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Privatizing Social Security: A Critical Assessment*

by Pascal Belan† and Pierre Pestieau‡

The purpose of this paper is to provide a critical evaluation of theoretical models showing that shifting from pay-as-you-go to fully funded social security schemes can be made Pareto-improving. Further, it argues that what often makes a reform towards funded schemes attractive is a number of additional features that could also have been introduced in the unfunded social security system.

The paper is organized in three main sections. The first one presents a taxonomy of social security systems; this allows us to show that in privatization programmes the issue is not just moving from unfunded to funded mechanisms but also, and above all, to individualize the system in such a way that there is no more redistribution. The second shows that funded and pay-as-you-go schemes are equivalent as long as the payroll taxes paid during the period of inception of the pay-as-you-go scheme are duly invested. Finally, the third section presents two models of Pareto-improving social security reforms and discusses the assumptions on which they rely.

1. Introduction

The heavy reliance on pay-as-you-go schemes of pensions provision in a large number of countries has been justified during the decades of rapid growth in population and productivity. However, with the prospect of an unprecedented ageing of the population, combined with a decline in productivity growth, one has the feeling that increasing reliance on funded schemes would help avoid unsustainable pressure on public finances. Unfortunately, such a shift is known to have a short-run cost. The transition generation is required to pay twice for its own retirement, through the funded scheme and for the then retired generation through the pay-as-you-go mechanism. To avoid this double burden, we should have kept and invested the contributions paid by the working generation when the pay-as-you-go scheme was introduced, instead of transferring it to the retired generation which had not contributed to it.

To illustrate the difficulties facing most social security systems, the example of the U.S. is quite useful (Quinn and Mitchell, 1996). Past and current retirees have received much more back from social security than they and their employers contributed, even allowing for a reasonable rate of return. A man with average earnings who retired in 1980 could expect to receive benefits 3.7 more than his contributions would have generated had they been invested in low-risk government bonds. The ratio was even higher for a similar woman (4.4), and much higher for lower income people. There was some redistribution within cohorts of retirees, but that intragenerational redistribution was dominated by the intergenerational redistribution. As the system reaches maturity and the dependency rate (ratio of beneficiaries to workers) continues to increase, the ratio of social security benefits to taxes paid declines. Nowadays a

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† CREST, Laboratoire de Macroéconomie.

‡ CORE, CREPP & DELTA.

Table 1:
Characteristics of social security systems (polar cases)

Financing principle	pay-as-you-go *or* fully funded
Financing sources	wage-related contributions *or* general taxation
Intergenerational redistribution	strong *or* nil
Universality	universal *or* restricted coverage
Intragenerational redistribution	flat benefit* *or* actuarial fairness
Organization	public, private *or* involving unions and management
Accounts	collective *or* individualized
Efficiency	strong *or* weak distortions
What is defined	defined benefits *or* defined contributions
Trust	*from* nil *to* strong

*Sometimes with means-testing

(ii) sources of finance for retirement: wage-related contributions paid by employees and employers, or government funds (general taxation);
(iii) with the pay-as-you-go technique there is intergenerational redistribution which tends to benefit older generations and not necessarily the needier ones;
(iv) social security can cover the whole population with a minimum pension for people without entitlements; or it can be restricted to the minority of individuals holding steady employment;
(v) social security can effect some intragenerational redistribution by, for example, giving a uniform pension to everyone; in case of actuarial fairness, there is no redistribution;
(vi) besides the traditional dichotomy between public and private organization, there is the possibility of employer/employee joint responsibility (e.g., collective agreements and an industry-wide bipartisan approach);
(vii) accounts can be individualized in such a way that for the worker there is perfect transparency in the link between contribution and expected benefits;
(viii) the allocative distortions of social security depend closely on the above features; they are likely to be minimized with a contributions-linked benefits approach. Social security contributions are then viewed like other any private insurance premium;
(ix) we can distinguish systems where contributions are fixed or where benefits are fixed, or at least defined with respect to current wages (given the replacement ratio);
(x) finally, there is the crucial issue of trust in the system. Do people expect to receive from the public scheme what they feel entitled to? Do they trust financial markets?

Quite clearly, there is a close interdependence between these features. For example, as already mentioned, distortions are likely to be negligible in a system with actuarial fairness; defined benefits are easier with pay-as-you-go and public organization. Intergenerational redistribution is impossible within a fully funded scheme. Universal coverage is easier with a public organization. At the same time, one could have actuarial fairness with pay-as-you-go; a public system can be funded and have individualized accounts.

