

## Privatizing Social Security\*

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This paper studies the political sustainability of the existing pay-as-you-go Social Security system in the face of recent demographic patterns. We analyze different approaches to privatizing the system and consider what it would require for them to be politically implementable. The analysis is based on an overlapping-generations economy where an initial generation would choose to implement a pay-as-you-go social insurance system. We study the sustainability of this system in each subsequent period. We describe some transition policies that make the current generations of agents at least as well off as the maintenance of the Social Security system. All feasible transition policies use debt to finance the benefits during the transition period, shifting at least some of the cost to unborn generations. © 1999 Academic Press

*Key Words:* Social Security; privatization; political implementability; overlapping generations; general equilibrium.

### INTRODUCTION

The original intent of the U.S. Social Security program was to create a funded system for the insurance of retirement income against the sort of catastrophic events that wiped out much private savings in the great

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depression. By the late 1930s, that original vision had been altered and the U.S. system became a pay-as-you-go plan where current generations of retirees are provided for by current generations of workers. It is now well known that changes in the demographics of the U.S. population have placed the U.S. Social Security in jeopardy. This is because future generations of retirees are likely to have too few workers per retiree to keep the system intact without dramatic increases in tax rates. These problems are mirrored in many other countries. Many authors have predicted that the system would collapse as a result and there are many proposals to reform the existing system. Neglected in many discussions of Social Security reform is the issue of whether reform proposals are politically feasible. In Cooley and Soares (1996, 1999) we describe a general equilibrium framework for analyzing the political economy of Social Security. In this paper we extend that framework and use it to consider the political viability of alternative ways of eliminating the current Social Security system and replacing it with private savings. The particular question we address is the following. Is there a transition policy that will have the political support of the population that will lead to a smooth transition from pay-as-you-go to a private Social Security system?<sup>1</sup>

In Cooley and Soares (1999) we showed that rational economic agents would vote to put into place a pay-as-you-go Social Security plan, even though social welfare would be higher absent such a system. Stated differently, Social Security is both implementable and sustainable and sustainability implies that people would not choose to abandon it. That analysis assumed that the demographic features of the U.S. population are constant. In fact, they have changed since the implementation of the Social Security system. The baby boom generation (born in the late 1940s and early 1950s) is aging and will begin to retire and collect benefits in the first decades of the next century. There has also been a trend toward earlier retirement and an increase in life expectancy. Together, these factors imply that the share of the population getting benefits from the system will increase dramatically. In Cooley and Soares (1996) we considered the effect of a baby boom on the sustainability of pay-as-you-go social insurance. We showed that, if people could abandon the system immediately, then the baby boom would lead them to do so. If, however, they must honor existing obligations to the retired generations, then the system would never collapse.

We study the Social Security system using an overlapping-generations economy where agents live for a maximum of four periods and labor supply is endogenous. Agents in this economy work for the first three

<sup>1</sup> We consider the privatization of Social Security to mean the elimination of Social Security benefits and their replacement by endogenous voluntary private savings.

periods of their lives and retire during the fourth period. We assume that the level of benefits is a constant proportion of the average labor income per worker. This implies that the level both of benefits and of taxation will automatically adjust to changes in productivity and labor supply making the economic viability of the system automatic. With this assumption in place, we look at the political viability of the system by considering whether voters will continue to support it as the demographics change. In addition, we study whether there are transition policies—policies that would replace Social Security by private savings according to some schedule—that would be acceptable to voters.

Given the political robustness of pay-as-you-go Social Security it is a bit difficult to talk about the possibility of transitions to a fully privatized system. Here we pose the problem somewhat differently. We consider policies that would replace the existing system gradually by phasing out Social Security benefits over several generations according to an arbitrary schedule. We then consider alternative ways of financing this gradual transition. We search for alternatives that would leave no generations worse off. This enables us to describe transition policies that would, in principle, be politically feasible. Of course, there is no sense in which these policies are consistent with the forward-looking assumption made when Social Security is initially implemented.

There is a large recent literature that considers ways to reform the existing Social Security system. Much of the existing literature on Social Security evaluates the gains of privatizing Social Security using partial equilibrium overlapping-generations models. Feldstein and Samwick (1996) and Altig and Gokhale (1997) present partial equilibrium analyses of similar ways of reforming a pay-as-you-go Social Security system to a funded system without reducing the promised level of benefits of the retirees. Partial equilibrium analyses abstract from the impact of Social Security on the supply of factors and on factor prices.

The reform of the Social Security system has also been studied in general equilibrium models. Kotlikoff (1997) analyzes the long-run efficiency gains from privatizing Social Security in a calibrated deterministic overlapping-generations economy. He evaluates the impact on savings, labor supply, and aggregate welfare under different assumptions about the instruments used to finance benefits during the transition. Huang *et al.* (1997) look at the effects of a privatization policy and of a reform of the social security system in a stochastic environment. This paper differs from the previous literature in that we focus on the political implementability of alternative privatization policies. The existing literature considers whether the United States should privatize the social security system; we search for privatization schemes that would be politically implementable.

We examine several transition policies that involve a gradual shrinking of Social Security from a pay-as-you-go system to an economy without a Social Security system. We allow for the possibility that these transitions could be financed by taxes on labor income, consumption, and the issuance of debt. We find some policies that are preferred by all the agents to the maintenance of the Social Security system and are therefore implementable. The one striking conclusion that emerges from this search for feasible policies is the following: in order to be politically feasible, a transition policy would have to rely heavily on the use of debt to finance the transition. The use of debt, of course, shifts the burden to future generations. Those generations, however, would be willing to bear the burden because they would inherit an economy with a higher capital stock due to the higher savings that the privatization of the Social Security system would induce.

## 1. THE ECONOMIC ENVIRONMENT

We study an economy where in each period a large number of agents with a maximum lifetime of four periods are born or immigrate into the economy. In each period of their lives these agents have an exogenous probability of surviving into the next period. The demographic process is stochastic, implying that the size of each cohort is a random variable. The number of age- $i$  individuals in the population in the current period, given by  $N_i + M_i$ , where  $N_i$  is the number of age- $i$  agents that survived from generation  $i - 1$  in the preceding period, and  $M_i$  is the number of age- $i$  immigrants during the current period, will change over time according to realizations of a stochastic process that will be described later.

