FREE CHOICE OF UNFUNDED SYSTEMS: A FIRST ASSESSMENT

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Abstract

The first pillars of social security systems differ widely across European countries both in the contribution rate and intra-generational redistribution. What would the impact of these differences be if EU citizens had free access to all systems ? This paper aims to highlight some basic features of this question in a very simple two-country model.

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Keywords: unfunded systems, intragenerational redistribution, free choice.

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1 Introduction

Most European countries have set up a mandatory unfunded pension scheme, often called ”first pillar”, financed through contributions levied on wages. Although this common characteristic is crucial, the systems significantly differ in two dimensions at least. First, even if systems have evolved, they can still be classified as they were initially at their set up, as mostly of the ”Beveridgean” type or of the ”Bismarckian” type” : in the former, pension benefits are almost flat while, in the latter, they are directly linked to previous wages and contributions. Second, the level of the mandatory contributions - hence the level of the pension benefits - strongly varies across countries. For example, this level represented in 2003 roughly 9% of the GDP in the United Kingdom, $16,5\%$ in France, $19,5\%$ in Germany, and 32.7% in Italy[2]. Thus, the *redistribution* carried out within a generation, and *the level* of the contributions are two major characteristics that differentiate European systems. Currently the minimal contributing period necessary to give pension rights is long, thereby limiting the ”portability” of the systems. This limitation constitutes a barrier to workers’ mobility, barrier that some people would like to abolish. More generally, the possibility for any EU citizen to choose the system of any EU country could be contemplated. Given the current differences in the systems, this possibility could trigger a drastic change in individuals choices. Would all systems survive and what would be the impact on efficiency, redistribution, and ultimately

[2]Cross countries comparisons are however rather hazardous, and vary according to the definition of social security. In line with the objectives of the paper, I have tried to consider only the first pillars the systems. Data for France and Italy are taken in http ://www.ssa.gov/policy/docs/progdesc/ssptw/2004-2005/europe/guide.html. The same document gives $23,8\%$ for UK, but it includes the second pillar, which is also mandatory but funded (for a description of the UK system see for example the European Commission and the Council Joint report Adequate and sustainable Pensions (2003).

on citizens welfare ? The purpose of this paper is to explore these questions.

The analysis is limited to two countries with identical fundamental characteristics : each economy is represented by the same overlapping generations model. The labor productivity and rate of return on investment are exogenous, and constant over time. Each individual lives for two periods. When young, he works (labor is inelastic), consumes and saves for his retirement period. Workers within a generation differ in their productivity. Initially, an unfunded social security system is in place in each country, mandatory for its citizens. A system is characterized by two parameters, the contribution rate on earnings, and the ”bismarckian” factor that determines the intra-generational redistribution operated by the system[3]. Even though the economies are identical, these parameters may differ in the two countries, to account of the stylized facts referred to above. I investigate the situation in which the citizens of both countries can freely choose either system, without having to move.

What effect may have free choice ? Roughly speaking, the choice of an individual is determined by a comparison of the ”rates of return” that he expects from each system (Aaron [1966]). Two factors influence this comparison. Not surprisingly, a first factor is related to the dynamical efficiency of intergenerational transfers (Samuelson [1958]). If for example the growth rate of the population is less than the rate of return on physical investment, efficiency considerations favor the system with the lower contribution rate. The second factor that influences individuals' choice is the redistribution operated by each system. In contrast to efficiency, this element affects individuals in a differential way according to their earnings. It depends on the bismarckian factors, but not only. Indeed, the *effective* redistribution within a system is also affected by the distribution of earnings of its contributors.

[3] I use here the modeling of Casamatta, Cremer and Pestieau (2000).

A simple example illustrates this point. Assume that systems differ only by their bismarckian factors : contribution rates are equal and one system is beveridgean, the other one is bismarckian. If individuals have identical preferences, they will choose a system only on the basis of their income. Presumably, at the opening of the systems, low-income workers choose the beveridgean system, and the wealthy workers the bismarckian one. If this is the case however, the contributors' earnings to the beveridgean system will be smaller than those of the overall poulation. As a result, the effective redistribution within the system decreases and the initial incentives to choose it is reduced. Thus, to assess the full impact of free choice, this paper considers a long run situation, as described by a stationary equilibrium under rational expectations : the wage distribution of the contributors to each system is endogenous, determined by individual choices, and moreover is correctly anticipated. I identify the conditions under which only a unique system can be active at equilibrium or those allowing both systems to be active.

If both systems cannot be active in equilibrium, one will be selected in the long run by all citizens and the other one will be *de facto* eliminated. How to interpret this result ? To suppose as in this paper that the opening of the systems would take place without any adjustment in their characteristics is not very realistic. If the initial systems cannot be both active, adjustments must be sufficiently fast in order to avoid one system to be eliminated. However, the current differences between systems are so important, and the resistance to reforms are so strong, that assuming a fast adjustment is also not very realistic.

