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Does the common labor market imply the need for a European public pension system?

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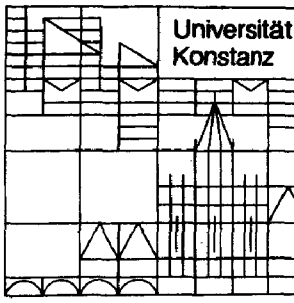

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Does the Common Labor Market Imply the Need for a European Public Pension System?

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Abstract: In a recent paper, Homburg and Richter have argued that with free mobility of labor within a common labor market there is a need to harmonize and even consolidate pay-as-you-go financed national public pension systems to reach an efficient allocation of labor. We show that with free and unrestricted mobility of labor there is no need for consolidation. In contrast, if mobility is restricted in such a way that fertility-caused differences in population growth cannot be equalized by migration, one gets a large variety of minimum coordination requirements for an efficient equilibrium.

Key words: European integration, Public pension systems, Labor mobility

JEL classification: H55, H 73, R23

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1 Introduction

In a recent paper, Homburg and Richter (HR)(1993) have argued that with free labor mobility within a common market such as the EU the allocation of resources across member states will be inefficient if workers' locational choices are influenced by the presence of national pension schemes, which are financed according to the pay-as-you-go principle (PAYG). More precisely, each social security scheme levies an implicit tax on its members which is determined by the difference between the net return to the social security contribution and the return to an equivalent amount of money invested in the capital market. The return to the contribution is itself the product of the size of the contribution and the growth rate of GNP. Other things being equal, workers will migrate to countries with the lowest implicit tax and thereby distort allocational efficiency.

Now the authors argue that not even a complete equalization of social security contributions ("harmonization of public pension schemes") would eliminate the distortionary incentives because the rates of return may still differ among countries due to differences in fertility and thus population growth. The only conceivable way to avoid this inefficiency, they assert, would be to consolidate national pension schemes in one big "European public pension scheme" (ibid., p.60).

In this paper we shall show that this conclusion is unwarranted and that mere harmonization of social security schemes is sufficient to bring about an efficient resource allocation unless the labor force is divided into one (small) freely mobile and one (large) completely immobile segment. In this case, a large variety of different minimum coordination requirements compatible with an efficient allocation of labor can be deduced. Thus, the simple policy implications for the polar cases of no and unrestricted mobility do not carry over to the case of restricted mobility. Even worse, minimum coordination requirements can not be deduced from observable data. The productivity differences before migration are an insufficient indicator for the post-migration efficient equilibria. Thus, minimum coordination schemes can not be deduced from this information.

Our argument unfolds as follows. In Section 2 we shall briefly recapitulate the assumptions of the model by Homburg and Richter, Section 3 analyzes

an equilibrium with freely mobile labor and Section 4 with a segmented labor force. Section 5 contains a summary and conclusions for social policy within the EU.

2 Assumptions and Notation

Without loss of generality we present the model by Homburg and Richter in a simplified version with only two member states (jurisdictions) within a community, characterized by superscripts f ("France") and g ("Germany").[1] The following assumptions are maintained:

- Total population growth is zero. Thus in a two-period overlapping-generations-model a total of $\bar{N}$ identical young households enters the labor force in each period t and retires one period later. The fertility-caused distribution of labor across jurisdictions in period t is described by the pair $(\bar{N}_t^f, \bar{N}_t^g)$ whereas the distribution of labor after migration is denoted by the pair (N_t^f, N_t^g).

- The only consumer good and (the identical) physical capital can be freely traded across member states so that - in the absence of taxes on capital returns - there is only one interest factor R_t each period.

- Apart from capital, there are two other factors of production: homogeneous labor of which one unit is supplied by each member of the young generation denoted by N_t^i, and exogenously given land, denoted by L^i $(i = f, g)$.

- The production function of jurisdiction i $(i = f, g)$ is denoted by $Y_t^i = F^i(L^i, K_t^i, N_t^i)$ and has the usual neoclassical properties.