The agents in each generation maximize their discounted lifetime utility. The "momentary" utility function is assumed to take the constant relative risk aversion form of a Cobb–Douglas consumption–leisure index,

$$U(c_i, l_i) = \frac{(c_i^\sigma l_i^{1-\sigma})^{1-\rho}}{1-\rho}, \quad (1)$$

where  $\rho$  is the inverse of the intertemporal elasticity of substitution, and  $\sigma$  is the coefficient of consumption on the Cobb–Douglas index.

We differentiate risk-sensitive behavior from intertemporal substitution by assuming that agents face a nonstationary recursive "risk sensitive" discounted dynamic programming problem as defined by Hansen and

Sargent (1994).<sup>2</sup> For an agent of age  $i$  this is given by

$$V_i = U(c_i, l_i) + \beta \Gamma(s'_{i+1}V'_{i+1}), \tag{2}$$

where  $\beta$  is the subjective discount factor,  $c_i$  is consumption, and  $l_i$  is leisure of an age- $i$  individual, and

$$\Gamma(V'_{i+1}) = \frac{2}{\xi} \log E \left[ \exp \left( \frac{\xi s'_{i+1} V'_{i+1}}{2} \right) \right]. \tag{3}$$

$\xi$  is the risk sensitivity parameter and  $s'_{i+1}$  is the exogenous random probability of the age- $i$  agent alive in the current period surviving from age  $i$  to age  $i + 1$ . We use primes to denote next period values throughout. By attributing different weights to different realizations of the next-period value function,  $\Gamma$  allows us to incorporate some risk sensitivity into the discounting of the future. For example, if  $\xi > 0$ ,  $\Gamma(\cdot)$  is concave, indicating a preference for risk.

Agents in this economy accumulate claims on government debt and on real capital, used in production by firms, to help smooth consumption across time. The budget constraint facing an individual of age  $i$  can be written as

$$a'_{i+1} = (1 + (1 - \tau_k)r)a_i + y_i - (1 + \tau_c)c_i + TR_i, \tag{4}$$

where  $y_i$  is the real net labor income plus social security transfers (in units of the consumption good) of an age- $i$  individual,  $a_i$  denotes the asset holdings of an age- $i$  individual at the beginning of the period, and  $r$  denotes the rate of return on these assets.  $\tau_k$ ,  $\tau_l$ , and  $\tau_c$  are the tax rates on capital income, labor income, and consumption, respectively, while  $TR_i$  is a lump-sum transfer. We also assume that there are no voluntary intergenerational transfers and agents will not accumulate assets in the last period of life.

We choose the construct of four-period-lived agents because, in the United States, current life expectancies and work-life expectancies imply that individuals spend somewhere between three and four years working

<sup>2</sup> This specification will allow us to work with a LEQA (linear/exponential/quadratic approximation) method to study overlapping generations models in a stochastic environment. The linear decision rules that we obtain when we apply LEQA will incorporate "risk-sensitive" behavior.

for every year of retirement. We assume that agents may work the first three periods of their lives, but must be retired in the fourth period.

Before their mandatory retirement, age- $i$  workers supply endogenously  $h_i$  hours of labor and have different productivity levels represented by  $\varepsilon_i$ , an efficiency index representing the productivity of an hour of work supplied by an agent of age  $i$ . After retirement, the noncapital income of a retiree is just the social security benefit,  $b$ . The level of benefits is computed by applying a replacement rate,  $\theta$ , to a base income that we take to be a function of the income of the agents currently employed,

$$b = \theta w \bar{h} \bar{\varepsilon}, \quad (5)$$

where  $w \bar{h} \bar{\varepsilon}$  is the weighted average earnings of the working generations. Under these assumptions, the net labor income of an individual is given by

$$y_i = \begin{cases} (1 - \tau_1) w h_i \varepsilon_i, & \text{for } i = 1, 2, 3, \\ b, & \text{for } i = 4. \end{cases} \quad (6)$$

The production technology of the economy is described by a constant-returns-to-scale function,

$$Y = F(K, L) = \Psi K^{1-\alpha} L^\alpha, \quad (7)$$

where  $\Psi \geq 0$ ,  $\alpha \in (0, 1)$  is the labor share of output  $Y$ , and  $K$  and  $L$  are the capital and labor inputs. The capital stock is equal to the aggregate asset holdings of the agents in the economy net of the public debt. It depreciates at a constant rate  $\delta$  and evolves according to the law of motion

$$K' = (1 - \delta)K + I. \quad (8)$$

There is a government in this economy that implements the pay-as-you-go social insurance system chosen by the agents through voting. The government must impose taxes or issue debt so that its budget is balanced each period,

$$\tau_1 w L + \tau_k r K + \tau_c C + D' - (1 + r(1 - \tau_k))D = B + G, \quad (9)$$

where  $B$  is the level of total benefits paid to the current retirees,  $D$  is the current level of government debt, and  $G$  is the level of government expenditures, which we assume to be a constant share,  $g$ , of total output. We assume that the government distributes the accidental bequests to all agents in equal amounts as lump-sum transfers.

At the beginning of each period there are  $N_i + M_i$  agents in the  $i$ th generation,  $N_i$  surviving from the preceding period and  $M_i$  immigrants. We make the simplifying assumption that the immigrants come into the economy with exactly the same level of wealth as the domestic agents from the same cohort.

We assume initially that the vector  $[M_i \ N_i]_{i=1,\dots,4}$  grows at a constant rate. A generation of size  $N_1$  is born each period and it will live for a maximum of four periods. The share of age- $i$  agents in the population is

$$\mu_i = \frac{N_i + M_i}{\sum_{l=1}^4 N_l + M_l}$$

and the probability of an age- $i$  agent currently alive surviving to next period is

$$s_i = \frac{N'_{i+1}}{N_i + M_i}.$$

Initially, this is assumed to be deterministic.

After the initial period the vector  $[M_i \ N_i]_{i=1,\dots,4}$  follows a stochastic process that is calibrated by fitting a simple time-series process to U.S. data. We assume that this change in the demographic process is unanticipated by the agents living in the initial period. Furthermore, we assume that agents do not take into account how unexpected shocks to the demographic process may affect the sustainability of the social security system.