The question addressed by this paper is political. The opening of systems limits the *marges de manoeuvre* of a "country". Our analysis however differs from the approach referred to as the political approach to social security. The purpose of this approach, initiated by Browning (1975), is to explain the characteristics of a system by considering various decision-making processes, such as planner, median voter, lobbies (see for example the review by Galasso and Porfeta (2002)). Our paper clearly differs since its goal is to analyze the interaction between different systems taking the characteristics of the systems as ”given”, inherited from the past. On this respect, the closest analysis to ours is that of Casarico (2000). She also looks at the specific problem of integration and pension systems, with a focus that is somewhat complementary to ours. .A more precise comparison is given after the analysis of the model.

To incorporate political elements in the analysis would be of course most interesting. It would require to describe the adjustments of the systems confronted with the impact of free choice. The analysis would then be similar in some aspects to that of ”fiscal competition”. A basic concern is whether factor mobility, as dictated by the european construction, necessarily undermines redistributive policies. Not surprisingly, the literature on taxation between areas -regions, jurisdictions, countries- and the limitation to redistribution due to the mobility of capital or labor, is vast and is still growing (see for example Epple and Romer (1991) or the survey of Cremer and Pestieau (2002)).

The plan of paper is as follows. Section 2 introduces the model, and determines initial equilibrium when a mandatory system is in place within each country. Section 3 studies long-run equilibrium when the two systems are opened to the citizens of both countries. Some dynamics are considered in Section 4. Proofs are gathered in the final section.

2 The model

The economy in a country The economy of each country is described by the same overlapping generations model. The structure is close to that of Diamond (1965) : agents live for two periods, there is a single good that can be either consumed or invested, and population grows at a constant rate[4] $g - 1$.

The technology of production is linear with marginal productivities of capital and labor that are constant over time. This assumption excludes endogenous variations in productivity, as would obtain with a non linear production function. The quantity of good available at date t results from labor of the current young generation and from the return on investment at the previous period. An amount s of capital invested in period $t-1$ will produce rs units of good in period t where r is the exogenous output.

An individual works only during the first period of his life, with an inelastic supply normalized to 1. Workers differ in their productivity/wages : A w-worker produces and earns w. Wages are distributed on $[w_{min}, w_{max}]$ with a mean denoted by $\overline{w}$. The distribution is continuous, constant across generations[5]. An individual has no income in addition to labor earnings in the first period.

Individual preferences bear on consumption levels when young and old, denoted by c^j and c^v (there is no altruism motive), and are strictly increasing in each argument. I shall assume no liquidity constraint. This assumption allows one to conduct the analysis without further assumptions on preferences (see below). In particular, preferences may be heterogeneous.

Pension systems I consider *unfunded* systems. A system is characterized by two parameters specifying the contribution rate, τ, and the redistribution "bismarckian" factor α.

Contributions are levied on wages, with a constant contribution rate. If τ is

[4]Growth in productivity/wages can be introduced in the usual way, by interpreting $g - 1$ as the growth rate of the aggregate wage bill .

[5]Note that the wage distribution being identical in the two countries, the wage distribution in the union of the two countries is identical to that of a single country.

the contribution rate, each young worker whose wages are w contributes τw. By construction, the system is balanced. Thus, if at date t w_t is the average wage level of the contributors to the system and g_t is the number of contributors per pensioner, the *average* pension benefits received by a pensioner, π_t, is given by :

$$\pi_t = \tau g_t w_t. \tag{1}$$

The bismarckian factor determines the benefit rule, which relates the pension benefits of a specific pensioner to the contributions he made in the previous period. Let us consider a pensioner at t who earned w at period $t-1$ while the average wage over the contributors to the system was w_{t-1}. He thus contributed w/w_{t-1} times the average level of contributions. If the bismarckian factor is α the pensioner receives benefits equal to

$$\pi_{w,t} = (\alpha \frac{w}{w_{t-1}} + (1-\alpha))\pi_t. \tag{2}$$

A pensioner whose contribution was equal to the average contribution per capita, $w = w_{t-1}$, receives benefits equal to the average benefits per pensioner, π_t, whatever value for α. Note that for $\alpha = 0$ all pensioners receive this level, independently of the amount of their previous contributions : the system is Beveridgean. At the opposite, a Bismarckian system obtains for $\alpha = 1$, since pension benefits are proportional to contributions. Thus, for α between 0 and 1, the system combines a Beveridgean and a Bismarckian systems.

Intertemporal wealth Let us consider an individual who receives labor income net of contributions, $(1-\tau)w$, in the first period of his life, and a pension benefit $\pi_{w,t}$ in the second period. He faces the following successive constraints :

$$c^y + s = (1-\tau)w, \; c^o = sr + \pi \tag{3}$$

where s is an investment if positive and a loan if negative. This implies that the discounted value of consumption levels is equal to (intertemporal) wealth, defined as the value of net labor income plus the discounted rights to pension :

$$c^y + c^o/r = (1-\tau)w + \tau\frac{\pi}{r}. \tag{4}$$

Conversely, *in the absence of liquidity constraint*[6], the above intertemporal constraint describes all feasible consumption plans : (3) and (4) are equivalent.

In this paper, I assume away liquidity constraints, which makes the analysis much more tractable. Indeed, without liquidity constraints, the welfare of an individual varies as his wealth. Therefore the impact of a pay-as-you-go system on an individual's welfare can be analyzed through the impact on wealth. Similarly, the choice between two systems is determined by comparing the wealth values expected from contributing to either system.

The initial situation At the ”initial” situation, each young worker contributes to the mandatory pension system of his country, system characterized by the parameters (τ, α).