- Wage payments are equal to the marginal productivity of labor, $w_t^i = F_N^i(L^i, K_t^i, N_t^i)$. Profits in both regions are shared equally between members of the old generation.

[1] The choice of countries is completely arbitrary and reflects in no way the recent proposal of forming a "core Europe".

- At the beginning of period 1, the government of jurisdiction i levies a contribution $b^i \in [0,1]$ from each worker living there and distributes the proceeds equally as "public pension" among all retirees in its jurisdiction.
- After the values of factor prices and social security contributions are made public, in each period young families can make their locational decisions. Families have no locational preferences as such. In contrast, retirees can not move. [2]
- Three different qualities of policy adjustment have to be distinguished:
  - The weakest form of adjustment is the *coordination* of public pension systems. Two cases have to be considered: Pension systems may be coordinated such that country i's contribution rate (a) may not exceed, or (b) is equal to a certain level defined by country j, $b^i \leq ab^j$, $b^i = ab^j$.
  - As a special case of coordination, PAYG-systems are said to be *harmonized* if $b^i = b^j$.
  - If national systems are converted to a single "European" public pension system, the systems are said to be *consolidated* .

3 The Homburg and Richter result reconsidered

In this section it is assumed that moving costs are zero for the whole population in region i, $i = f, g$. According to the above assumptions, a representative individual maximizes his utility through two different decisions:

1. choice of locality in the jurisdiction in which lifetime income is higher,
2. spreading consumption in such a way over the lifecycle that lifetime utility is maximized.

[2]This assumption takes into account that, within the European Union, pension payments for mobile workers are calculated due to the principles valid in the countries of employment. Thus, migration of retirees does not alter their claims to pension payments.

Thus we can write

$$\max_{i=f,g;c_t^1;c_{t+1}^2} u(c_t^1, c_{t+1}^2) \qquad s.t. \tag{1}$$

$$c_t^1 + \frac{1}{R_{t+1}} c_{t+1}^2 = w_t^i + b^i\left(\frac{\mathbf{E}N_{t+1}^i}{N_t^i}\frac{1}{R_{t+1}} - 1\right)$$

with **E** being an expectations operator indicating that from an individual's point of view future population is unknown. An interregional equilibrium with free migration is characterized by a distribution of the total population $\bar{N}$ over the two regions f and g such that the expected effective income of a representative individual is equal in both regions:

$$\begin{aligned} & F_N^f(L^f, K_t^f, N_t^f) + b^f\left(\frac{\mathbf{E}N_{t+1}^f}{N_t^f}\frac{1}{R_{t+1}} - 1\right) \\ = \; & F_N^g(L^g, K_t^g, N_t^g) + b^g\left(\frac{\mathbf{E}N_{t+1}^g}{N_t^g}\frac{1}{R_{t+1}} - 1\right) \end{aligned} \tag{2}$$

On the other hand, an interregionally efficient allocation of labor will be reached if total output is maximized. [3] The associated Lagrangean is

$$\mathcal{L} = F^f(L^f, K_t^f, N_t^f) + F^g(L^g, K_t^g, N_t^g) + \lambda_t(\bar{N} - N_t^f - N_t^g), \tag{3}$$

implying

$$F_N^f(L^f, K_t^f, N_t^f) = F_N^g(L^g, K_t^g, N_t^g). \tag{4}$$

For an interregional equilibrium to be efficient, the marginal productivity of labor has to be equal in both regions. Thus we get from (2) and (4)

$$b^f\left(\frac{N_{t+1}^f}{N_t^f}\frac{1}{R_{t+1}} - 1\right) = b^g\left(\frac{N_{t+1}^g}{N_t^g}\frac{1}{R_{t+1}} - 1\right). \tag{5}$$

Analyzing this condition we get the second proposition of HR (p. 59):

> **Proposition 1:** With national public pension schemes, a time-path of distributions of people $(N_t^f, N_t^g)_{t=1,2,...}$ is interregionally efficient if either of the following two conditions is met:
>
> $$\begin{aligned} &a) \quad b^i = 0 \qquad i = f, g \\ &b) \quad b^f = b^g \quad and \quad \frac{N_{t+1}^i}{N_t^i} = 1 \qquad i = f, g \end{aligned}$$

[3] See for example Wildasin 1987, p.1137.