On the basis of the above taxonomy, Table 2 contrasts two polar systems; an ideal system from the "continental" (Bismarckian) viewpoint, widely accepted just after World War II, and an extreme form of privatized social security like that in Chile. In most proposed reforms of social security systems the key issue is that of shifting from pay-as-you-go to funding in

Table 2:
Two typical social security systems

	Bismarckian	**Chilean**
Financing principle	pay-as-you-go	funding
Financing sources	mostly contributions	wage-related contributions
Intergenerational redistribution	to the benefit of older generations	nil
Universality	universal coverage	restricted coverage
Intragenerational redistribution	earnings-linked benefits	actuarial fairness
Organization	unions and management (with public control)	private
Accounts	collective	individualized
Efficiency	strong distortions	weak distortions
What is defined	defined benefits	defined contributions*
Trust	low	high initially

*With a guaranteed minimum pension

order to foster saving and overcome financial difficulties. In fact, along with that shift most reforms include a move towards less intragenerational redistribution, individualized accounts, privatization and defined contributions schemes. These latter aspects are to a large extent much more important and disruptive than a simple shift from unfunded to funded systems. In the next section, we show that such a shift on its own is rather innocuous under some assumptions.

3. Equivalence between pay-as-you-go and funded systems

All things being equal

Most often in academic discussions or political debates, the comparison between a funded and an unfunded approach bears on other dimensions such as the redistributiveness of those two alternatives. Yet if one really wants to contrast these two mechanisms on their intrinsic merits, it is important to keep everything else constant. Going back to Table 1, one need only focus on the first row.

Let us denote the (per unit) payroll tax by τ and the pension benefit by p, the rate interest by r and population growth rate by n. For the time being, we drop any time index as if we were in the steady state. Each generation receives:

$$\left(-\tau + \frac{p}{1+r}\right)$$

or, with pay-as-you-go[2],

[2] $(1+n)\tau = p$.

$$\left(-\tau\frac{r-n}{1+r}\right),$$

that is a loss as long as $r > n$. This latter condition, a rate of interest being higher than the rate of population growth, is considered as generally fulfilled and corresponds to the concept of dynamic efficiency.

It is well-known that if $r = n$, namely if the golden rule is verified, the net intergenerational transfer is nil, which is precisely the property of a fully funded scheme (Aaron, 1966). In that particular case there seems to be equivalence between the two techniques of financing retirement. In fact, this assertion is not entirely correct. In the closed economy setting[3] adopted in this paper, a shift from a pay-as-you-go to funded scheme would imply an increase in saving and thus a move towards dynamic inefficiency ($r < n$).

To obtain a true equivalence between the two techniques, one does not need the golden rule. It suffices to invest the amount of payroll taxes collected in the period of inception of a pay-as-you-go social security system and to give the returns of these public assets to all subsequent generations. In each period, these returns will offset the liability implied by the pay-as-you-go scheme.

Conversely, privatization which involves in moving from an unfunded to a fully funded scheme is neutral if public borrowing is used to finance the retirement of the transition generation. In other words, a pension privatization that leaves the mandatory contribution rate equal to the payroll tax of the former public system, and that does not alter the terms of eligibility or magnitude of retirement benefits under the old system, will have no impact on the disposable income and wealth of individuals who move from the old system to the new. The current generation of pensioners would also be unaffected. The government will run an increased deficit, but this will be exactly offset by the increase in private savings arising from the surplus of the private pension plans. Under these circumstances, there is no reason to expect an increase in the national saving rate. In effect, the privatization simply converts an implicit government obligation to future retirees into explicit debt. We now formally demonstrate this argument using a simple overlapping generations model.[4]

Equivalence in a model with identical individuals

Each individual lives for two periods. There are N_t identical individuals born at time t and comprising generation t. Consumers inelastically supply one unit of labour in first period and receive a wage w_t. They pay a contribution τ_t used to finance the pension benefits of the retirees belonging to generation $(t-1)$. Besides the pay-as-you-go scheme, there is a public debt. In each period of time, the government borrows an amount that is used to redeem the previous period debt plus interest. A tax θ_t^1 is imposed on workers and finances public debt interest. Workers' disposable income is divided between consumption and savings. In his second period of life, an individual born in t is retired and receives a pension p_{t+1} from the pay-as-you-go system. He also pays a tax θ_{t+1}^2. First and second period consumptions and

[3] Note that in an open economy, if $n = r$, borrowing is always desirable and therefore a shift from a funded to a pay-as-you-go scheme is always Pareto-improving.