## 2. EQUILIBRIUM

The economic problem of an age- $i$  individual is to choose a sequence of consumption, leisure, and asset holdings, given a sequence of policies for social insurance, that maximize the expected discounted value of lifetime utility subject to her budget constraints. We write this as

$$V_i(a_i, A, D, S; \Theta) = \max_{a_{i+1}, l_i} \{U(c_i, l_i) + \beta \Gamma(s'_{i+1} V'_{i+1}(a'_{i+1}, A', D', S'; \Theta'))\} \tag{10}$$

s.t.

$$a'_{i+1} = (1 + (1 - \tau_k)r)a_i + y_i - (1 + \tau_c)c_i,$$

$$y_i = \begin{cases} (1 - \tau_l)wh_i\varepsilon_i, & \text{for } i = 1, 2, 3, \\ \theta w\bar{h}\varepsilon, & \text{for } i = 4. \end{cases}$$

$$l_i + h_i = 1,$$

$$A' = T(A, D, S; \Theta),$$

$$S' = Q(S),$$

$$D' = P(A, D, S; \Theta),$$

given  $\Theta$ ,

$$V_5 = 0.$$

Here,  $A$  represents the distribution of capital across agents and  $S$  represents the demographic state of the economy including immigration flows and the distribution of agents across generations.  $T(A, D, S; \Theta)$  is the law of motion of the distribution of capital, while  $P(A, D, S; \Theta)$  is the law of motion of public debt and  $Q(S)$  is the exogenous law of motion of the demographic variables.  $\Theta$  is a given sequence that describes the social security policy or the transition policy in each period.

A set of decision functions  $c_i(a, A, D, S; \Theta)$ ,  $h_i(a, A, D, S; \Theta)$ ,  $a_i(a, A, D, S; \Theta)$ , laws of motion  $T(A, D, S; \Theta)$ ,  $P(A, D, S; \Theta)$ ,  $Q(S)$ , and value functions  $V_i(a, A, D, S; \Theta)$  are obtained for the current state of the economy  $(A, D, S)$ .

In our model, competitive firms maximize profits, which are equal to  $Y - wL - rK$ , taking the wage rate and interest rate as given. The first-order conditions for the firm's problem determine the following functions for the net real return to capital and the real wage rate:

$$\begin{aligned} R &= (1 - \alpha)\Psi\left(\frac{K}{L}\right)^{-\alpha} - \delta, \\ W &= \alpha\Psi\left(\frac{K}{L}\right)^{1-\alpha}. \end{aligned} \tag{11}$$

**DEFINITION.** An *equilibrium* is a set of value functions,  $V_i(a, A, D, S; \Theta)$ , decision rules for consumption, individual labor supply, and asset holding  $c_i(a, A, D, S; \Theta)$ ,  $h_i(a, A, D, S; \Theta)$ ,  $a_i(a, A, D, S; \Theta)$ , for  $i = 1, \dots, 4$ , laws of motion for the distribution of capital  $T(A, D, S; \Theta)$ , and for the level of public debt  $P(A, D, S; \Theta)$ , a sequence of relative factor price functions



$\{W(A, D, S; \Theta), R(A, D, S; \Theta)\}$ , functions for the level of capital per capita  $\hat{K}(A, D, S; \Theta)$ <sup>3</sup> and for the effective labor supply per capital  $\hat{L}(A, D, S; \Theta)$  such that these functions satisfy:

1. The individual's dynamic program (10).
2. The first-order conditions of the firm's problem (11).
3. Factor markets clear:

$$\hat{K} = \hat{K}(A, D, S; \Theta) = \frac{N^- + M^-}{N + M} \left( \sum_{i=1}^4 \mu_i^- a_i - \hat{D} \right),$$

$$\hat{L} = \hat{L}(A, D, S; \Theta) = \sum_{i=1}^3 \mu_i h_i(a, A, D, S; \Theta) \varepsilon_i.$$

4. The commodity market clears:

$$\begin{aligned} \sum_i \mu_i (c_i(a, A, D, S; \Theta) + a_i(a, A, D, S; \Theta)) \\ = \hat{F}(\hat{K}, \hat{L}) + (1 - \delta) \hat{K}. \end{aligned}$$

5. The law of motion for the distribution of capital is generated by the decision rules of the agents:

$$T(A, D, S; \Theta) = [a_i(a, A, D, S; \Theta)] \quad i = 1, \dots, 3.$$

6. The government budget is balanced.

### 3. SOCIAL SECURITY POLICIES

In Cooley and Soares (1999) we describe how an initial generation of agents, when offered the opportunity to implement a Social Security system, would make that choice, knowing that subsequent generations would have the opportunity to either keep the implemented system or abandon it. In this paper we assume a similar arrangement and we describe here, briefly, the assumptions that underlie it.

<sup>3</sup> A variable with a hat indicates that the variable is expressed in per capita terms while one with a minus sign as a superscript means that it is a variable from the preceding period.

### *The Voting Decision*

First, we assume sincere voting; that is, everyone votes for their most preferred alternative at every stage of the game. As in Cooley and Soares (1999), we introduce a reputational mechanism to deal with the time inconsistency problem<sup>4</sup> and to show how Social Security would be implemented and sustained by rational forward-looking agents. The reputation mechanism is represented by a trigger strategy where the equilibrium of the one-shot game serves as a credible threat to induce more “cooperative” behavior from agents. If the workers today vote against paying Social Security benefits, then agents next period lose confidence in the sustainability of the system. This loss of credibility means the cost of defecting today involves the collapse of the system tomorrow.

Let  $SS^*$  be a rule that specifies the Social Security system. The assumed expectations mechanism is

$$SS^{er} = \begin{cases} SS^*, & \text{if } SS = SS^*, \\ 0, & \text{otherwise.} \end{cases} \quad (12)$$

In the initial period, agents choose the equilibrium policy that will be implemented with the associated expectations mechanism described by (12). Agents (workers) will only vote for sustainable levels of  $SS^*$ . This Social Security system will be sustainable if the median voters in later generations find it in their interest to preserve the system until their retirement. That is, it is sustained if the threat that it will not be in place when they retire is sufficient to sustain it.

At each date the current retirees will have sustained the system from which they expect to get benefits. We assume that what the retirees are entitled to is a level of benefits computed according to an implicit rule. The rule we propose here is one where the benefits to retirees are proportional to the average labor income of current workers,  $b = \theta w \bar{h} e$ . The parameter  $\theta$  will fully describe the Social Security system.

We assume that, before the implementation of Social Security, the economy is in a steady state and the demographic variables grow at a constant rate. When the initial generation of agents is offered the opportunity to implement a Social Security system they make demographic projections based on this process.

<sup>4</sup> Social insurance is a time-inconsistent policy because forward looking rational agents will not believe it is sustainable. The current period workers will have to support the costs of any Social Security benefits without getting any direct current benefits from it. Even though it might be rational to adopt a Social Security system, there is always an incentive to deviate from it.