In a perfect-foresight steady-state equilibrium, region-specific differences in fertility have to be arbitrated away by migration. The fiscal incentives to reach this goal can be implemented by either converting the PAYG to fully-funded systems (a) or by harmonizing premiums between the regions (b). The second possibility has to be accompanied by a constant region-specific population after migration.

As mentioned in HR (pp. 59, 60), it is unclear whether this condition can be met from the first period of labor mobility on. Without productivity growth and with a constant total population, the efficient distribution of the population does not change over time. Thus, if it will be met for one period, this condition is individually rational for every subsequent period. Contrary to HR (p. 60), we argue that with free mobility and perfect foresight this condition will indeed be met from the first period of labor mobility on.

Consider the decision problem of a representative young individual in the first period of labor mobility, $t = 0$. In absence of any mobility costs and without further obligations to the home country's old generation, he will migrate to region f if

$$\begin{aligned} & F_N^f(L^f, K_0^f, N_0^f) + b^f\left(\frac{\mathbf{E}N_1^f}{N_0^f}\frac{1}{R_1} - 1\right) \\ > \; & F_N^g(L^g, K_0^g, N_0^g) + b^g\left(\frac{\mathbf{E}N_1^g}{N_0^g}\frac{1}{R_1} - 1\right) \end{aligned} \tag{6}$$

Migration will take place as long as both sides are equal. The expression breaks down in three different parts: Premium payments b^i are choice-variables of the governments, the current population in region j, N_0^j, is a choice variable of the current young generation, and the future population N_1^j is unknown at $t = 0$. The locational choice of a representative individual is independent of decisions in the past. With harmonized premium payments and perfect foresight ($\mathbf{E}N_1^j = N_1^j$) the only consistent belief of the individual is to assume that in the next period $N_1^j = N_0^j$. In this model, the native country of a consumer is totally irrelevant for his decision where to settle. With free mobility, it is possible to reach interregional efficiency from the first period on by harmonizing the pension systems. There is no further need for consolidation in this model:[4]

[4]It should be mentioned that for every other belief of the future population structure the result no longer holds. However, assuming stationarity of the population is the only belief

Proposition 2: With free mobility of labor and perfect foresight, a time path with $N_t^j = N^j \quad \forall t \geq 1 (j = f, g)$ constitutes an equilibrium from the first period of labor-mobility on. Harmonization of premium payments is thus not only sufficient for efficiency in the steady state but also in the first period of labor mobility.

4 Imperfect mobility of the labor force

In this section, we will show that the consolidation of the regional PAYG-systems may be necessary if only part of the population in every region is freely mobile. If there are region-specific differences in fertility that can not be offset by migration, harmonization of premium payments may no longer be sufficient to reach interregional efficiency. In order to derive this result, we introduce the following notation:

Assume w.l.o.g. $\bar{N}_t^f < \bar{N}_{t+1}^f < \bar{N}$ being the population in region f in two subsequent periods indicating that f is the growing region between these two periods if no migration takes place. Let $\widehat{\alpha}^i < 1, i = f, g$ be the fraction of region i's population that can freely and costlessly migrate to the other region. $N_t^i, i = f, g$ denotes the population of generation t in country i after migration has occurred. Let $\beta^i, i = f, g$ be the fertility-caused population-growth factor in region i, $\bar{N}_{t+1}^i = \beta^i N_t^i, i = f, g$. Furthermore, assume that the fertility-caused differences in population cannot fully be compensated by migration, $(1 - \widehat{\alpha}^f) N_{t+1}^f > N_t^f$.[5]