[4] This idea was first developed by Bierwag et al. (1969) in an overlapping generations model with exogenous growth and identical agents.

savings are respectively denoted c_t, d_{t+1} and s_t; r_{t+1} is the real interest rate between t and $(t+1)$. Thus, individuals face the following budget constraints:

$$c_t + s_t = w_t - \tau_t - \theta_t^1 \tag{1}$$

$$d_{t+1} = (1 + r_{t+1})s_t + p_{t+1} - \theta_{t+1}^2 \tag{2}$$

All consumers have identical preferences which, for a consumer born in period t, are represented by the utility function:

$$u_t = u(c_t, d_{t+1}). \tag{3}$$

The utility function is assumed to be strictly quasi-concave, twice continuously differentiable. Its first order partial derivatives are strictly positive and such that $u'_c(0, d) = \infty$ and $u'_d(c, 0) = \infty$. Maximization of (3) subject to (1) and (2) results in the following first-order condition:

$$u'_c(c_t, d_{t+1}) = (1 + r_{t+1})u'_d(c_t, d_{t+1}). \tag{4}$$

The productive sector of the economy is described by a linear homogenous production function $F(K_t, L_t)$, where K_t is the capital stock and L_t is aggregate labour. The capital–labour ratio is denoted by $k_t = K_t/L_t$. Profit maximization leads to following conditions (given a depreciation rate of the capital stock μ per period):

$$1 + r_t = F'_K(k_t, 1) + (1 - \mu) =: \rho(k_t) \tag{5}$$

$$w_t = F'_L(k_t, 1) =: \omega(k_t). \tag{6}$$

With a pay-as-you-go system, contributions of the young finance pensions of the current old. Then:

$$N_t p_{t+1} = N_{t+1}\tau_{t+1}.$$

Denoting n_{t+1} as the growth rate of labour force between t and $(t+1)$, this leads to:

$$p_{t+1} = (1 + n_{t+1})\tau_{t+1}. \tag{7}$$

The payment of interest on the public debt is financed by new borrowing or through taxation of young and old generations. Denoting the government debt per worker at the end of period t by δ_t, we have:

$$N_t\delta_t + N_t\theta_t^1 + N_{t-1}\theta_t^2 = (1 + r_t)N_{t-1}\delta_{t-1},$$

which becomes:

$$(1 + n_t)(\delta_t + \theta_t^1) = (1 + r_t)\delta_{t-1} - \theta_t^2. \tag{8}$$

Finally, the capital market equilibrium requires that aggregate level of saving equals the total stock of capital plus debt:

$$(1 + n_{t+1})k_{t+1} + \delta_t = s_t. \tag{9}$$

Thus, intertemporal equilibrium is summarized by the three following equations:

$$u'_c(c_t, d_{t+1}) = \rho(k_{t+1})u'_d(c_t, d_{t+1}) \tag{10}$$

$$c_t = \omega(k_t) - (1 + n_{t+1})k_{t+1} - (\delta_t + \tau_t + \theta_t^1) \tag{11}$$

$$d_{t+1} = \rho(k_{t+1})(1 + n_{t+1})k_{t+1} + \rho(k_{t+1})\delta_t + (1 + n_{t+1})\tau_{t+1} - \theta^2_{t+1}$$
$$= \rho(k_{t+1})(1 + n_{t+1})k_{t+1} + (1 + n_{t+1})(\delta_{t+1} + \tau_{t+1} + \theta^1_{t+1}). \quad (12)$$

One obtains the intertemporal evolution of the capital–labour ratio (for a given sequence $(\delta_t, \theta^1_t, \tau_t)_{t\geqslant 0}$ and a given initial capital stock $k_0 = \overline{k_0}$) by replacing c_t and d_{t+1} in (10) by their expressions (11) and (12). It can then be used to generate the time paths of the other endogenous variables.

We immediately note some redundance between the instruments. The evolution of capital–labour ratio and consumptions through time depends on the sum $x_t := \delta_t + \tau_t + \theta^1_t$. Any change in policy that does not modify x_t has no real effect on the economy.

Thus, we can deduce several equivalences concerning financing principles of the pension system. Before going further, notice that a fully funded system which provides a return equal to the interest rate is a perfect substitute for private savings and has no effect on the dynamic equilibrium.

