on characterizing the set of allocations that the government can implement for a given policy reform p. This formulation is a Stackelberg game and assumes that the government chooses the optimal tax burden p* taking into account the decision rules of all individuals the economy, and the effect of their decisions on market prices. Thus, the government problem amounts to maximizing its objective function over the set of implementable allocations together with the status quo constraints.[3] From the optimal allocations we can decentralize the economy finding the prices and the tax policy

[3] Throughout the paper we assume that the government can commit to its policies ignoring time consistency issues. Clearly, this is an important restriction that affects the results. The analysis of a time consistent reform goes beyond the scope of this paper.

associated to the social security reform. We skip the derivation of the set of implementable allocations throughout the paper, since they are similar to formulations derived by Erosa and Gervais (2002) and Garriga (1999), and are relatively easy to derive by combining the consumer first-order conditions with their intertemporal budget constraint, see Chari and Kehoe (1999).

The set of constrained efficient allocations can be obtained through the following maximization problem:

$$\max \quad \sum_{t=2}^{\infty} \beta^{t-2} U(c^t, l^t)$$

$$s.t. \quad \sum_{i=1}^{I} \mu_{i,t} c_{i,t} + K_{t+1} - (1-\delta) K_t + G_t \leq F(K_t, \sum_{i=1}^{I} \mu_{i,t} e_{i,t} l_{i,t}), \quad t \geq 2 \tag{1}$$

$$\sum_{i=1}^{I} \beta^{i-1} (c_{i,t+i-1} u_{c_{i,t+i-1}} + l_{i,t+i-1} u_{l_{i,t+i-1}}) = 0, \quad t \geq 2 \tag{2}$$

$$\sum_{s=i}^{I} \beta^{s-i} \left[c_{s,s-i+2} u_{c_{s,s-i+2}} + l_{s,s-i+2} u_{l_{s,s-i+2}} \right] = u_{c_{i,2}} \left[(1 + (1-\tau^k) r_2) \bar{a}_{i,2} + \tau_i \right], \quad i = 2,...,I \tag{3}$$

$$\sum_{s=i}^{I} \beta^{s-i} u(c_{s,s-i+2}, 1 - l_{s,s-i+2}) \geq \bar{U}_i, \quad i = 2,...,I \tag{4}$$

$$U(c^t, l^t) \geq \bar{U}_1, \quad t \geq 2 \tag{5}$$

Constraint (1) is the standard period resource constraint. Constraint (2) is the implementability constraint for each generation born after the reform is implemented. Constraint (3) represents the implementability constraints for those generations alive at the beginning of the reform, where τ^k is the benchmark tax on capital income which is taken as given and $\bar{a}_{i,2}$ are the initial asset holdings of generation i. Notice that taking τ^k as given is not an innocuous assumption, since that way we avoid confiscatory taxation of the initial wealth. Also, τ_i represents the nonnegative lump sum transfer to the initial old of cohort i. Finally, constraints (4) and (5) guarantee that the policy chosen makes everybody better off than continuing with the status quo policy. In particular, given that the government objective function does not include the initial s generations Equation (4) will be binding.

The policy maker discounts the future at the exponential rate β. Pareto optimality of the reform implies that the rate β has to be big enough to satisfy the participation constraints of all future generations. In particular, if β were too low then the long run capital stock would be too low and then constraint (5) would be violated in the long run.

In this case newborns would rather live in an economy with an unfunded social security system than in an economy with a fully funded system. That restricts the range of admissible values for l to values where the steady state solution of the government problem for a newborn is not worst off than in the benchmark economy. Of course, within a certain range there is some discrectionality in the choice of this parameter, implying a different allocation of welfare gains across future generations. In order to impose some discipline we choose l so that the level of debt in the final steady state is equal to that of the status quo economy, so that all debt issued along the transition is fully paid back before reaching the new steady state. Therefore, our choice of the parameter $l = 0.963$ implies the full repayment of the implicit debt of the initial social security system.

Further Constraints on the Ramsey Problem

Imposing restrictions in the set of fiscal instruments amounts to imposing additional constraints on the Ramsey problem.