At all periods, the average level of wages of the contributors is $\overline{w}$. Also the numbers of contributors per pensioner is equal to g. This gives $g_t = g$, and $w_{t-1} = w_t = \overline{w}$. Therefore, from expressions (1) and (2), a $w-$worker will receive a pension benefit equal to $\pi\ [\alpha w + (1-\alpha)\overline{w}]\tau g$. Plugging this value into (4) gives the value for wealth :

$$W(w) = [1 + \tau(\frac{g}{r} - 1)]w + \tau\frac{g}{r}(1-\alpha)(\overline{w} - w). \tag{5}$$

To highlight the impact of each characteristic, it is convenient to define

$$R = 1 + \tau(\frac{g}{r} - 1). \tag{6}$$

[6]This assumption makes sense only if aggregate saving are positive (see also in the following footnote).

In the absence of redistribution, $\alpha = 1$, the wealth of a $w-$worker is given by Rw. The factor R can be described as the *rate of return* of the system. Indeed in the absence of a pay-as-you-go-system, $\tau = 0$, an individual's wealth is simply equal to his wage. The impact of the system is positive if the rate R is larger than 1, i.e. if the growth rate of the population is larger than the rate of return on investment. In this case, autarky, defined as the situation without intergenerational transfers, is "dynamically" inefficient : as shown by Samuelson (1958), the introduction of transfers from young to old individuals at an appropriate level improves the welfare of all[7].

In the presence of redistribution, the analysis remains valid "on average" only. To see this, note that whatever value for α, average wealth is equal to $R\overline{w}$, by expression (5). Also, the wealth of a worker with average income is $R\overline{w}$. For other workers, wealth is affected by an additional term, positive for wages less than the average and negative otherwise. As a result, a dynamically inefficient system can nevertheless be beneficial to some workers, or that an efficient system can be detrimental to others.

3 Equilibrium under free choice

This section considers the situation in which each country opens its social security system to any citizen of the other country. More precisely, each young worker must contribute to a social security system, but can freely choose between the two

[7]The argument cannot be extended too much : it cannot be deduced from expression (6) that, if $g > r$, increasing the rate of contribution always leads to a Pareto improvement. Beyond a certain contribution rate, no young individual saves, which invalidates the approach by intertemporal wealth. To treat this question correctly, the return on capital must be endogenous, determined by a production function. Then, the rate of return becomes larger than population growth if saving/investment is sufficiently low.

systems without moving. Let A and B denote the two countries. The characteristics of the system in country $I = A, B$ are (τ^I, α^I). As already said, these parameters can differ significantly. The rate of return of system I in the initial situation is, according to (6), equal to

$$R^I = 1 + \tau^I(\frac{g}{r} - 1).$$

The system that has the highest rate of return will be referred to as the *more efficient* system. For example, in the situation where $g > r$, the more efficient system is the one with the largest contribution rate.

To choose between systems A and B, a $w-$worker evaluates the wealth that he expects from each. Let us spell out this evaluation. Let w^I be the average wage of the young contributors to system I at the current period. Pension benefits will depend on the average wage of contributors at the subsequent period, w_+^I, and on the growth rate of the number of contributors, $g_+^I - 1$. Given these values, a $w-$worker will receive, according to (1) and (2), a pension benefit equal to

$$[\alpha^I \frac{w}{w^I} + (1 - \alpha^I)]\tau^I g_+^I w_+^I.$$

This yields the intertemporal wealth :

$$(1 - \tau^I)w + \tau^I \frac{g_+^I}{r}[\alpha^I w + (1 - \alpha^I)w^I]\frac{w_+^I}{w^I}.$$

At an equilibrium, the future realized values must be correctly expected. We look for a *stationary equilibrium*, meaning that

(1) in each system, the number of contributors grows at a constant rate equal to that of the population, and the average wage of the contributors is constant over time, and

(2) these variables are correctly expected.

Before making this definition more precise, it is convenient to analyze an individual's choice given some expectation. Under the assumption of stationarity, $g^I = g$, $w_+^I = w^I$. This gives the following value for the wealth derived from system I :

$$W^I(w^I, w) = R^I w + \frac{g}{r}\tau^I(1-\alpha^I)(w^I - w) \tag{7}$$

Therefore, at equilibrium, an individual chooses a system by comparing the values $W^A(w^A, w)$ and $W^B(w^B, w)$, as given by expression (7), in which w^A and w^B are the expected average wage of the contributors to each system. The analysis of this choice leads to a simple typology of the systems.