Example 1

Consider an economy with a pay-as-you-go system, represented by a sequence of contributions $(\tau_t)_{t\geqslant 0}$. To minimize complexity, it will be the only instrument used by the government: in each period, $x_t = \tau_t$. In t_0, the government shifts from the pay-as-you-go system to a fully funded one. As the latter is equivalent to private savings, we don't introduce it explicitly. To make the transition, the government borrows an amount equal to the pensions due to the retired generation. In future periods, refunding will be financed by new debt and taxes on the old generation.[5] Then, from period t_0 on, individuals contribute only to a fully funded system (or save privately) and pay a tax in their second period of life (so $\theta^1_t = 0$, for all t).

If, in each period $t \geqslant t_0$, public borrowing equals the amount of pensions that would have been paid with the pay-as-you-go system ($N_t\tilde{\delta}_t = N_{t-1}p_t$), one obtains:

$$\tilde{\delta}_t = \tau_t. \quad (13)$$

Thus, the new policy does not change the term x_t. With equation (8), the government revenue constraint is satisfied, given tax on the retired generation amounting to:

$$\tilde{\theta}^2_{t+1} = (1 + r_{t+1})\tilde{\delta}_t - (1 + n_{t+1})\tilde{\delta}_{t+1}$$
$$= (1 + r_{t+1})\tau_t - (1 + n_{t+1})\tau_{t+1}. \quad (14)$$

Such a shift does not modify the intertemporal evolution of the capital-labour ratio, consumption or utility. Nevertheless, abolishing the pay-as-you-go system augments private savings. To see this, consider the first-period budget constraint of an agent born in t:

$$s_t = \omega(k_t) - \tau_t - c_t.$$

Shifting to a fully funded system, or equivalently abolishing the pay-as-you-go system, will result in an individual savings increase equal to the government debt per worker:

$$\tilde{s}_t = \omega(k_t) - c_t = s_t + \tau_t = s_t + \tilde{\delta}_t.$$

To illustrate this idea, let us consider a Cobb–Douglas example with:

[5] Considering taxes on the working generation, the older generation or both, leads to the same equivalence.

$$u(c_t, d_{t+1}) = \ln c_t + \frac{1}{2} \ln d_{t+1}$$

and

$$f(k_t) = 6k_t^{1/3}.$$

In period 0, $k_0 = 0.5$. One distinguishes four cases, each implying a specific profile of generational utilities:

α: equilibrium without pay-as-you-go pensions;
β: equilibrium with pay-as-you-go pensions introduced at a rate $\theta = \tau_t / w_t = 1/6$ and including a "free lunch" to the retirees of period 0;
γ: equilibrium with pay-as-you-go pensions introduced in period 0 and cancelled without compensation and without announcement in period 3;
δ: equilibrium with a pay-as-you-go system introduced in period 0, cancelled in period 3, but with compensation of generation 2's retirees financed by public debt.

Clearly, δ and β are identical. These profiles are given in Figure 1. None of them is Pareto-superior.

Example 2

The equivalence between a pay-as-you-go system and public debt has another consequence when a pension system is introduced. In most countries, the inception of the public pension system has benefited the initial retirees, who did not contribute during their working life. This decision, motivated by high poverty rates, is not inherent to unfunded pension systems. In fact, the contributions of initial workers could be invested and the government could give part of the investment return to subsequent generations. In subsequent

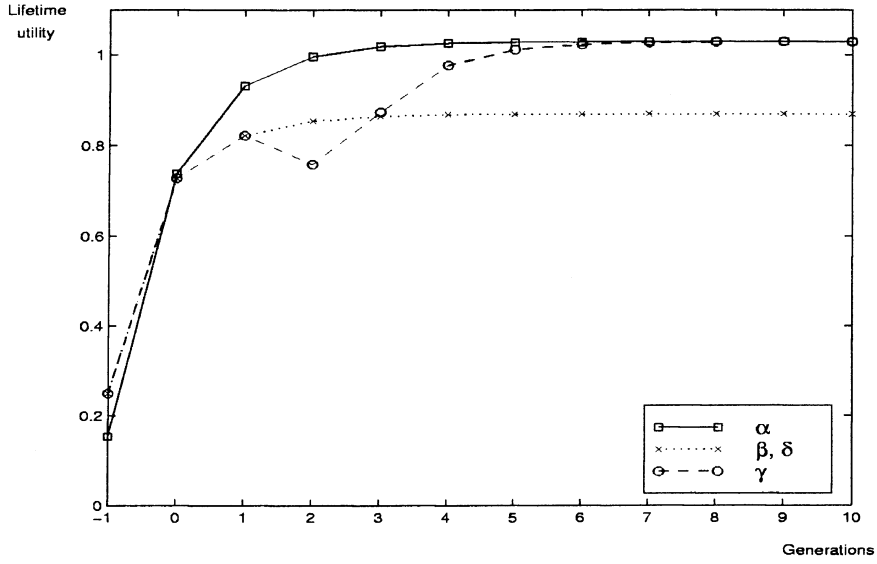

Figure 1: Profiles of generational utilities

periods, the young would pay contributions to finance pensions. In other words, the pay-as-you-go system is introduced without a "free lunch".