In particular, a regime we will investigate is the one in which capital income taxes are left unchanged relative to the benchmark. Then, reformulating this constraint in terms of allocations we need to impose:

$$\frac{u_{c_{1,t}}}{u_{c_{2,t+1}}} = \frac{u_{c_{2,t}}}{u_{c_{3,t+1}}} = ... = \frac{u_{c_{I-1,t}}}{u_{c_{I,t+1}}} = b\left[1 + (1 - t^{k})(f_{k,t+1} - d)\right], \quad t \geq 2$$

For example, if we wanted to impose that labor income taxes are equal across age, but not necessarily constant over time, then we would have to impose:

$$\frac{u_{l_{1,t}}}{u_{c_{1,t}} e_1} = \frac{u_{l_{2,t}}}{u_{c_{2,t}} e_2} = ... = \frac{u_{l_{I,t}}}{u_{c_{I,t}} e_I}, \quad t \geq 2$$

5. Results leaving capital income taxes unchanged

Given that the nature of our exercise is inherently dynamic we focus directly on the design of a Pareto efficient transition in an environment where the government is restricted to use distortionary taxes, debt, and a one period lump-sum transfer to the

initial old[4] as the only fiscal instruments.

We explore time paths of the main macro aggregates and the welfare effects associated to a reform in which the Ramsey problem only uses labor income taxes, and leaves the capital income tax as in the benchmark economy. Later we will compare the results with an environment in which the Ramsey problem also maximizes over capital income taxes. We do so in order to decompose the welfare gains that come directly from the elimination of distortions inherent to the financing of PAYG systems (i.e. payroll taxes), as compared to the gains coming from rationalization of other distortions (i.e. capital income taxes).

In addition to lump-sum transfers to the initial generations alive, the optimal reform implies substantial tax cuts during the initial periods of the reform in order to compensate the welfare losses of the initial generations due to the loss of the retirement pension. However, in order to compensate for these potential welfare losses the government sets tax rates that are not equal across cohorts.

The optimally chosen level of transfers to the initial old is reported in Table 2:

Table 2: Transfers to Initial Generations (% Entitlements)

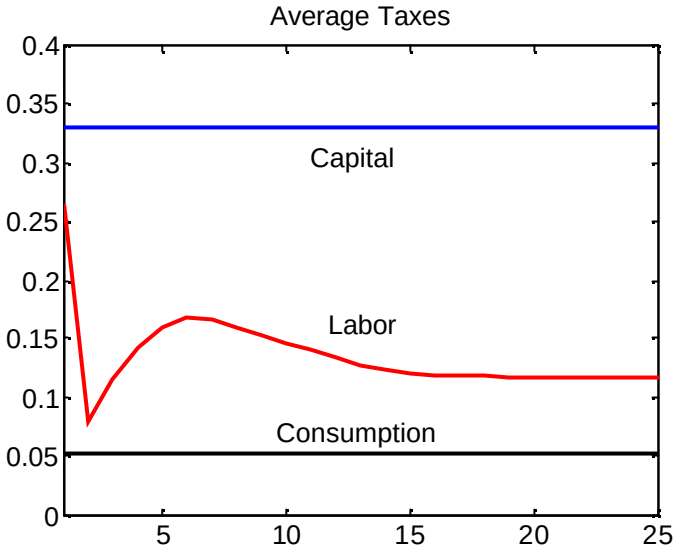
20-54	55-59	60-64	65-69	70-74	75-79
0	0	0	0.36	0.50	0.65

Notice that the government only needs to give transfers to the currently retired cohorts, and that these transfers are only a very small fraction of the social security entitlements under the PAYG system. In total, these transfers amount to only 20% of the total entitlements, which are 147% of GDP in the status quo economy. The reason is that individuals (more so the young) will benefit from lower tax rates and higher wages in the future.

Figure 2 describes the evolution of the average optimal taxes along the reform. We decentralize the resulting allocation leaving consumption taxes unchanged, even though it is possible to decentralize the same allocation in alternative ways.

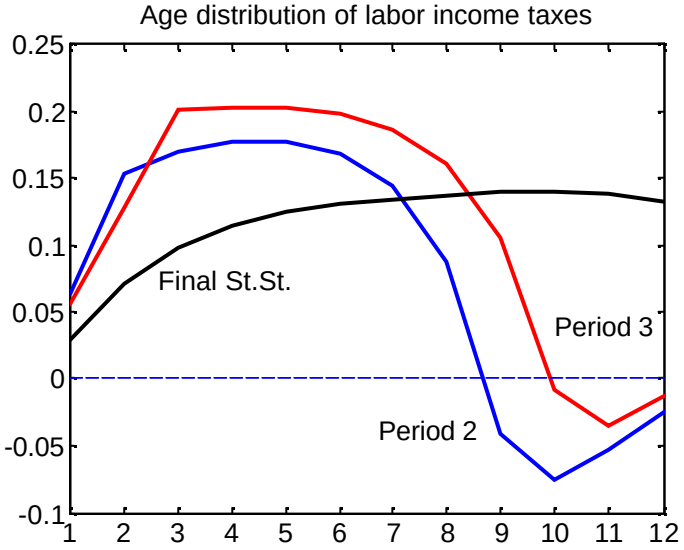
[4] We also explored the situation in which the government cannot use lump-sum transfers to the initial old. In that case the government would choose labor and capital income subsidies for the elderly as a compensatory device. However, this strategy is not feasible whenever the government is constrained to set the same tax rates for all cohorts as in our scenario 2.