Interregional efficiency again requires the maximization of total output under the restriction that the sum of the populations in the two regions is equal to the total population and the additional constraints implied by the maximum migration rate, $N_t^i \geq (1 - \widehat{\alpha}^i) \bar{N}_t^i$. The associated Lagrangean is:

$$\begin{aligned} \mathcal{L} = F^f(L^f, K_t^f, N_t^f) + F^g(L^g, K_t^g, N_t^g) + \lambda_t(\bar{N} - N_t^f - N_t^g) \\ + \mu_t^f(N_t^f - (1 - \widehat{\alpha}^f)\bar{N}_t^f) + \mu_t^g(N_t^g - (1 - \widehat{\alpha}^g)\bar{N}_t^g) \end{aligned} \tag{7}$$

Calculating and rearranging the first-order conditions of the above Kuhn-

consistent with the underlying model structure.

[5]Otherwise we would be back in the scenario of Section 3.

Tucker problem, we get:

$$F_N^f + \mu_t^f = -\lambda_t \tag{8}$$

$$F_N^g + \mu_t^g = -\lambda_t \tag{9}$$

$$N_t^f + N_t^g = \bar{N} \tag{10}$$

$$\mu_t^f (N_t^f - (1 - \widehat{\alpha}^f)\bar{N}_t^f) = 0 \tag{11}$$

$$\mu_t^g (N_t^g - (1 - \widehat{\alpha}^g)\bar{N}_t^g) = 0 \tag{12}$$

There are two possible cases: First assume that $F_N^f > F_N^g \quad \forall \quad \alpha^i \in [0, \widehat{\alpha}^i], i = f, g$. By (10) and (11) we can conclude $\mu_t^g - \mu_t^f > 0$, because both, μ_t^f and $\mu_t^g \geq 0$, $\mu_t^f > 0$ would imply migration from f to g, $N_t^f = (1-\alpha^f)\bar{N}_t^f$. Migration in both directions can never be optimal, thus only $\mu_t^g > 0$, $N_t^g = (1 - \widehat{\alpha}^g)\bar{N}_t^g$. Maximal migration from the relatively unproductive to the relatively productive region is efficient. Furthermore, it increases the net population growth rate in this region. From $F_{NN}^i < 0, i = f, g$ (the second derivative of the production function with respect to labor is negative), maximum migration minimizes the difference in marginal productivities. A similar argument holds for $F_N^f < F_N^g$ in the first period. We summarize in the following

Lemma 1: An interregional equilibrium is interregionally efficient if a)

$$F_N^i(L^i, K_t^i, N_t^i) > F_N^j(L^j, K_t^j, N_t^j) \quad \wedge \quad N_t^j = (1 - \widehat{\alpha}^j)\bar{N}_t^j \tag{13}$$

or b)

$$\exists \alpha^i \in [0, \widehat{\alpha}^i] \quad \text{such} \quad \text{that} \quad \mathrm{N_t^i} = (1 - \alpha^i)\bar{\mathrm{N}}_\mathrm{t}^\mathrm{i}, \quad \mathrm{N_t^j} = \bar{\mathrm{N}}_\mathrm{t}^\mathrm{j} + \alpha^i \bar{\mathrm{N}}_\mathrm{t}^\mathrm{i}$$
$$\wedge \quad F_N^i(L^i, K_t^i, N_t^i) = F_N^j(L^j, K_t^j, N_t^j) \tag{14}$$

Every mobile household has the same optimization problem as before whereas every immobile household only chooses the optimal consumption path in its region. Thus, mobile households will migrate as long as the effective income in the foreign country is higher than in the home country. Migration stops if either a) there is maximum migration and the foreign country's income is higher or equal than the home country's income, or b) the effective income is equal in both countries for a level of migration between zero and the maximum fraction.