#### 4. CALIBRATION

To solve this model numerically we assign values to the parameters of preferences and technologies. Some parameters are taken from empirical estimates or standard calibrations of similar models; others will be set to match observations on the capital–output ratio, the rate of return, wages, and hours worked. We calibrate the model assuming a period is 15 years. Agents in this model are assumed to be born at the age of 21 when they become full-time workers, working 45 years, and then retiring.

To compute the initial steady state, we set the population growth to be 1.2% per year, the average population growth rate in the United States for the period 1920–1946. For the four-generation model this translates to a growth rate of  $n = 0.18$ . This will also be the expected growth rate of the population before the implementation of the Social Security system. We calibrate the initial size of each generation based on the averages for the period 1946–1959, a period chosen because Social Security began to have fairly broad coverage in the early 1950's.

##### *Preferences*

We set the coefficient of risk aversion  $\rho$  equal to 2 and we chose the value for the discount factor so that in equilibrium the capital–output ratio was approximately 2.93 for the period corresponding to about 1970–1990 as observed in the U.S. data. We set  $\beta$  to be the equivalent in the four-generations model of the value (0.988). Assuming that agents live for 80 years, this means that  $\beta$  will be such that  $\beta = 0.988^{60/4}$ .

We take the coefficient of consumption in the utility function,  $\sigma$ , to be 0.4; this value implies that on average agents in the labor force allocate a third of their time to market activities. The risk sensitivity parameter is set to  $-0.05$  so that we work with risk-sensitive preferences as in Tallarini (1998) and Huang *et al.* (1997).  $\sigma < 0$  implies that  $\Gamma(V)$  is convex in  $E[V]$  and therefore the agents prefer an early resolution of uncertainty.

##### *Technology*

Following Cooley and Prescott (1995), the share of labor in the production function is set to be 0.6. We set the depreciation rate to be 6% on an annual basis, which is the estimate in Stokey and Rebelo (1995). Finally, the total factor productivity in the production sector is normalized to 1. The age-specific endowments of efficiency units shown in Table I are constructed to provide a realistic age distribution of earnings using the Current Population Survey (CPS) March demographic files for 1989–1991. We compute these indices as the ratio of the average hourly wage for each age group to the average hourly wage of all the age groups.

TABLE I  
Labor Supply

Generations	1	2	3
Efficiency index	0.9043	1.1828	1.1873

### Demographic Process

Our framework requires calibrating innovations to the size of each cohort in the population. We calibrate the initial size of each generation based on the averages for the period 1946–1959, a period chosen because Social Security began to have fairly broad coverage in the early 1950s. The sizes of each cohort,  $N_i$ , follows a simple time-series process:

$$N_i = \begin{cases} N_i^- + \text{cste}_1 + \text{trend}_1 \cdot \text{period}, & \text{for } i = 1, \\ N_{i-1}^- + M_{i-1}^- + \text{cste}_1 + \text{trend}_i \cdot \text{period}, & \text{for } i = 2, 3, 4. \end{cases} \quad (13)$$

The immigration flow,  $M$ , is described by the following process:

$$M = M^- + \text{cste}_0 + \text{trend}_0 \cdot \text{period}.$$

The calibration of the parameters of the demographic processes is given in Table II. Also presented are the realized shocks to these processes for three subsequent periods in the model. The corresponding behavior of the share of each generation in the population over time is described in Fig. 1. It is clear that the share of the older generation increases while the relative size of the younger generations decreases.

TABLE II  
Generation Sizes and Shocks

	$N_1$	$N_2$	$N_3$	$N_4$	$M$
	Generation sizes				
Initial level	35098.667	29163.9693	20448.7408	11141.4347	2845.669
Constant	2455.24	8114.17	-824.019	-3726.29	-3223.62
Time trend	513.6809	-36.9968	16.2108	87.9621	32.7317
St. dev.	174.73	1764.92	64.6803	47.9278	65.7491
	Shocks				
1961–1975	2146.6	3134.584	2727.181	1861.024	1151.161
1976–1990	-7382.12	2039.647	582.4536	-634.878	-410.197
1991–2005	-14171.7	3511.365	362.3908	-2009.82	0

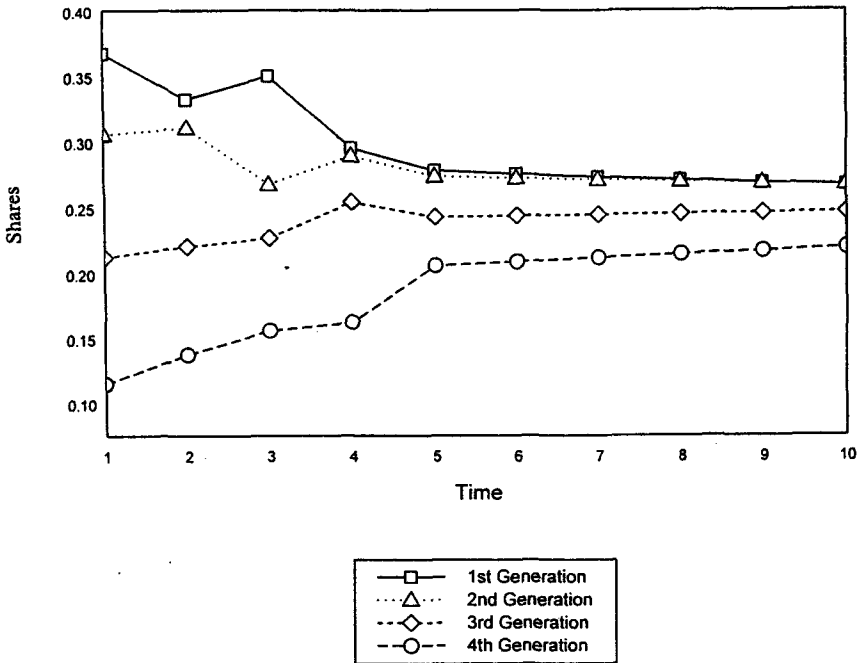


FIG. 1. Shares of the generations along the path.

*Exogenous Political Parameters*

We specify the level of government purchases per-capita so that its ratio to output is 19.7%.<sup>5</sup> Part of these expenditures is financed by a tax on labor income at the rate of 23% (see Joines, 1981) and the remainder is financed by taxing capital income.

The parameter choices are summarized in Table III.