Figure 2: Average Taxes



Labor income taxes are substantially lowered the first period following the reform, but then they are increased to repay the initial debt issued and reach a new long run equilibrium around 12% on average. Figure 3 displays its distribution across age at different points in time.

Figure 3: Labor Income Taxes across Different Cohorts at Different Time



The average labor income tax rate varies substantially across cohorts in the initial periods of the reform. However, these differences are importantly reduced in the long-run. The government finds optimal to use different tax rates to compensate the potential

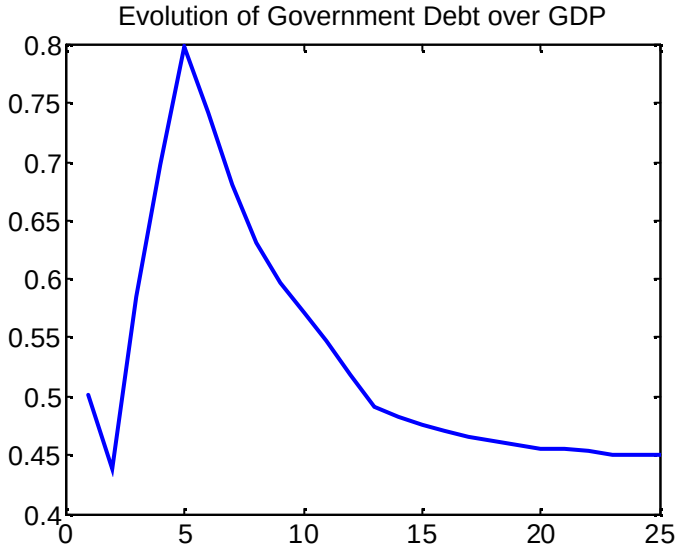
welfare losses accruing to each cohort associated to the privatization.

The optimal labor income tax schedule follows a hump shape as a function of age. In fact, this is a standard result in which labor income taxes track the shape of the efficiency units of labor (notice that this implies progressive labor income taxes). In the initial periods (t=2,3), however, this shape is much more pronounced, since the government finds optimal to encourage labor supply of the elderly by subsidizing their labor income (remember that compulsory retirement can be interpreted as a confiscatory tax on labor income upon retirement). Again, if the government could not use lump-sum transfers it would choose to heavily subsidize labor income as a compensatory scheme. In subsequent periods the shape of the labor income taxes slowly converges towards its final steady state.

In steady state, the labor income tax schedule is hump-shaped, partially replicating the pattern of the endowment of efficiency units of labor. We observe that tax discrimination is especially important in the initial periods of the transition path.

The initial tax cuts, together with the lump-sum transfers to the initial old, necessarily imply that government debt has to increase in the initial periods following the reform. Next, Figure 5 displays the evolution of government debt over GDP associated to the optimal policy.

Figure 5: Evolution of Debt to GDP Ratio



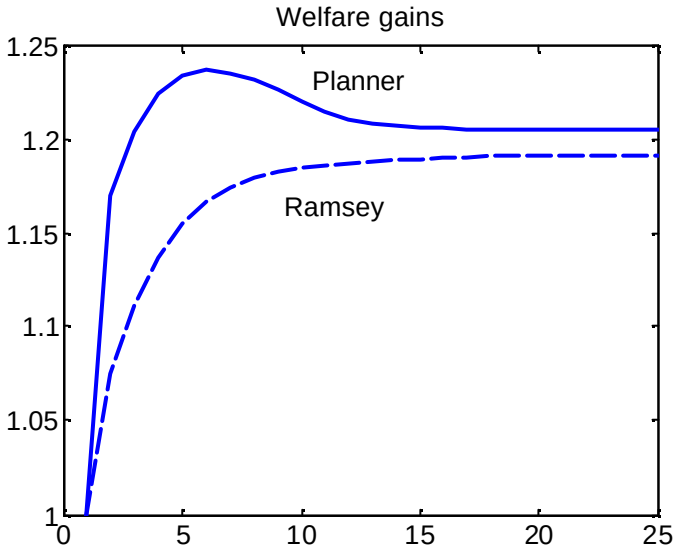
Notice that the increment in debt is substantially lower than the total implicit debt of the social security system (147% of GDP). Notice that a privatization of the social security system leaving all distortions unaffected would require lump-sum transfers and an

increase in debt once and for all exactly equal to the whole implicit debt. This reform would be Pareto neutral.