The equivalence properties imply that there exists a way of redistributing investment return between generation that leaves the intertemporal evolution of the capital–labour ratio and consumptions unchanged. Suppose that there is initially no pension system and no public debt: $\delta_t = \tau_t = \theta_t^1 = \theta_t^2 = 0$ for all t. In period 0, the young pay an amount $\tilde{\tau}_0$ which will be invested in the financial markets, and which results in negative public debt: $\tilde{\delta}_0 = -\tilde{\tau}_0$. In subsequent periods, the social security revenue constraint is: $\tilde{p}_t = (1 + n_t)\tilde{\tau}_t$. We assume that the government gives back part of the return on the public asset to retired generation in each period:[6]

$$\tilde{\theta}_{t+1}^2 = (1 + r_{t+1})\tilde{\delta}_t - (1 + n_{t+1})\tilde{\delta}_{t+1}$$

for $t \geqslant t_0$. If the amount of tax is designed to equalize the public asset and the contributions paid by workers in each period ($\tilde{\delta}_t = -\tilde{\tau}_t$), the dynamic equilibrium is the same as that obtained without pension system (or equivalently with a fully funded system). To do so, the tax on each retired person would be:

$$\tilde{\theta}_{t+1}^2 = (1 + n_{t+1})\tilde{\tau}_{t+1} - (1 + r_{t+1})\tilde{\tau}_t. \tag{15}$$

Notice that this tax could be positive or negative depending on the values of the worker population growth rate, the interest rate, and contributions in t and $(t + 1)$. Suppose a constant contribution. Then, the tax will be positive (respectively negative) if the interest rate is lower (higher) than the worker population growth rate.

So, any perfect foresight dynamic equilibrium obtained with a pay-as-you-go system is also a dynamic equilibrium that could be obtained with a fully funded system associated with a public debt. Intergenerational allocation of resources can be the same, despite the fact that the pension-financing methods are different.

Equivalence with heterogenous individuals and endogenous labour supply

Let us now consider the possibility of wage differentials across agents $i = 1, \ldots, m$: w_{it}.[7] One can easily show that equivalence is assured as long as the relation between contributions and benefits remains unchanged when shifting from unfunded to funded schemes (Belan, 1997). This includes not only the benefits from the social security system but also the benefits (or the cost) implied by the existence of public assets (or public debt). With a payroll tax τ_i corresponding to wage w_{it},[8] one can consider two cases, with or without redistribution.

In the first case, let us assume a flat pension benefit. With funding, one has:

$$p_{t+1} = (1 + r_{t+1})\overline{\tau}$$

where $\overline{\tau}$ is the average payroll tax. With pay-as-you-go, and initial contributions invested, one obtains the same outcome:

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[6] The government could give back these returns to workers only, or to both workers and retired people. Equivalence would be maintained.

[7] Type i individual's wage would be equal to $w_{it} = h_i\overline{w}_t$, where h_i is an ability index and $\overline{w}_t$ is the average marginal productivity of labour.

[8] For simplicity, we assume that contributions are time invariant.

$$p_{t+1} = (1 + n)\overline{\tau} + (r_{t+1} - n)\overline{\tau}.$$

In the second case, that of pure actuarial fairness, individual i's pension is:

$$p_{it+1} = (1 + r_{t+1})\tau_i$$

with funded or unfunded schemes. In the pay-as-you-go scheme, the agent with ability h_i (or wage w_i) receives an interest income from the public asset (which has been created when social security was started) that is proportional to his ability.