3.1 The system that is more favorable to high-income individuals.

Given some expectations w^I for each system I, the difference in wealth values $W^A(w^A, w) - W^B(w^B, w)$ is linear with respect to wage w, hence monotone. For example it is increasing in w if

$$R^A - R^B \geq \frac{g}{r}\tau^A(1-\alpha^A) - \frac{g}{r}\tau^B(1-\alpha^B). \tag{8}$$

This implies that if an individual prefers A to B, all workers who earns more than him also prefer A to B. Note that condition (8) is independent of the expected levels w^A and w^B. This leads us to say that *system A is more favorable to high-income workers than system B if condition (8) is met.*

The favorable relation is determined by the difference in efficiency, as measured by $R^A - R^B$, relative to the difference in the *extent of the redistribution*, as measured by the expression on the right-hand side. Note that the extent of the redistribution is determined both by the bismarckian factor and the contribution rate. It is interesting to recall that, in Europe, systems with rather flat benefits tend to be associated with low contribution rates. Thus consider the case where the system with the smaller bismarckian factor, say A, has the smaller contribution rate :

$\alpha^A > \alpha^B$ and $\tau^A > \tau^B$. In such a case, the more bismarckian system A is not necessarily the more favorable to high-income. To see this, replacing the R^I by their expressions, inequality (8) writes also as

$$\tau^A(1 - \frac{g}{r}\alpha^A) \leq \tau^B(1 - \frac{g}{r}\alpha^B), \tag{9}$$

the two members of which can be reasonably supposed to be positive. In the neutrality case for example, $g = r$, the system that is more favorable to high-income is the one with the lowest product $\tau(1 - \alpha)$. The smaller the ratio g/r, i.e. the more inefficient a pay-as-you-go system, the more a low contribution rate tends to favor high-income workers.

Example To illustrate this point, let us consider the case of France (A) and United Kingdom (B). The UK system, although much more redistributive than the french system[8], can be more favorable to high-income thanks to its low contribution rate. This is especially true if pay-as-you-go systems are perceived as inefficient.

To fix the idea, the tax rate in B is roughly half that in France. Also take $\alpha^A = 0.8$ and $\alpha^B = 0.2$. The threshold value of g/r that determines whether A is more favorable to high income than B is $1/1.4 \approx 0.7$. Thus for

1. $g/r > 1$, A is more efficient and more favorable to high income than B
2. $1 > g/r > 0.7$, A is less efficient but more favorable to high income than B
3. $g/r < 0.7$, A is less efficient and less favorable to high income than B.

This clearly shows that the ratio of growth rate to interest rate plays a crucial role. Which value is reasonable ? This is quite a delicate question because it is not clear

[8]This remark does not account for the reform which has just been decided in France. Indeed the minimum level for pension benefits has been increased up to 85% of the minimal wage. For a rather large fraction of low-income earners, this constraint may become binding, which would make the French system more beveridgean than previously. I thank Thomas Piketty to have mentioned to me this point.

which rate should be chosen for r. A period here represents roughly thirty years. If one takes the return on stock market since the second world for r, and the projected growth rate of aggregate wage bill for g, the compounding effect will give a very low value for g/r. This however is due to the equity premium puzzle. If indeed individuals are risk averse, one should take the much smaller rate on long term bonds. This neglects several points. A payg system provides retirees with an annuity, thereby insuring them against the risk of living old. Making insurance compulsory avoids the usual problems encountered in markets with asymmetric information. As documented by various studies, the premium associated to the longevity risk is roughly 5% (see Brown, Mitchell, and Poterba (2001)). To take into account of this premium, an extra return on a payg could be introduced. One can argue that a compulsory fully funded system can also provide an annuity. In our model a compulsory fully funded system is equivalent to no system since it can be undone by individuals, thanks to the absence of liquidity constraints. This would lead to take for r the return on funded systems, accounting for commercial and administrative costs.

Due to all these problems and the uncertainty on future, we shall illustrate in next section the equilibria for different values of g/r .

3.2 Equilibrium

Given an expected average wage w^I of the contributors to each system I, let w^* be the wage level defined by $W^A(w^A, w^*) - W^B(w^B, w^*) = 0$. Assuming system A to be more favorable to high-income, all individuals whose wages are higher than w^* choose system A.

The threshold w^* may not be in the range of wages $[w_{min}, w_{max}]$. If $w^* < w_{min}$ for example, all individuals choose A, and if $w^* > w_{max}$, all choose B. At a stationary equilibrium, the expected average contributors' wages are equal to those derived from individual choices. This leads to the definition :

Definition. *Let system A be more favorable to high-income than B : (8) is met. An equilibrium is determined by average wages w^A and w^B that satisfy*

$$w^A = E[w|w \geq w^*], w^B = E[w|w \leq w^*]$$

where w^* is defined by $W^A(w^A, w^*) - W^B(w^B, w^*) = 0$.

The equilibrium is called

an A-equilibrium if only system A is active, i.e. if $w^* \leq w_{min} = w^B$

an AB-equilibrium if both systems are active i.e. if $w_{min} < w^B < w^A < w_{max}$

a $B-$equilibrium if only system B is active, i.e. $w_{max} = w^A \leq w^*$.

Before going further it is helpful to note that surely, *the system the less favorable to high-income is eliminated whenever it is also the less efficient*. The intuition is clear. Assume by contradiction B to be active. Consider a $w-$worker with wage w^* (take $w = w_{max}$ if A is not active). By choosing A, the worker would benefit both from the larger efficiency return provided by A. Furthermore, since the wage w^* is not greater than w^A, he can only benefit from redistribution in A instead of being penalized by it in B. The analysis is more complex if, from the point of view of low-income workers, efficiency and redistribution benefits enter into conflict. The following proposition characterizes the equilibrium configurations in function of the parameters.