As we can observe in Figure 5, the privatization generates an initial increase in government debt (up to 80% of GDP), but then this debt is progressively eliminated. In the end, the level of government debt is equal to that of the benchmark economy. This implies that a substantial fraction of the initial debt issued will be repaid by the young generations alive at the beginning of the reform. A different path of debt and welfare gains would result if we allowed for some of the welfare gains to accrue to the initial generations alive.

Overall, such a reform generates substantial welfare gains for newborn generations, while leaving cohorts initially alive indifferent by construction. The welfare gains accruing to newborns are plotted in Figure 6.

Figure 6: Welfare Gains of Newborn Generations



Notice that the welfare gains associated to the reform just discussed, labeled as "Ramsey" in Figure 6, are substantial. Measured as equivalent variation in consumption the welfare gains are equivalent to future newborns enjoying between 15% and 20% more consumption than the newborns in the status quo economy with a PAYG social security system.

The parameter l controls the relative weight that the government places between present and future generations. A different value for this parameter or letting the initial old enjoy some of the welfare gains of the reform would result in a different

distributional pattern of welfare gains.

Finally, it is worth noting that the observed difference between the welfare numbers just discussed and the welfare gains labeled as "Planner" are a measure of the welfare cost of distortionary taxation, since "Planner" displays the welfare gains associated to the first best-allocation. For the parameterized value of ? it is clear that the planner can front load much more the welfare gain on the initial generations than when distortionary taxes have to be used to compensate the status quo generations. Nonetheless, it is important to remark that in the long run the welfare cost of distortionary taxation is substantially smaller.

6. Results with an unconstrained set of fiscal instruments

Now we turn to the case in which the Ramsey problem is not constrained in the set of fiscal instruments. That way both capital and labor income taxes are optimally chosen for each cohort at each point in time. Clearly, in this environment the allocations result in higher welfare. Yet, the relevant question is how big are they relative to the previous case.

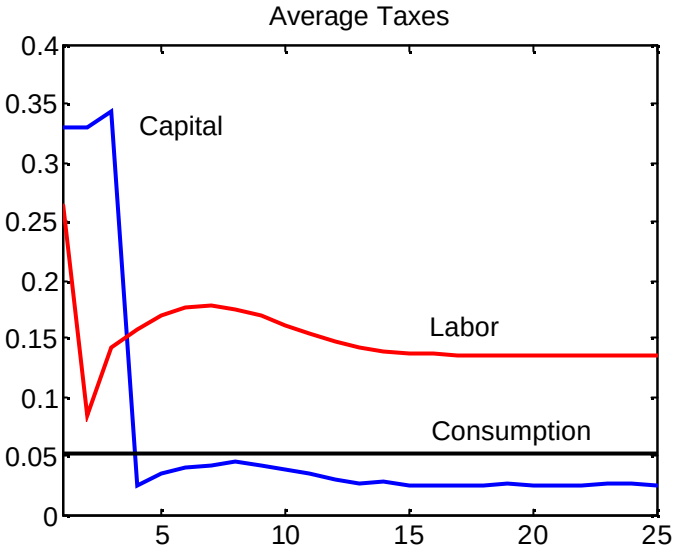
In this environment the level of initial transfers needed is smaller, 15% of the initial social security entitlements, as compared to the 20% of the previous case. This was to be expected since the Ramsey problem might find optimal to compensate welfare losses by lowering the capital income taxes on the initial wealth held by the old cohorts of households.