TABLE III  
Benchmark Calibration—Four Generations

$\beta$	$\rho$	$\sigma$	$\varphi$	$\alpha$	$\delta$	$g$	$\xi$
0.8344	2	0.4	1	0.6	0.6047	0.197	-0.05

<sup>5</sup> Value computed using data from the National Income and Product Accounts of the United States, U.S. Department of Commerce.

## 5. FINDINGS

For this model economy, the utility levels of the agents alive in the initial period when Social Security is first proposed are single peaked over the policy parameter  $\theta$ . The median voter is located in the second generation of workers. The replacement rate that maximizes the utility level of the median voter is given by the parameter  $\theta^* = 0.4228$ . This level is sustainable for the expected path of the population structure, so it is a political equilibrium. This replacement rate corresponds to an initial ratio of Social Security benefits to output of approximately 3.29%. This ratio increases along the path and the value for the period corresponding to the 1900's in our model is 5.11%. This value seems reasonable when compared to the 1994 value of the NNP share of Social Security expenditures, 5.2%. Moreover, it implies a Social Security tax on labor income at a rate that varies from 5.49% initially to 8.52% currently, with future rates reaching 12%.

The equilibrium levels of the assets for each generation and the aggregate stock of capital per capita are strictly decreasing with the level of the Social Security benefits. The introduction of the pay-as-you-go Social Security system also distorts labor supply decisions. The intuition for these results is straightforward and well known. In an overlapping generations environment without altruism, older generations have a higher marginal propensity to consume than do younger generations. The introduction of Social Security implies a redistribution of resources away from the young to the old. This increases consumption and decreases savings. Further, the increase in the taxation of labor income and in retirement benefits lowers the incentive of agents to work. The impact on the capital stock is stronger than that on labor supply and the capital-labor ratio decreases, increasing the interest rate and decreasing wages.

### *Sustainability*

Suppose now that the initial assumption about demographics made by the agents in this economy turns out to be incorrect; how would this affect the sustainability for the system? To address this issue we calibrate the process for innovations to each cohort in the population. The size of each cohort follows a simple time-series process that takes account of varying birthrates, deathrates, and immigration.

We simulate the model with these demographic processes for a sequence of realizations of the exogenous stochastic rate of the economy,  $S$ . We assume that agents do not take into account how unexpected shocks might affect the sustainability of the Social Security system. For each realization of  $S$  we compute the expected path of the economy and check

for sustainability of the Social Security system by comparing the utility of the agents when the system is maintained and when it is abandoned. Figure 2 shows the equilibrium capital-output ratio ( $K/Y$ ) and the effective labor supply per capital ( $L/N$ ) in the absence of a Social Security system ( $\theta = 0$ ) and for the equilibrium replacement rate ( $\theta = \theta^*$ ) for the expected evolution of the population in this economy.

In our economy, the realized dynamics of the post-war baby boom would cause the implemented Social Security system to collapse after four periods even though it is sustained after the first big unexpected change in the age distribution of the population. Until the fourth period in the model, which roughly corresponds to the current decade, only the first generation prefers to let the system collapse when the alternative is to maintain the status quo. This means that the Social Security system is stable in the sense that it will not collapse. In the fourth period the two younger generations prefer to abandon the status quo Social Security system; the agents would choose to privatize the system in the period when the baby boom generation retired. The increase in the relative size of the older generation seems therefore to be the fundamental cause of the abandonment of Social Security.

If, however, the claims of the current generation of retirees were viewed as an entitlement that must be honored, the system would not collapse. In this case, the middle-aged agents would form a majority that would oppose the collapse of the Social Security system while the younger and the older generations would support the abandonment of the system. The political position of the older generation in this case is interesting. When it is known that the system will collapse in the following period, there is an immediate response from the current workers who increase their labor supply to provide for their retirement by accumulating more assets. Labor income increases and, given the current capital stock, so does the interest rate. Besides the higher level of Social Security benefits stemming from the application of the same replacement rate to a higher basis, the current retirees also gain from an increase in their capital income.<sup>6</sup>

## 6. TRANSITION POLICIES

Since, in the long run, the level of welfare is lower in the economy with a pay-as-you-go Social Security system, privatizing the system will be welfare-improving. This does not mean, however, that it is politically

<sup>6</sup> Even though this result shows the importance of taking into account the impact of the different policies on the aggregate variables of the economy, it also underlines the need to build models with realistic decision periods where the capital stock would respond faster.

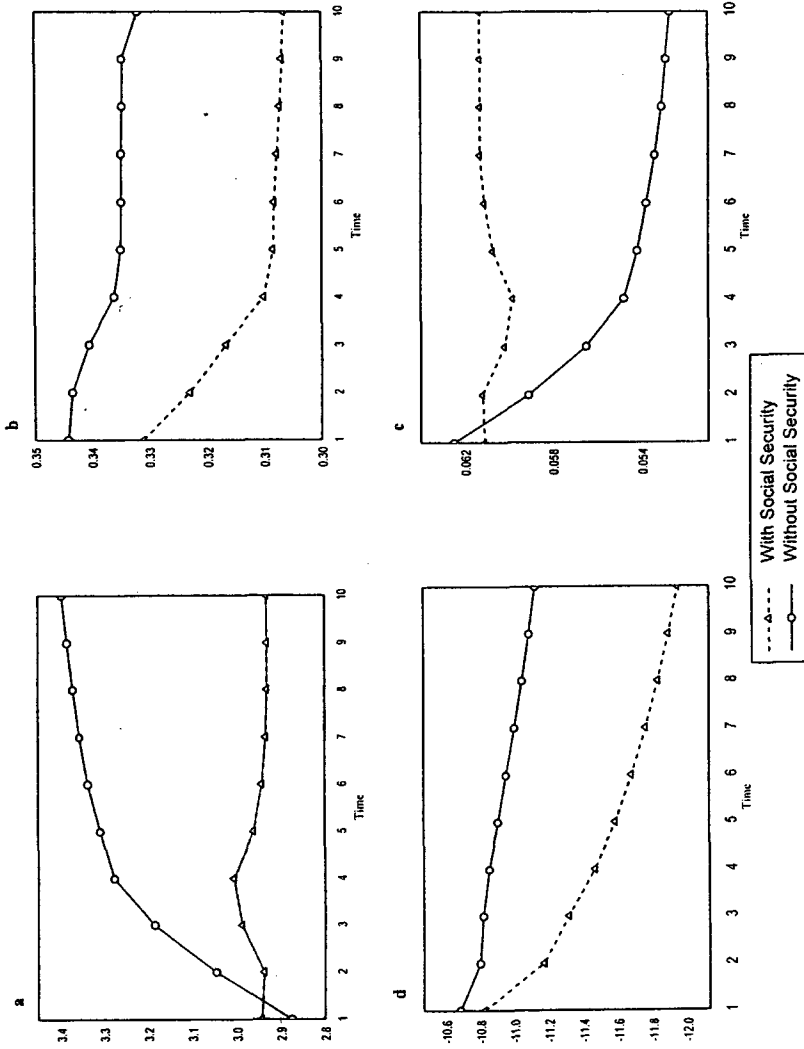


FIG. 2. The transition path. (a) Capital/output ratio, (b) effective labor supply, (c) welfare of young agents, and (d) interest rate on the transition path.



feasible to do so. For a reform to occur, it must be implementable in the sense that it must be welfare-improving for a majority of the current population.