Proposition 1. *Let system A be more favorable to high-income than B There exists*

– *an $A-$equilibrium if and only if*

$$W^A(\overline{w}, w_{min}) - R^B w_{min} \geq 0 \Leftrightarrow R^B - R^A \leq \frac{g}{r}\tau^A(1-\alpha^A)\frac{\overline{w} - w_{min}}{w_{min}} \tag{10}$$

– *a $B-$equilibrium if and only if*

$$W^B(\overline{w}, w_{max}) - R^A w_{max} \geq 0 \Leftrightarrow \frac{g}{r}\tau^B(1-\alpha^B)\frac{w_{max}-\overline{w}}{w_{max}} \leq R^B - R^A \tag{11}$$

– *an $AB-$equilibrium if*

either an $A-$ and a $B-$ equilibrium both exist : (10) and (11) hold

or no one exists : neither (10) nor (11) holds.

Corollary. *The system the more favorable to high-income can be eliminated only if, at the initial situation, all individuals are better off with the other system : If A is more favorable to high-income a $B-$equilibrium exists only if*

$$W^B(\overline{w}, w) \geq W^A(\overline{w}, w) \text{ for any } w.$$

As expected if A is more efficient, only an A-equilibrium exists : because if $R^B - R^A \leq 0$, (10) holds but not (11). Otherwise, the trade off between efficiency and redistribution for low income or top income workers determines equilibrium configurations. To see this, let us explain how the equilibrium conditions are obtained. To check whether A alone can be in equilibrium, assume that A is chosen by every worker. The average wage w^A is equal to the overall mean $\overline{w}$. To form an equilibrium, it suffices that workers whose wages are close to the minimum level w_{min} have no incentives to subscribe to B. This gives condition (10), which results from the following trade off. By subscribing to B, on one hand w_{min} workers lose all the redistribution benefits in A without getting any in B (because wages in B are roughly identical), but on the other hand benefits from the larger return in B (assumed to be more efficient). If the loss outweighs the efficiency gain, an $A-$equilibrium is obtained. Since the larger the ratio $\overline{w}/w_{min}$, the larger the loss in redistributive benefits, a low value for the minimum wage makes more likely an $A-$ equilibrium.

Similarly, assuming B to be chosen by every worker, the average wage w^B is equal to the overall mean $\overline{w}$. A $B-$equilibrium is obtained if workers whose wages are close to the maximum level w_{max} have no incentives to subscribe to A : this gives condition (11). Thus, condition (11) is very strong : individuals with top income prefer system B applied to the whole population than R^A, the return to A *without* redistribution. Accordingly all individuals are better off under the B-equilibrium than under the initial situation (the corollary). Also, the larger the ratio $w_{max}/\overline{w}$ is, the more a top income worker pays for redistribution by subscribing to B ; for large enough $w_{max}/\overline{w}$ the loss outweighs the efficiency gain of susbscribing to B rather than to A : B alone is not in equilibrium.

Note that the above arguments are valid whatever the assumption on the distribution of earnings, whether continuous or not : only the incentives of the top or bottom income workers matter. This insight is likely to be quite robust and to extend to more general benefit rules. On the other hand, the characteristics of a mixed equilibrium, in particular the threshold earnings depend on the distribution[9].

3.3 Example

Consider again the illustrative case in which $\alpha^A > \alpha^B$ and $\tau^A > \tau^B$. One immediately gets that the more beveridgean system B is the only active at equilibrium if pay-as-you-go systems are sufficiently inefficient, and similarly the more bismarckian A is the only active at equilibrium if pay-as-you-go systems are sufficiently

[9] The AB equilibria may be a little bit different : some may be semi-pooling, meaning that individuals with the same wage choose distinct systems (of course they must be indifferent between both.

efficient[10]

Taking the values of example in Section 2, this gives

1. $g/r > 1$, an A-equilibrium obtains because system A is more efficient and more favorable to high income than B,
2. for $g/r < 0.7$, a B-equilibrium obtains because A is less efficient and less favorable to high income than B.

It remains to determine what happens when efficiency and redistribution enter into conflict, which occurs here when system A, the more favorable to high-income, is not the more efficient (i.e. for $1 > g/r > 0.7$). Since the condition that determines which system is more favorable to high-income is independent of the wages distribution, in contrast with those that characterize equilibrium configurations. It follows that conditions (8), (10) and (11) can be all satisfied simultaneously, leading to three equilibria.

The case $g/r = 0.8$ is illustrated in figure 1. In the top graph, the dashed line represents : $W^A(\overline{w}, .) - R^B w$, so that there is a $B-$equilibrium if $w_{max} < b \approx 1.5$, and the normal line represents $W^B(\overline{w}, .) - R^A w$, hence there is an $A-$equilibrium if $w_{min} < a \approx 0.6$. The thick line represents the difference in wealth, at the initial situation, $W^A(\overline{w}, .) - W^B(\overline{w}, .)$. It is increasing in w : A is more favorable to high income than B. Also, the difference is negative at the mean value $\overline{w}$: B is more efficient than A.

The bottom figure gives the incetives to ch the difference in wealth, at the initial situation, $W^A(\overline{w}, .) - W^B(\overline{w}, .)$. It is increasing in w : A is more favorable to high income than B. Also, the difference is negative at the mean value $\overline{w}$: B is more efficient than A.