Assume that young individuals in t expect no further migration in $t+1$, $\mathbf{E}N^i_{t+1} = \bar{N}^i_{t+1} = \beta^i N^i_t$. Then we get the following conditions for an interregional equilibrium:

Lemma 2: A distribution of the total population $\bar{N}$ in period t is an interregional equilibrium if: [6]

(i) for $i,j = f,g$: $\quad N^i_t = (1-\widehat{\alpha}^i)\bar{N}^i_t, \quad N^j_t = \bar{N}^j_t + \widehat{\alpha}^i\bar{N}^i_t$

$$\begin{aligned} \wedge \quad & F^i_N(L^i,K^i_t,N^i_t) + b^i(\beta^i\frac{1}{R_{t+1}} - 1) \\ \leq \quad & F^j_N(L^j,K^j_t,N^j_t) + b^j(\beta^j\frac{1}{R_{t+1}} - 1) \end{aligned} \tag{15}$$

(ii) for $i,j = f,g, \alpha^i \in [0,\widehat{\alpha}^i)$: $\mathrm{N}^i_t = (1-\alpha^i)\bar{N}^i_t, \quad N^j_t = \bar{N}^j_t + \alpha^i\bar{N}^i_t$

$$\begin{aligned} \wedge \quad & F^i_N(L^i,K^i_t,N^i_t) + b^i(\beta^i\frac{1}{R_{t+1}} - 1) \\ = \quad & F^j_N(L^j,K^j_t,N^j_t) + b^j(\beta^j\frac{1}{R_{t+1}} - 1) \end{aligned} \tag{16}$$

Next we will show that the consolidation of public pension systems is sufficient to reach an interregional efficient allocation of labor: With a "European" PAYG-financed pension system the virtual rate of return is equal to the European population growth rate. For $\bar{N}$ being constant over time we get

$$\begin{aligned} F^i_N(L^i,K^i_t,N^i_t) + b(\frac{1}{R_1} - 1) > F^j_N(L^j,K^j_t,N^j_t) + b(\frac{1}{R_1} - 1) \\ \Leftrightarrow F^i_N(L^i,K^i_t,N^i_t) > F^j_N(L^j,K^j_t,N^j_t). \end{aligned} \tag{17}$$

Lemma 3: A consolidated PAYG-system induces no further distortion. Labor migrates to the region of highest productivity until the maximum migration takes place.

However, we want to find out whether efficient equilibria are possible even without consolidated public pension systems. Thus, the minimum requirement for adjustment that is consistent with efficiency will be calculated. But before efficiency and equilibrium conditions are compared, we will prove an elementary property concerning the ratio of the Aaron-conditions of both countries:

[6] All terms are evaluated at the indicated migration rate.

Lemma 4:

1. $\beta_t^f - R_{t+1} > 0 \quad \Leftrightarrow \quad \frac{\beta_t^g - R_{t+1}}{\beta_t^f - R_{t+1}} < 0$

2. $\beta_t^f - R_{t+1} < 0 \quad \Leftrightarrow \quad \frac{\beta_t^g - R_{t+1}}{\beta_t^f - R_{t+1}} > 1$

Proof: By assumption f is the growing region, $\beta_t^f > 1$. Because $N_t^g + N_t^f = \bar{N} = \beta_t^f N_t^f + \beta_t^g N_t^g$, it must be that $\beta_t^g < 1$. Thus, $\beta_t^f - R_{t+1} > \beta_t^g - R_{t+1}$. If $\beta_t^f - R_{t+1} > 0$, $\frac{\beta_t^g - R_{t+1}}{\beta_t^f - R_{t+1}} < 1$. Furthermore, $\beta_t^g - R_{t+1} < 0$ which proves part 1 of Lemma 4. If $\beta_t^f - R_{t+1} < 0$, again, $\beta_t^g - R_{t+1} < 0$, and thus $\frac{\beta_t^g - R_{t+1}}{\beta_t^f - R_{t+1}} > 1$ which proves part 2 of Lemma 4.

It is now possible to compare efficiency and equilibrium conditions. Let $\bar{H}$, H^{α^i} and $\widehat{H}^i$ be the productivity difference between region f and g if no migration, migration at rate α^i and maximum migration from i to j takes place.