In this section we consider several transition policies that involve a gradual phaseout of the Social Security system over four periods. To restrict the number of possible transition policies, we only study those where the youngest agents—those who benefit most from the elimination of the current system—are the first to pay contributions without ever getting direct benefits. The existing Social Security replacement rate is reduced over a period of three generations. For instance, instead of getting the current share,  $\theta^*$ , of the labor income as Social Security benefits, the retirees in successive periods would get  $0.75 \times \theta^*$ , then  $0.5 \times \theta^*$  and  $0.25 \times \theta^*$  (or  $\theta^*$ , then  $2/3 \times \theta^*$  and  $1/3 \times \theta^*$  if we honor the payments of the current retirees). The schedule for phasing out Social Security is completely arbitrary. Evaluating the distribution of wealth and welfare across generations for such a scheme, however, does enable us to characterize what elements must be present for a transition plan to be politically feasible. These transitions have the feature that is common to many current proposals to reform Social Security: the future benefits promised to workers are reduced and in return they pay less in Social Security taxes over their lifetimes than they would with full maintenance of the existing system. We allow for the possibility that benefits can be financed by taxes on labor income, capital income, and consumption and by issuing debt.<sup>7</sup>

As expected, the level of capital per capita and the effective labor supply per capita tend to increase with the privatization of the Social Security system. In fact we find that the levels of these two variables are higher in each period under most of the privatization policies than they are with the status quo Social Security system.

Policies that rely on labor income taxes favor the older generations while those that tax capital income and consumption are favored by the younger generations and would be opposed by the oldest generation. We also note that, given the effect that an expected privatization of the Social Security system has on the supply of labor, the older generation always supports transitions that maintain the current replacement rate and lower the future rates.

No transition policy considered would have been implemented in the first two periods because they would not have been chosen by a majority of the

<sup>7</sup> When we use debt to finance the Social Security expenditures, we allow 40% of these expenditures to be covered by debt while the rest are financed by taxes on income or consumption.

population. A majority of agents always prefer to maintain the Social Security system as it is. Only in the third period (which corresponds roughly to the 1980's) and in the fourth and fifth periods (when the system would collapse because of the baby boom retirements) would transition policies be favored by a majority of voters. The only ones that would be preferred are those where a significant share of the costs of the transition would be financed by debt. The use of debt transfers part of the costs of the privatization of the system to future generations. Hence, all the currently living generations prefer a policy that is partially financed by debt to the same policy without debt. During the transition, the workers can take advantage of the lower tax rates and increase labor supply in order to save and consume more.

Finally, for all the policies analyzed, the transition policy where the lowering of the replacement rate begins next period and is financed by a combination of debt and consumption taxes is the policy that maximizes the average utility of the agents living in each period.

One clear result that emerges from this analysis is a condition for constructing an implementable privatization policy. The policy should transfer part of the costs of the transition to future generations by using debt finance.

### 6.1. Implementable Transition Policies

In this section we construct privatization policies that will phase out the Social Security system in four periods starting in the period in the model corresponding to the current decade. We consider policies that do not leave any of the currently living generations worse off than they would be with the continuation of the existing pay-as-you-go Social Security system.<sup>8</sup> In the previous section we took implementable reforms to be those that are welfare-improving for a majority of the current population. The motivation for considering a stronger condition here is to avoid the possibility of a minority of voters having a reason to block the reform of the Social Security system. For instance, a policy that would transfer the costs of the privatization of the system to one single generation while making all the others better off would have the support of the majority of the population but might not be politically feasible.

We consider plans where all the working agents are taxed at the same rate in each period. We can discriminate across generations by the type of taxation used to finance social security and the evolution of the replacement rate over the transition period.

<sup>8</sup> There is no implication that these policies would be the outcome of a democratic decision, as it might always be possible to find alternatives that would make a majority of the population better off.

We search for policies that have these characteristics by varying the Social Security policy in three ways:

1. We no longer restrict the sequence of replacement rates to represent a smooth phaseout of the Social Security system.
2. We consider financing the transition using either labor income taxation or consumption taxation but not capital income taxation.
3. We vary the share of the benefits financed by using debt.

We begin by assuming that a given share of the benefits is paid using debt and we calculate a sequence of replacement rates such that the current younger agents will not get any Social Security benefits when they retire and all the other agents will be as well off as with the current Social Security system. If, given this sequence, the younger agents are worse off than with the current system, that means that we need to shift to future generations a higher share of the costs of the transition policy. That is, we need to increase the share of the benefits paid using debt. If the younger agents are better off, we can decrease the share of debt used.

We iterate on the share of the benefits paid using debt until the young agents are as well off with the corresponding privatization policy as with the current system. With this methodology we can find the minimum share of the benefits paid using debt such that all the currently living agents will be indifferent between the privatization policy and the Social Security system. Two conditions would be sufficient to guarantee it. The first is that the welfare of the current young agents increases with the share of the benefits paid using debt. The second is that, for a given level of this share and for the chosen type of taxation, there is a unique sequence of replacement rates that makes the three older generations as well off as with the maintenance of the Social Security system. If the sequence is not unique we need to choose the least costly of all the possible sequences. There is no way we know of to verify that these conditions hold, but the computational experiments seem to indicate they do.

The results for the chosen policies are summarized in Figs. 3 and 4. In Fig. 3 we plot the sequence of the capital–output ratio, the effective labor supply, the benefit–output ratio, and the debt–output ratio along the path starting in the current period. We plot the evolution of these variables for the feasible privatization policies, for the implemented Social Security system, and for the Social Security system financed with consumption taxes.