[10]The first case holds if both inequalities, $g < r$ and $\tau^B(1 - \alpha^B g/r) < \tau^A(1 - \alpha^A g/r)$ hold, and the second if both inequalities are reversed.

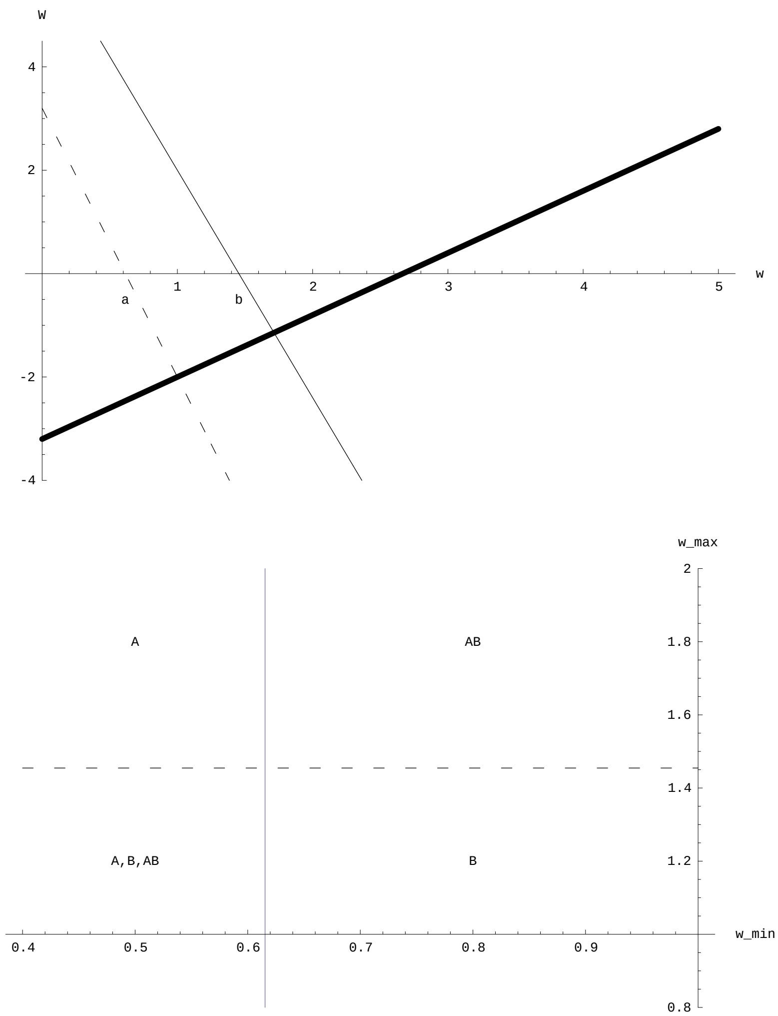

FIG. 1 – $\tau_A/\tau_B = 2$, $\alpha^A = 0.8$, $\alpha^B = 0.2$, $g/r = 0.8$, $\overline{w} = 1$.

Top graph : The horizontal axis represents w, and the vertical axis gives differences in wealth, multiplied by 100. The thick line : $W^A(\overline{w}, .) - W^B(\overline{w}, .)$.

dashed line : $W^A(\overline{w}, .) - R^B w$: there is a $B-$equilibrium if $w_{max} < b \approx 1.5$.

normal line : $W^B(\overline{w}, .) - R^A w$: there is an $A-$equilibrium if $w_{min} < a \approx 0.6$.

Bottom graph : Equilibria as function of w_{min} and w_{max}

The dashed line represents : $W^A(\overline{w},.) - R^B w$: there is a $B-$equilibrium if $w_{max} < b \approx 1.5$.

The normal line represents $W^B(\overline{w},.) - R^A w$: there is an $A-$equilibrium if $w_{min} < a \approx 0.6$. Depending on the range of earnings keeping the mean constant, the type of equilibria are summarized in the bottom figure. When the range is small ($w_{min} > 0.6$ and $w_{max} < 1.5$), system B is the only equilibrium. One checks that for these values, at the initial situation, all citizens in A indeed prefer system B : the difference $W^A(\overline{w},.) - W^B(\overline{w},.)$ is indeed negative.

As the range is increased, we move to the north west and only the $A-$ equilibrium remains : the redistribution effects become dominant. The workers who most benefit from redistribution and those who are the more penalized by it are both encouraged to choose the system the more favorable to high income. This is not specific to this example : for sufficiently large w_{max} and sufficiently low w_{min}, only condition (10) holds.

In light of these results, one may wonder whether introducing free choice is good. The answer is clearly positive in the situation of the corollary, since the new equilibrium is Pareto improving. This means that redistribution effects are mild. Instead, if the A equilibrium obtains, not only the less efficient system is in place, but the new situation may be even (weakly) Pareto dominated by the initial one. Indeed, at a $A-$equilibrium, the welfare of citizens in country A is unchanged. In contrast, in country B, workers whose wage is smaller than the cutoff value w^c that satisfies $W^A(\overline{w}, w^c) = W^B(\overline{w}, w^c)$ are worse off. This value (here around 2.8) is surely larger than the mean value (since A is less efficient than B), which in turn is typically larger than the median value. Therefore more than a majority of workers in B are worse off. Actually it can even happen that all workers in B are hurt[11] this occurs here if $1.5 < w_{max} < 2.8$. How can this happen ? The dynamics

[11]In other words, while B must be Pareto improving to be alone in equilibrium, it is by no means

contemplated below helps to understand this point : Assuming that initially all workers with w smaller than w^c choose B, then system A becomes much more attractive. ∎

To sum up, even though the model is very simple, the long run situation is not that easy to determine. The analysis shows that :

- the system the more favorable to high income is not necessarily the more bismarckian one

- the system the more favorable to high income, if it is not the more efficient, will not necessarily eliminate the other system

- multiple equilibria are possible, and an equilibrium in which both systems are active can exist.