We have to consider four different cases:

Case 1: $\widehat{H}^g > 0$, maximum migration from country g to country f is efficient. The efficiency and equilibrium conditions are compatible if the following condition is met:

$$\widehat{H}^g \geq b^g\Big(\frac{\beta_t^g - R_{t+1}}{R_{t+1}}\Big) - b^f\Big(\frac{\beta_t^f - R_{t+1}}{R_{t+1}}\Big) \tag{18}$$

According to Lemma 4 it follows that b^f and b^g have to be coordinated such that

$$b^f \geq b^g \frac{\beta_t^g - R_{t+1}}{\beta_t^f - R_{t+1}} - \frac{\widehat{H}^g R_{t+1}}{\beta_t^f - R_{t+1}} \quad \text{for} \quad \beta_t^f - R_{t+1} > 0 \tag{19}$$

$$b^f \leq b^g \frac{\beta_t^g - R_{t+1}}{\beta_t^f - R_{t+1}} - \frac{\widehat{H}^g R_{t+1}}{\beta_t^f - R_{t+1}} \quad \text{for} \quad \beta_t^f - R_{t+1} < 0 \tag{20}$$

$$\widehat{H}^g R_{t+1} \geq b^g(\beta_t^g - R_{t+1}) \quad \text{for} \quad \beta_t^f - R_{t+1} = 0. \tag{21}$$

What are the implications of the above inequalities?

For $\beta_t^f - R_{t+1} > 0$ we get $\frac{\beta_t^g - R_{t+1}}{\beta_t^f - R_{t+1}} < 0$ and $\frac{\widehat{H}^g R_{t+1}}{\beta_t^f - R_{t+1}} > 0$. From (19) it follows that $b^f > 0$. If the population-growth factor in region f is larger than the interest factor (Aaron-Condition), the PAYG-system increases incomes in region f whereas incomes are reduced in g. Both, differences in productivities

and rentabilities of the pension systems induce migration from region g to region f. There is no need for any kind of coordination between the two regions.

For $\beta_t^f - R_{t+1} < 0$ we get $\frac{\beta_t^g - R_{t+1}}{\beta_t^f - R_{t+1}} > 1$ and $\frac{\widehat{H}^g R_{t+1}}{\beta_t^f - R_{t+1}} < 0$. There is no need for coordination, if $-\frac{\widehat{H}^g R_{t+1}}{\beta_t^f - R_{t+1}} > 1 \Leftrightarrow \widehat{H}^g R_{t+1} \geq R_{t+1} - \beta^f$. The productivity difference has to be larger than the discounted implicit tax induced by the PAYG in f. If this condition does not hold, the pension systems have to be coordinated according to (20) implying that the contribution rate in f must not exceed a certain level. If (20) is not fulfilled, migration to country f will be too low in equilibrium. Even worse, for $\bar{H} R_{t+1} < b^g(\beta_t^g - R_{t+1}) - b^f(\beta_t^f - R_{t+1})$ migration will go to country f and the "productivity-gap" will be widened.

For $\beta_t^f - R_{t+1} = 0$, (21) is fulfilled $\forall b^f \in [0,1]$. Again, there is no need for coordination. To summarize:

> **Result 3:** For $\widehat{H}^g > 0$ and $\beta_t^f - \beta_t^g > 0$, PAYG-systems do not have to be coordinated if the implicit tax in region f does not exceed the productivity difference, $R_{t+1} - \beta^f \leq \widehat{H}^g R_{t+1}$. If this condition does not hold, social security systems have to be coordinated according to (20).

An interesting implication of (18) is that harmonisation of premium payments is a special case of efficient coordination:

$$\widehat{H}^g \geq b\Big(\frac{\beta_t^g - \beta_t^f}{R_{t+1}}\Big) \tag{22}$$

This instrument is, however, unnecessarily strong for an efficient allocation of labor.