Let us now turn to the other issue, that arising from endogenous labour supply. If social security is financed by a proportional tax on labour income and provides a uniform retirement benefit, it is likely to have a distortionary effect on the labour–leisure choice regardless of the financing method. The tax is viewed as a compulsory levy. The only difference is that part of the retirement benefit with pay-as-you-go is financed with the return from the social security funds invested in the initial period. Consider the case where the two schemes are actuarially fair and offer individualized retirement accounts. It is clear that with funding there is no distortion. The funded social security scheme is perceived as any insurance; the payroll tax is identical to an insurance premium. With pay-as-you-go, one could also have the same perception if the accounts are transparent and individualized. Yet, the social security benefits consists of two parts: (i) $(1 + n)\tau_i$ arising from the pay-as-you-go scheme; (ii) $(r_t - n)\tau_i$ arising from the social security fund. To avoid any tax distortion, it is crucial that individuals see through these two veils that they will get back what they have contributed to plus interest.[9]

Table 3 summarizes the different cases. Quite clearly, the most difficult cases are those with heterogenous individuals and no redistribution. Then, for the PAYG to be equivalent to funding, one needs to transfer to public assets an amount that is proportional to individuals' ability. When labour supply is endogenous, there is an additional difficulty as labour supply affects the amount of capital returns. In Table 3, l^* is the non-distortionary labour supply and l^o is the distortionary one.

In the current debate on privatization, suggested reforms generally comprise three features: (i) a shift towards funding; (ii) compensatory borrowing to finance the transition; and (iii) earnings-linked benefits and individual accounts. It is clear that with such reforms, there is no equivalence. Moreover, it will not be Pareto-improving (see Diamond, 1965; Breyer, 1989; Peters, 1991; Verbon, 1989). Can it be at least welfare improving? The issue of welfare-improvement rests a lot on the choice of the welfare function and is not dealt with here. We now turn to the issue of Pareto-improvement in a representative agent setting.

4. Can privatizing social security be Pareto-improving?

On the basis of what we have seen above a move from pay-as-you-go cannot be Pareto-improving with exogenous growth and with non-distortionary payroll taxation. By relaxing either of these assumptions, it is possible to get a Pareto-improving reform.

Model with endogenous labour supply

A number of economists (for example, Kotlikoff, 1996; Breyer and Straub, 1993;

[9] In fact, the French occupational pension scheme is operated that way: pay-as-you-go and individualization. Yet, it is widely perceived as distortionary.

Table 3:
Equivalence under alternative settings

	No redistribution		**Linear redistribution**	
	PAYG	Funding	PAYG	Funding
One individual and fixed labour	$(1+n)\tau+(r-n)\tau$	$(1+r)\tau$	$(1+n)\tau+(r-n)\tau$	$(1+r)\tau$
Different individuals and fixed labour	$(1+n)\tau_i+(r-n)\tau_i$	$(1+r)\tau_i$	$(1+n)\overline{\tau}+(r-n)\overline{\tau}$	$(1+r)\overline{\tau}$
One individual and endogenous labour	$(1+n)\tau l^*+(r-n)\tau l^*$	$(1+r)\tau l^*$	$(1+n)\tau l^o+(r-n)\tau l^o$	$(1+r)\tau l^o$
Different individuals and endogenous labour	$(1+n)\tau_i l_i^*+(r-n)\tau_i l_i^*$	$(1+r)\tau_i l_i^*$	$(1+n)\overline{\tau} l^o+(r-n)\overline{\tau} l^o$	$(1+r)\overline{\tau} l^o$

Homburg, 1990) have noted that if the shift from an unfunded to a funded scheme was accompanied by a reduction of distortions, then the ensuing efficiency gain could be used along with public borrowing to finance the transition. They use an overlapping generations growth model with endogenous labour supply. The payroll tax imposed on labour income yields a distortion that increases with the degree of substitutability between leisure and consumption.

To illustrate this idea, we adopt a simple example wherein the consumer's choice is limited to two variables, lifetime income

$$x_t = (1 - \theta)w_t l_t + (1 + r_{t+1})^{-1} p_{t+1}$$

and leisure $(1 - l_t)$, where l_t denotes labour supply. In the absence of a tax levy, the equilibrium is given by E in Figure 2. This equilibrium is also obtained with a funded pension system. If instead the government imposes a payroll tax at the rate θ to finance an unfunded retirement pension p_{t+1}, the equilibrium is E', at an inferior level of utility. The government can thus collect an amount Δ without affecting the utility of the generation working at the time of the reform. The new equilibrium would then be E'' in Figure 2. Compared to E', E'' provides the same utility and an extra revenue of Δ. Very likely, this will not be enough to entirely finance the reform in one period; one has to rely on borrowing to finance the difference during the transition.

Formally, using a loglinear utility function, one writes:

$$u_t = \ln c_t + \frac{1}{2} \ln d_{t+1} + \ln(1 - l_t).$$

The analysis proceeds in two stages. First, one computes the optimal values of c_t and d_{t+1} for given x_t. Second, one calculates the optimal supply of labour. It is then possible to derive the indirect utility in which the equilibrium value of $p_{t+1} = \theta w_t l_t (1 + r_{t+1})$ is introduced. This yields:

$$v_t = B + \frac{3}{2} \ln w_t + \ln \frac{(1 - \theta)^{0.6}}{1 - 0.6\theta}$$

where B is a constant. In doing so, we assume that $r_t = n$; but in the unfunded case the payroll tax θ distorts the choice between x and l, whereas in the funded case the contribution is viewed as standard saving.