At this point, it is worth comparing our approach with Casarico's paper (2000), which also considers how the differences in pension systems may affect economic integration. The analysis is somewhat complementary from ours. There are two countries with identical economies in which production is carried out through a neoclassical production function. One country has a pay as you go system, the other one has a fully funded one. Both are compulsory and redistribution plays no role (the analysis is conducted with a representative individual in each country). The paper focuses on the impact on factor prices when capital becomes fully mobile, labor remaining immobile. Before capital integration, investment, hence its return, in the two countries differ owing to the different pension systems. Capital integration has a welfare effect because the return to investment is equalized across countries. In contrast with our analysis, workers cannot choose the system. If they could they would all choose the more efficient (since there is no redistribution).

sufficient. If $1.5 < w_{max} < 2.8$ and $w_{min} < 0.6$, B is Pareto improving but is completely eliminated since only the $A-$ equilibrium exists.

4 Dynamics

By keeping the tax rate constant, the balance of a system is ensured through adjustments in pension benefits. As a result, a system can be thought as a defined contribution one. In a correct expectations framework, as just considered, it is also a defined benefit one. It may no longer be true under some dynamics. Dynamics are determined by expectations and information. At the time workers have to choose a system, they are concerned with the wage level of the current contributors to each system, because it will determine determine the future redistributive gains or losses within a system, and also with the wage level of next contributors, which will give the level of pension benefits.

Starting from the initial situation in which each system in place in a country is exclusively for the citizens, I consider here the evolution of the systems driven by myopic expectations. Myopic expectations are quite natural : workers at time t, who do not know yet the choice of their contemporaries and descendants, expect that they will perform the same choice as the previous generation.

Thus, initially, all workers assume the average contributors wage to be identical in each system, equal to $\overline{w}$. A threshold value w_0^* for wages is determined, according to which all workers with income larger (resp. smaller) than the threshold choose A (resp. B), still assuming A more favorable than B. Afterwards, the evolution of the system is described as follows. Let w_{t-1}^* be the threshold value between A and B at time $t-1$. Under myopic expectations, the average wage level of the current and next contributors to each system are expected to be

$$w_{t-1}^A = E[w|w \geq w_{t-1}^*], w_{t-1}^B = E[w|w \leq w_{t-1}^*].$$

Hence, a $w$worker at date t evaluates the wealth generated by system I according to $W^I(w_{t-1}^I, w)$, which is defined by (7), and chooses according to the sign of

$W^A(w^A_{t-1}, w) - W^B(w^B_{t-1}, w)$. A new threshold w^*_t level is determined, and so on.

.

Proposition 2 *Let system A be more favorable to high-income than B. Assume wages to be uniformly distributed. Under myopic expectations, dynamics converge to an equilibrium. If A is more efficient than B, the (unique) A equilibrium is reached at the first step. If A is less efficient than B, and the $B-$ equilibrium exists, it is reached in two steps. Otherwise either the mixed equilibrium or the A-equilibrium is eventually reached.*

The assumption of a uniform distribution is strong, but can be relaxed. It ensures the convergence of the dynamics.

Concluding remarks

Even though the model is too simple in many dimensions, it helps to highlight some features that should be quite robust. First, the analysis shows that the system that is preferred by high income workers is not necessarily the more bismarckian one. Both the levels of the contribution rates and the efficiency or inefficiency of unfunded systems play an important role. In particular, in situations in which unfunded are perceived as very inefficient, the system with the lower contribution rate is preferred. Second, a large dispersion of wage earnings eliminates the system the less favorable to high income even though it may be the more efficient : the redistribution effects become dominant for the workers who most benefit from redistribution or those who are the more penalized by it.

The analysis has been conducted under strong simplifying assumptions. It should be extended in several directions in order to test the robustness of the results. First production and endogenous factor prices could be introduced. Second, uncertainty on production and population growth would make the comparison between rates of return of the systems less trivial and more realistic. Liquidity constraints, which are likely to be binding on low income workers, should be taken into account. Finally, as said in the introduction, allowing for adjustments in the systems would be delicate, but interesting to explore, even if such adjustments can only be slow.

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5 Proofs

Proof of proposition 1 Let us determine the conditions under which there is an active equilibrium with only A. In this case $w^A = \overline{w}$ and $w^B = w_{min}$. An equilibrium is obtained if an individual whose wages are minimum is not incited to choose system B. This is written $W^A(\overline{w}, w_{min}) - W^B(w_{min}, w_{min}) \geq 0$, what gives the inequality (10) while using (7).