Case 2: Assume that $\exists \alpha^g \in (0, \widehat{\alpha}^g)$ such that $H^{\alpha^g} = 0$, efficiency requires less than maximum migration. Efficiency and equilibrium conditions are compatible, if

$$b^f = b^g \frac{\beta_t^g - R_{t+1}}{\beta_t^f - R_{t+1}} \qquad \text{for} \quad \beta_t^f - R_{t+1} \neq 0 \tag{23}$$

$$b^g = 0 \qquad \text{for} \quad \beta_t^f - R_{t+1} = 0. \tag{24}$$

In order to get the efficient rate of migration, the different rentabilities of the PAYG-systems have to be balanced by different contribution rates. The

region with a relatively high implicit tax has to compensate this disadvantage by a low contribution rate and vice versa. Again one has to distinguish three different cases:

(i) First assume $\beta_t^f - R_{t+1} > 0$. By Lemma 4 and (23) we get $b^f < 0$. In order to compensate for the implicit subsidy in region f, the contribution rate has to be strictly smaller than 0 if $b^g > 0$. Thus pension systems have to be consolidated if a conversion to fully funded systems is not possible. Otherwise there is too much migration from region g to region f.

(ii) $\beta_t^f - R_{t+1} < 0$. Now PAYG have to be coordinated such that $b^f = b^g \frac{\beta_t^g - R_{t+1}}{\beta_t^f - R_{t+1}} > b^g$. The region with the smaller implicit tax has to equalize total losses by setting a larger contribution rate.

(iii) Finally, if $\beta_t^f - R_{t+1} = 0$, $b^g = 0$ is the only contribution rate compatible with efficiency. Again, if the conversion of public pension systems to fully-funded systems is not possible, both systems have to be consolidated because otherwise too many people would migrate from region g to region f. To summarize:

> **Result 4:** For $H^{\alpha^g} = 0$ for some $\alpha^g \in (0, \widehat{\alpha}^g)$, PAYG have to be consolidated if $\beta_t^f - R_{t+1} \geq 0$. If $\beta_t^f - R_{t+1} < 0$, the systems have to be coordinated according to (23) or (24).

It should be mentioned that as a direct consequence of result (4), the mere harmonisation of premium payments is not compatible with efficiency in this case. In every case, violating the above coordination or consolidation requirement would induce too much or too little migration in equilibrium.

Case 3: $\widehat{H}^f < 0$, maximum migration from f to g is efficient. The efficiency and equilibrium conditions are compatible if the following condition is met for b^f and b^g:

$$-\widehat{H}^f \geq b^f \Big(\frac{\beta_t^f - R_{t+1}}{R_{t+1}} \Big) - b^g \Big(\frac{\beta_t^g - R_{t+1}}{R_{t+1}} \Big) \tag{25}$$

According to Lemma 4 it follows that

$$b^f \leq b^g \frac{\beta_t^g - R_{t+1}}{\beta_t^f - R_{t+1}} - \frac{\widehat{H}^f R_{t+1}}{\beta_t^f - R_{t+1}} \quad \text{for} \quad \beta_t^f - R_{t+1} > 0 \tag{26}$$

$$b^f \geq b^g \frac{\beta_t^g - R_{t+1}}{\beta_t^f - R_{t+1}} - \frac{\widehat{H}^f R_{t+1}}{\beta_t^f - R_{t+1}} \quad \text{for} \quad \beta_t^f - R_{t+1} < 0 \tag{27}$$

$$-\widehat{H}^g R_{t+1} \geq -b^g (\beta_t^g - R_{t+1}) \quad \text{for} \quad \beta_t^f - R_{t+1} = 0. \tag{28}$$

For $\beta_t^f - R_{t+1} > 0$ we get $\frac{\beta_t^g - R_{t+1}}{\beta_t^f - R_{t+1}} < 0$ and $\frac{\widehat{H}^g R_{t+1}}{\beta_t^f - R_{t+1}} < 0$. There is no need for coordination if $-\frac{\widehat{H}^f R_{t+1}}{\beta_t^f - R_{t+1}} \geq 1 \Leftrightarrow \widehat{H}^f R_{t+1} \leq R_{t+1} - \beta^f$. The productivity difference has to be larger than the implicit subsidy in region f. Otherwise, both systems have to be coordinated according to (26).