One sees immediately that the higher is θ, the larger is the efficiency loss. The term Δ in Figure 2 is:

$$\Delta = \frac{(1 - \theta)^{0.6}}{1 - 0.6\theta}.$$

This simple example shows that the key element in that reform is not so much the shift from unfunded to funded schemes but the shift from a distortionary scheme to a non-distortionary one.

So far, individuals are assumed to be identical. One can obtain the same conclusion if one assumes that the two schemes have the same redistribution rule. In contrast, if the unfunded scheme implies some intragenerational redistribution, whereas the funded scheme offers benefits that are proportional to contributions, Pareto-improvement is not obvious. The problem is how to compensate without too much distortion those who will lose in the reform process (see Brunner, 1994, 1996).

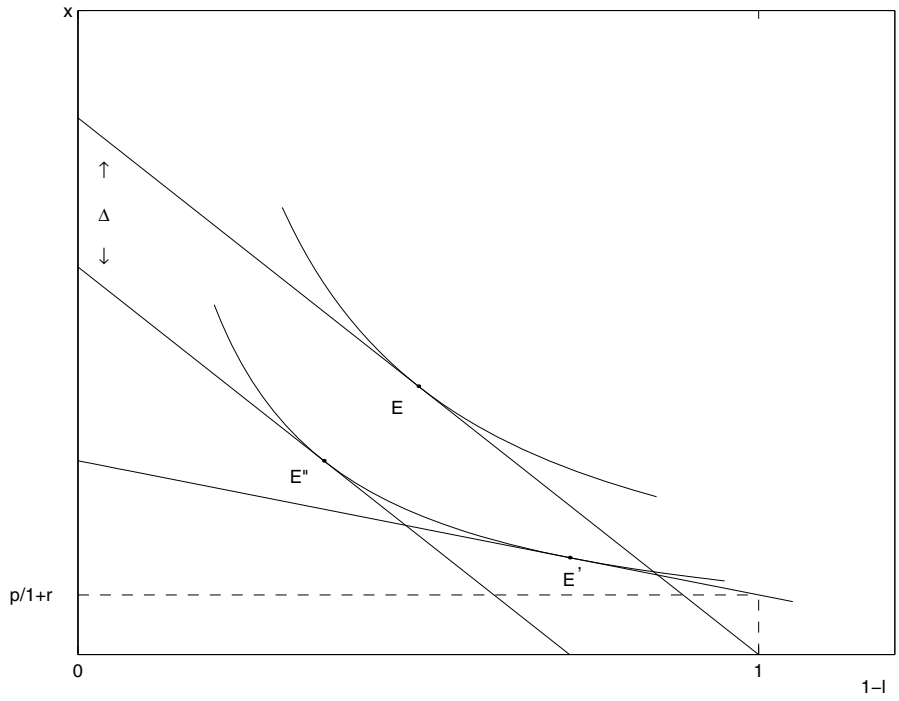

Figure 2: Extra revenue provided by the transition

A model with endogenous growth

The endogenous growth model is a useful framework for investigating the detrimental growth effects faced by countries which save too little.[10] We assume that population is constant and normalized to unity ($N = 1$). The production function is:

$$y_t = A_t k_t^{\alpha}$$

where $A_t = ak_t^{1-\alpha}$ is the term reflecting the technological externality. The interest rate and wage rate are equal to the marginal productivity of capital and labour, respectively: $1 + r_t = \alpha a = R$ and $w_t = (1 - \alpha)ak_t = \omega k_t$. Consequently, the production function for the whole economy can be written as:

$$y_t = ak_t.$$

With our loglinear utility function, saving is equal to $s_t = \frac{1}{2}w_t$. In period $t = 0$, we have pay-as-you-go social security that consists of a payroll tax rate θ imposed on workers born in 0

[10] This subsection is a summary of Belan et al. (1998). The reference model is Romer (1989). See also Romer (1986, 1990). Saint-Paul (1992) and Marchand et al. (1996) use Romer's endogenous growth model to assess the relative merits of pay-as-you-go social security.