In a similar way, a situation with only B active forms an equilibrium if an individual whose wage is maximal is not incited to choose system A. Since Since $w^A = w_{max}$ and $w^B = \overline{w}$, this gives $W^A(w_{max}, w_{max}) - W^B(\overline{w}, w_{max}) \leq 0$ which yields (11).

It remains to consider an AB-equilibrium. Let the function ϕ be defined on $[w_{min}, w_{max}]$ by $\phi(x) = W^A(w^A(x), x) - W^B(w^B(x), x)$ where $w^B(x) = E[w|w \leq x]$, and $w^A(x) = E[w|w \geq x]$. By continuity of the distribution of wages, the function ϕ is continuous. An equilibrium with two active systems is associated with w^* in $]w_{min}, w_{max}[$ that satisfy $\phi(w^*) = 0$. Note that (10) is equivalent to $\phi(w_{min}) \geq 0$ and (11) to $\phi(w_{max}) \leq 0$. The proof follows by continuity of ϕ. ■

Proof of proposition 2. To simplify notation, write $\pi^I = \frac{g}{r}\tau^I(1 - \alpha^I)$.

Initially, w-workers choose a system assuming equal average expectations for both systems : $\overline{w}^A = \overline{w}^B = \overline{w}$, hence according to the sign of

$$(R^A - R^B - \pi^A + \pi^B)w + \pi^A\overline{w} - \pi^B\overline{w}. \tag{12}$$

The assumption that system A is more favorable to high-income than B writes as $R^A - R^B - \pi^A + \pi^B$ be positive. Therefore all workers whose wage is larger than a threshold value w_0^* choose A and the others choose B.

Afterwards, the choice of a w-worker at t is made on the basis of the difference $W^A(w_{t-1}^A, w) - W^B(w_{t-1}^B, w)$. Plugging the value of w_{t-1}^I as a function of w_{t-1}^*, the difference is given by the function

$$F(w_{t-1}^*, w) = (R^A - R^B - \pi^A + \pi^B)w + \pi^A\overline{w}^A(w_{t-1}^*) - \pi^B\overline{w}^B(w_{t-1}^*) \tag{13}$$

in which

$$\overline{w}^A(x) = E[w|w \geq x], \text{ and } \overline{w}^B(x) = E[w|w \leq x].$$

By the same argument as used in the initial step, F is increasing in w. which determines a threshold value as follows :

If $F(w_{t-1}^*, w_{min}) \geq 0$, then everybody chooses A : $w_t^* = w_{min}$.

If $F(w_{t-1}^*, w_{max}) \leq 0$, then everybody chooses B : $w_t^* = w_{max}$.

Otherwise w_t^* is the unique solution to equation $F(w_{t-1}^*, w) = 0$.

These conditions define w_t^* as a function of w_{t-1}^* : $w^t = f(w_{t-1}^*)$.

Assume first A to be more efficient than B. By definition $\overline{w}^A(x) \geq x$ and $\overline{w}^B(x) \leq x$. Therefore surely $F(x, w) > 0$, whatever x and w. Therefore individuals all choose A at the first step, and keeps the choice : the (unique) A-equilibrium is obtained.

If A is less efficient than B, then it is important to determine whether the function f is monotone. Function f is increasing (resp. decreasing) if F is decreasing (resp. increasing) with its first argument, which is true if $(\pi^A \overline{w}^A - \pi^B \overline{w}^B)(x)$ is decreasing (resp. increasing).

Note that the inequalities $0 > R^A - R^B > \pi^A - \pi^B$ hold, the first one from efficiency and the second from A more favorable to high income than B. But the variations of the condiitional expectations with the threshold x depend much on the distribution of wages. For a uniform distribution $\overline{w}^A(x) = (w_{max} - x)/2$ and $\overline{w}^B(x) = (x - w_{min})/2$. This gives that f is increasing.

We shall prove that surely $w_1^* \leq w_0^*$. Recall that w^*0 is the threshold value associated with equal expectations for $\overline{w}^A = \overline{w}^B = \overline{w}$. At the subsequent step, the average wage in A can only been larger and that in B be smaller (inequalities $\overline{w}^A(w_0^*) \geq \overline{w}$ and $\overline{w}^B(w_0^*) \leq \overline{w}$ surely hold). This implies that the incentives to choose A is necessarily larger than it was at the first step. More formally

$$F(w_0^*, w_0^*) \geq (R^A - R^B - \pi^A + \pi^B)w_0^* + (\pi^A - \pi^B)\overline{w}.$$

The right hand side is (12), which defines the threshold value w_0^*. Therefore it is positive if $w_0^* = w_{min}.$, which implies also $w_1^* = w_{min}.$. It is null if w_0^* is an interior solution, which gives $w_1^* \leq w_0^*$.. Finally if $w_0^* = w_{max}$ surely $w_1^* \leq w^*0$.

We are almost done. Since $w^*1 \leq w^*0$ anf f is an increasing function, the sequence w_t^* decreases. Therefore all individuals choose B only if this the case at the initial step and then they confirm their choices, that is if $w_1^* \leq w_0^* = w_{max}$. This implies that a B-equilibrium exists. Otherwise, i.e. the sequence w_1^* converge to a threshold strictly less than w_{max} : the limit value corresponds to an AB or A-equilibrium. ∎

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