#### *Labor Income Taxation*

We assume that the debt accumulated during the transition will be financed by levying a tax rate on income (capital and labor income), which means that about one third of the debt will be financed by capital

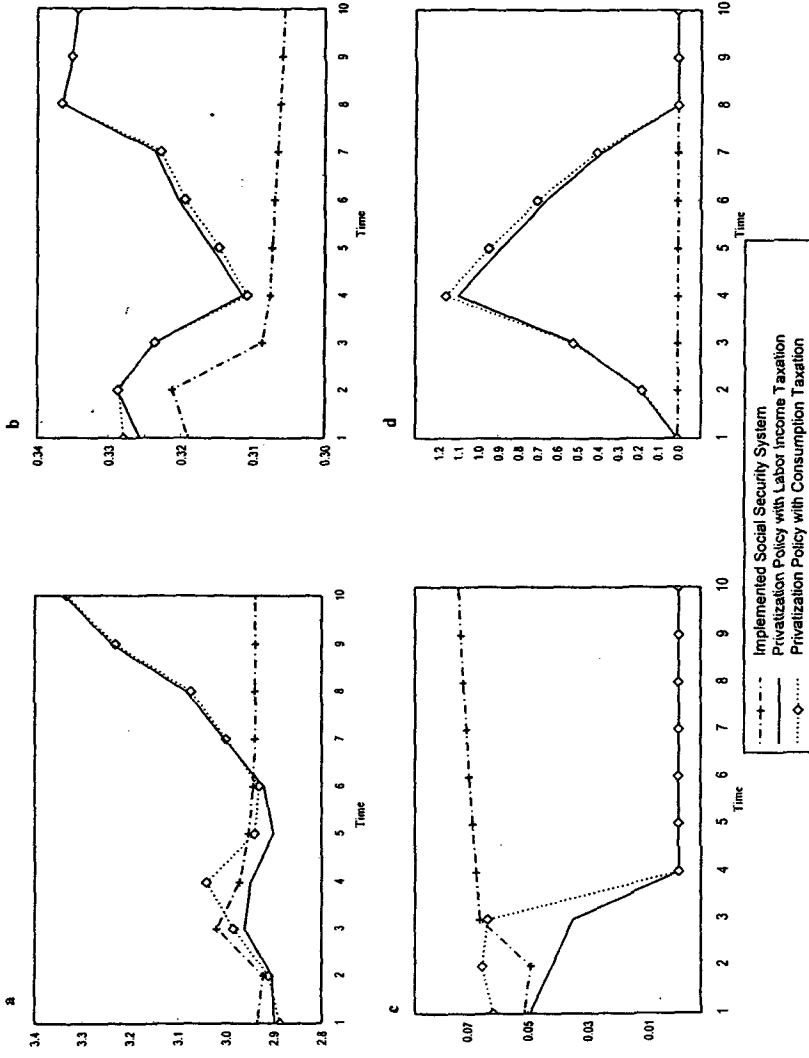


FIG. 3. The reform path. (a) Capital/output ratio, (b) benefits/output ratio, and (c) effective labor supply, (d) debt/output ratio on the transition path.

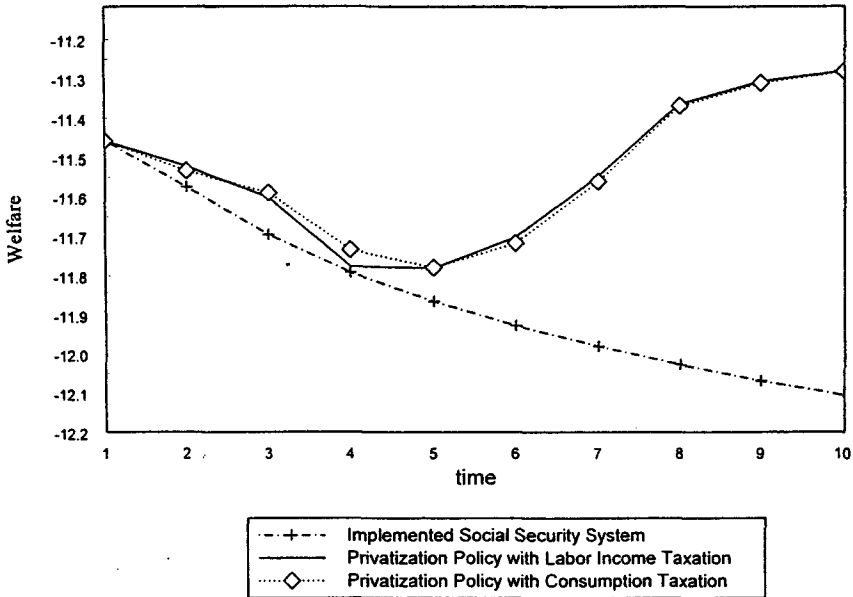


FIG. 4. Level of welfare of the young agents along the path.

taxation.<sup>9</sup> The minimum share of the transition costs that have to be covered by debt so that we are able to make all the agents as well off as with the maintenance of the system is around 23.34%. The replacement rates will evolve according to the sequence  $[0.9638\theta^*$ ;  $0.8512\theta^*$ ;  $0.5261\theta^*$ ;  $0]$ .

The sequences of the capital-output ratio, the effective labor supply, the benefit-output ratio, and the debt-output ratio for the privatization policy are shown in Fig. 3 (privatization policy with labor income taxation). These are shown along the transition path from the current period on. An important attribute of the equilibrium is that the benefits-output ratio declines steadily over the transition path [Fig. 3(c)]. Even though the capital-output ratio increases dramatically once the Social Security system is fully privatized, during the transition period it is lower than with the Social Security system [Fig. 3(a)]. This is a consequence of the level of debt

<sup>9</sup> Because the debt accumulated during the transition begins being paid when the currently young generation retires, the higher the share of the debt that is paid by taxing labor income, the lower the burden to the currently young agents. If all the debt repayment were financed by labor income taxes, the current young agents would be willing to pay higher taxes during the transition and less debt would be required to finance Social Security. This could generate a lower burden for the future generations.

used to finance the privatization's costs. A large portion of the assets accumulated by the agents is used to purchase government debt instead of physical capital [Fig. 3(d)]. The debt-output ratio peaks in the fourth period of the transition when it is 1.1022, while the capital-output ratio is 2.9485.