that finance retirement benefits of the generation born in $t = -1$. These workers of generation 0 save s_0. When they retire in period 1, they consume:

$$d_1 = Rs_0 + \theta w_1$$
$$= (R + \theta\omega)s_0.$$

In other words, their second-period consumption is proportional to their saving. Let us assume that instead of this pay-as-you-go social security system, the government offers each worker a subsidy on his saving equal to $\theta\omega$, but in exchange the pay-as-you-go retirement benefit ($p_1 = \theta w_1$) is cancelled. Let us denote the post-reform values of variables with primes. One can easily prove that saving is going to increase as a result of the reform ($s_0' > s_0$).[11] Henceforth,

$$d_1' = (R + \theta\omega)s_0' > d_1.$$

The utility of the transition generation increases as well. Furthermore, the generation born in period 1 benefit from a lifetime disposable income higher than the reform:

$$(1 - \theta)w_1' > (1 - \theta)w_1.$$

This proves that the reform is Pareto-improving.

Figure 3 illustrates the situation of the transition generation. Before the reform, the initial endowment is at A: $((1 - \theta)w_0, p_1)$. The optimal choice is represented by E. After the reform, the endowment is at A': $((1 - \theta)w_0, 0)$ and the optimal choice is given by the bundle E'. The slope of AD is equal to R and the slope of $A'D'$ is $(R + \omega\theta)$. This new equilibrium brings more utility and more saving. Henceforth, generation 0, that of transition, and generation 1 enjoy a higher level of welfare. In further periods, capital stock is accrued and subsequent generations are better off.

We have thus shown that some social security reforms can be Pareto-improving but they do not consist in just shifting from a pay-as-you-go to a funded scheme. The first implies that contributions can be collected in a non-distortionary way, which means that redistribution is no longer undertaken. The second reform rests on a subsidy on savings that could have been introduced with a pay-as-you-go scheme.

5. Conclusion

This last section illustrates well the gist of this paper. It presents two models of social security reform which can be viewed as amounting to just a shift of financing technique, whereas it implies taking care of allocative distortions, and in the case of heterogenous individuals, a change in the distribution of benefits. Furthermore, to make the reform politically acceptable, both reforms are shown to be Pareto-improving. Yet evidence on the extent of the deadweight loss of distortionary taxation or on the learning by doing technological externality, reveals that the expected efficiency gains one can expect from a reform are not negligible, but not important enough to finance the transition. Further, it is clear that as long as some redistribution is implemented, there will be distortions with or without funding.

[11] See Belan et al. (1998). With a loglinear utility function, this is pretty obvious.

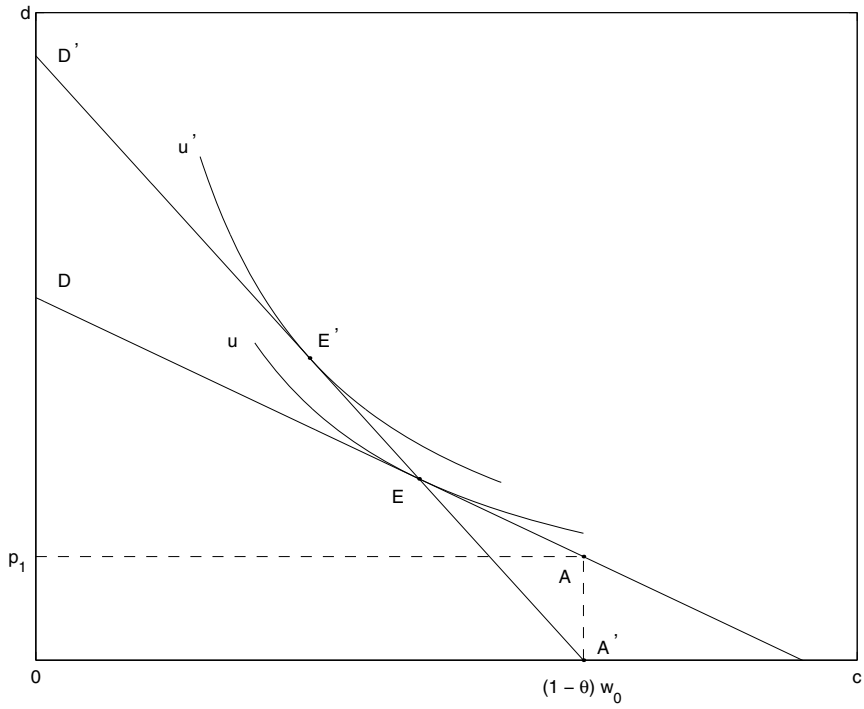

Figure 3: Utility and saving of the transition generation

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