The optimally chosen level of transfers to the initial old is reported in Table 2:

Table 3: Transfers to Initial Generations (% Entitlements)					
20-54	**55-59**	**60-64**	**65-69**	**70-74**	**75-79**
0	0	0	0.19	0.39	0.64

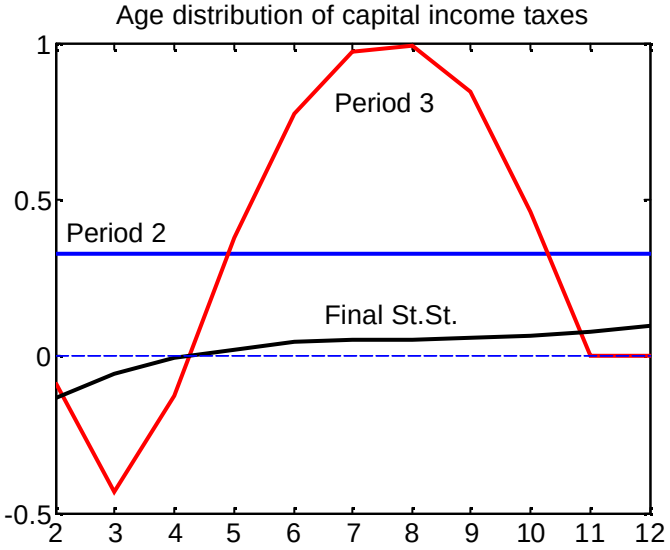
The evolution of the average tax rates is reported in Figure 7.

Figure 7: Average Taxes



Clearly the Ramsey problem finds it optimal to lower capital income taxes as well. In fact, these taxes are lowered on impact to almost 4% on average and roughly stay there even in the long-run. The reason why it is optimal to have a positive capital income tax in the long-run is that preferences are not separable in consumption and leisure (see Erosa and Gervais (2001) and Garriga (2003)).

Figure 8: Capital Income Taxes across Different Cohorts at Different Time



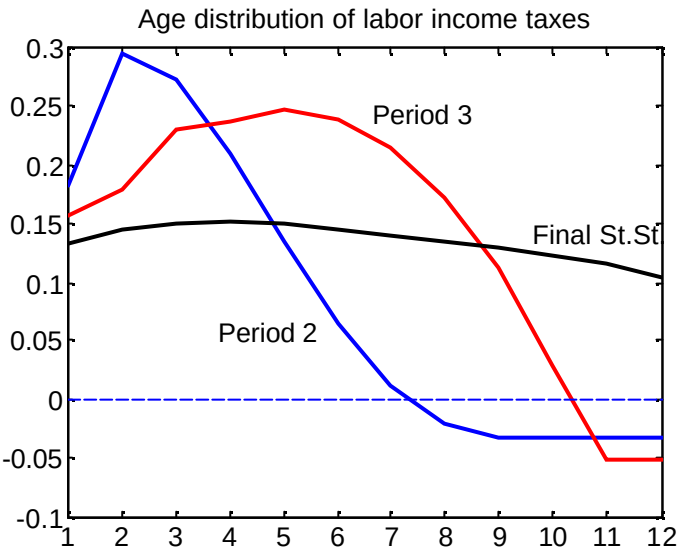
In the initial period of the reform (period 2) the government takes as given the initial capital income tax. However, in period 3 the planner heavily subsidizes the capital income of the young, while capital income taxes of the middle age and of the elderly are

quite substantial. In an environment in which the government would be constrained not to use lump-sum compensatory transfers to the initial generations the government would choose to heavily subsidize the capital income of the old as a compensatory device.

Finally, notice that the final steady state implies very small capital income taxes on average and increasing in age (with subsidies to the younger generations).

Next, Figure 9 displays the differences in labor income taxes for the initial periods of the reform and the long-run steady state.

Figure 9: Labor Income Taxes across Different Cohorts at Different Time

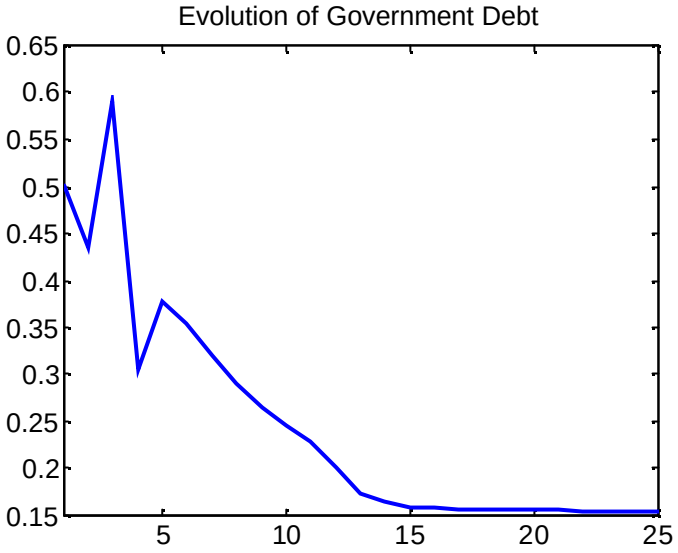


The optimal labor income tax roughly follows the same pattern as before, even though there are some differences. There are lower subsidies to the initial old, since the fiscal authority can also use capital income tax cuts to compensate the welfare losses. Also, the long run schedule changes a bit relative to the previous case.