The older agents are as well off even though their replacement rate is lower because the decrease in the future replacement rates leads to an increase in the effective labor supply. The increase in labor will increase both the aggregate labor income and the rate of interest, offsetting the direct effect of the decrease in the replacement rate. Notice that the effective labor supply jumps immediately to higher levels [Fig. 3(b)]. It is lower in the first periods after the privatization when a tax is levied on income to finance the payment of the debt. It then increases significantly.

### *Consumption Taxation*

If we use consumption taxation to finance the transition, the minimum share of the costs paid using debt is about 19.5% and the replacement rates will be as follows: [1.1988 $\theta^*$ ; 1.3263 $\theta^*$ ; 0.96 $\theta^*$ ; 0]. Figure 3 (privatization policy with consumption taxation) shows the corresponding evolution of the capital-output ratio, the effective labor supply, the benefit-output ratio, and the debt-output ratio. The debt-output ratio peaks in the fourth period of the transition, when it is 1.1644, which will imply a higher burden for the future generations than in the case where the benefits are partially financed by taxing labor income. But the future generations will benefit from a higher capital stock, even though the economy will converge in both cases to the same steady state. The capital-output ratio is 3.0406 in the fourth period of the transition.

When we use a tax on labor income and debt to finance the transition we make some of the future generations better off than when we use a tax on consumption. A tax on consumption is known to be more efficient than a tax on income as it is a nondistortionary wealth tax. That is, for a given sequence of replacement rates, the younger agents and the future generations will be better off with a tax on consumption than with a tax on labor. In order to make all the current generations as well off as with the existing social security system, we have to set different sequences for the replacement rates for the two types of taxation. A tax on consumption taxes the wealth of the older agents relatively more because they have a higher marginal propensity to consume. Accordingly, when we resort to a tax on consumption to finance the transition, we need to compensate the older generations by increasing their replacement rate. Because the general equilibrium effects of privatization on the capital stock and on the labor supply will not compensate the younger generations for the increase in the

consumption tax rate, this requires keeping the future levels of benefits at high levels and using more debt financing.

A tax on labor income taxation is *a priori* relatively better for the older generations for the same reasons. Thus, using it to finance the transition makes it possible to reduce the replacement rates of the older generations without making them worse off. This permits lower tax levels and less debt to finance the cost of the transition. The distortionary effect of labor income taxation is not strong enough to offset these effects and make the consumption taxation an obvious better alternative.

## 7. CONCLUDING COMMENTS

This paper has focused on the political implementability of alternative reforms to the Social Security system in a general equilibrium model with changing demographics. We describe several transition policies that lead to gradual privatization of the system and that would be supported by a majority of the population. We also describe some policies that involve gradual shrinking of the Social Security System from a pay-as-you-go system to a privatized Social Security system and that are implementable in the sense that they are preferred by all the agents to the maintenance of the current Social Security system. Our results also suggest that, to be politically feasible, Social Security reform should resort to debt to shift part of the costs of the transition to future generations. All the implementable policies rely on the use of debt to finance the transition.

The model economy we studied abstracts from many important issues that affect the viability of social insurance. In particular we do not address endogenous retirement decisions, nor do we allow Social Security to play a role as an instrument of intragenerational redistribution. All of these will affect the results of our model in important ways. But our results do suggest the importance of considering the general equilibrium effects of alternative proposals to reform Social Security.

## APPENDIX:<sup>10</sup> DEMOGRAPHIC PROCESS

Our framework requires calibration of the process for innovations to the size of each cohort in the population. The dimension of each cohort

<sup>10</sup> An additional appendix describing the solution algorithm is available from the authors.

TABLE A.1

Shares of Immigrants Across Generations			
$v_1$	$v_2$	$v_3$	$v_4$
0.4056	0.3513	0.1727	0.0704

follows simple time-series processes:<sup>11</sup>

$$N_i = \begin{cases} N_i^- + \text{cste}_1 + \text{trend}_1 \cdot \text{period}, & \text{for } i = 1, \\ N_{i-1}^- + M_{i-1}^- + \text{cste}_i + \text{trend}_i \cdot \text{period}, & \text{for } i = 2, 3, 4. \end{cases} \quad (14)$$

The immigration flow is described by the process

$$M = M^- + \text{cste}_0 + \text{trend}_0 \cdot \text{period}$$

and the flow of immigrants is distributed across generations in an constant way according to the shares  $v_i$ . That is,  $M_i = v_i M$ .

These shares shown in Table A.1 are computed using the observed values for the immigrant cohorts from 1992 to 1994 (I.N.S.).

We did not observe these shares directly in the data. The data give us the shares of immigrants from the following age groups: under 15, 15 to 29, 30-44, 45-64, and over 65 for the years 1992-1994.

We started by assuming that these shares were constant; then we computed the shares of age groups of a length of 5 years in a way that maintained a smooth pattern similar to the original one.

We had then for each year the number of immigrants for each of the following age groups: 0-4, 5-9, ..., 60-64, over 65.

The population is also distributed in 5 year age groups and we want to know in each period the immigration increment to each group during the following five years in order to get  $N_i = N_{i-1}^- + M_{i-1}^-$ .

For instance, if we have the 0-4 age group at real time  $t$   $N_{0-4,t}$ , we want to know how many immigrants will be flowing during the next five periods to what will be the 5-9 age group in 5 years real time. These will be the 0-4 immigrants in this period, then a part of the 0-4 and of the 5-9 immigrants in the next four periods. To compute these amounts we assume

<sup>11</sup> The sizes and the respective processes were computed from Citibase data for the U.S. population. As a proxy for the average sizes from 1990 to 2009 we used the average for the period 1990-1995.



that in these subgroups the immigrants of each age are equally distributed; that is, there is a fifth of each age.

So the flow of immigrants from  $t$  to  $t + 4$  into the age group 0-4 at time  $t$  will be

$$\begin{aligned}
 M_{0-4,t-t+5} &= IM_{0-4,t} \\
 &+ \frac{4}{5}IM_{0-4,t+1} + \frac{1}{5}IM_{5-9,t+1} + \frac{3}{5}IM_{0-4,t+2} + \frac{2}{5}IM_{5-9,t+2} \\
 &+ \frac{2}{5}IM_{0-4,t+3} + \frac{3}{5}IM_{5-9,t+3} + \frac{1}{5}IM_{0-4,t+4} + \frac{4}{5}IM_{5-9,t+4}.
 \end{aligned}$$

The estimates for the demographic processes are given in Table II. Also presented are the realized shocks to these processes for three subsequent periods in the model.

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