In steady state, the capital income tax schedule is slightly increasing in age, while the implied labor income tax schedule is hump-shaped, replicating the pattern of the endowment of efficiency units of labor.

Next, Figure 10 displays the evolution of government debt over GDP associated to the optimal policy.

Figure 10: Evolution of Debt to GDP Ratio

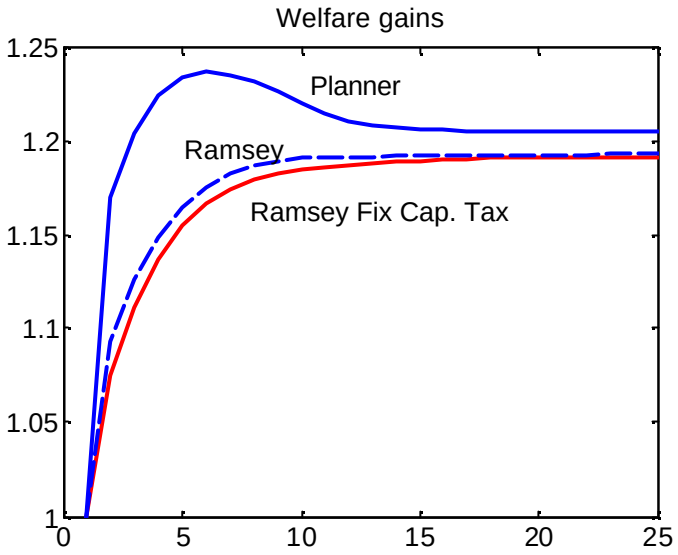


As we can observe in Figure 10, this privatization implies a lower need to issue debt, since the initial compensatory transfers are smaller.

In particular, the optimal level of debt increases up to 60% immediately after the start of the reform. Later it is gradually repaid until it converges to its final steady state value. Notice that the optimal level of debt in the long run is much smaller than before. This result comes from the fact that capital income taxes have been set optimally as well. Yet, the final level of debt depends on the discount factor l chosen.

The welfare gains accruing to newborns are plotted in Figure 11.

Figure 11: Welfare Gains of Newborn Generations



Notice that the welfare gains associated to the reform just discussed, labeled as "Ramsey" in Figure 11, are substantial. Yet, when we compare with the welfare gains obtained for the constrained case studied in the previous section, labeled as "Ramsey Fix Cap. Tax", we observe that the difference is relatively small. In particular, it is very small in the long-run.

From that experiment we conclude that most of the welfare gains accruing to a privatization come from the reduction of labor supply distortions, which are the distortions inherent in the financing of the Social Security system.

7. Conclusions

It is a common prediction of standard overlapping generations models that changing the PAYG nature of public social security systems towards a Fully Funded system might generate substantial efficiency and welfare gains in the long run. Moreover, given the demographic projections it might be unavoidable to engage in such reforms. However, these long run efficiency and welfare gains come at the cost of substantial welfare losses for initial generations, casting doubts on the political viability of such a fundamental tax reform.

In contrast, we argue that a privatization of the social security system can be interpreted as the explicit recognition of an implicit debt and there is no efficiency gain in doing so. As a consequence, potential efficiency gains upon reforming the system come from the

elimination of distortions and the optimal management of that implicit debt. Based on that argument, this paper studies the optimal design of a social security privatization in a Pareto improving way, applying an optimal fiscal policy approach. The government decides endogenously how to compensate the initial generations alive from the loss of future pensions and how to finance the transition from a PAYG system to a FF system, in an environment where welfare of the initial generations alive becomes policy constraint. We find that the government can design a Pareto efficient reform that exhibits sizeable welfare gains. Our approach explicitly provides quantitative policy prescriptions towards the policy design of future and maybe unavoidable social security reforms.

Finally, we observe that the welfare gains come from the reduction of distortions in the labor supply margin, so little is gained by changing the structure of capital income taxation as part of a potential reform.

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