For $\beta_t^f - R_{t+1} < 0$ we get $\frac{\beta_t^g - R_{t+1}}{\beta_t^f - R_{t+1}} > 1$ and $\frac{\widehat{H}^g R_{t+1}}{\beta_t^f - R_{t+1}} > 0$. There is no need for coordination, if $\forall b^g \in [0,1], b^g \frac{\beta_t^g - R_{t+1}}{\beta_t^f - R_{t+1}} - \frac{\widehat{H}^f R_{t+1}}{\beta_t^f - R_{t+1}} \leq 0$. As a sufficient condition for $b^g = 1$ it follows that $\widehat{H}^f R_{t+1} \leq \beta^g - R_{t+1}$. If the productivity difference is larger than the implicit tax in region g, there is no need for coordination. Otherwise, PAYG have to be coordinated according to (27).

For $\beta_t^f - R_{t+1} = 0$, the productivity difference has to be larger than total losses in region g, $\widehat{H}^f R_{t+1} \leq b^g(\beta^g - R_{t+1}) \Leftrightarrow b^g \leq \frac{\widehat{H}^f R_{t+1}}{\beta^g - R_{t+1}}$. To summarize:

> **Result 5:** For $\widehat{H}^f < 0$ and $\beta_t^f - \beta_t^g > 0$, PAYG-systems do not have to be coordinated if for $\beta^f - R_{t+1} < 0$, $\widehat{H}^f > R_{t+1} - \beta^g$, or for $\beta^f - R_{t+1} > 0$, $\widehat{H}^f > R_{t+1} - \beta^f$. In every other case, PAYG-systems have to be coordinated according to (26)-(28).

Again we should ask whether harmonisation of premium payments is sufficient for efficiency. One can easily verify that for $b^f = b^g = b$ it must be that $-\widehat{H}^f R_{t+1} \geq b(\beta^f - \beta^g)$, a condition that will not be fulfilled generally. As in case 1, violating the coordination requirement would lead to an equilibrium rate of migration less than optimal. Furthermore, income incentives might even induce migration to the region with the smaller marginal productivity.

Case 4: Assume that $\exists \alpha^f \in (0, \widehat{\alpha}^f)$ such that $H^{\alpha^f} = 0$. Efficiency and equilibrium conditions are compatible, if

$$b^f = b^g \frac{\beta_t^g - R_{t+1}}{\beta_t^f - R_{t+1}} \qquad \text{for} \quad \beta_t^f - R_{t+1} \neq 0 \tag{29}$$

$$b^g = 0 \qquad \text{for} \quad \beta_t^f - R_{t+1} = 0. \tag{30}$$

Comparing (28), (29) and (22), (23) it shows that the need for coordination is the same as in case 2. Figure 1 summarizes the results.

5 Conclusions

Let us summarize the above results. With unrestricted migration, harmonization of PAYG-financed public pension systems is necessary and sufficient to reach interregional efficiency in a steady-state equilibrium. Nevertheless, in the model of HR, the result is not only true for the steady state but also for the adjustment path that degenerates to a single period. Thus, consolidation is not necessary to reach interregional efficiency in every period.

Restricting mobility by the assumption that the part of the population that can freely migrate is insufficient to compensate for fertility based differences in population growth rates, one gets plausible cases for which consolidation is in fact necessary to get interregional efficiency. Harmonized public pension systems can lead to the wrong migration incentives if the difference in the rentabilities of these systems is larger then the productivity difference. In this case migration will be too small in equilibrium or, even worse, will go to the region with a lower productivity. Consolidation avoids wrong migration incentives at the price of a highly centralized system. Analyzing the minimum adjustment requirements being compatible with efficiency one gets a large variety of different coordination szenarios. It is a-priori unclear whether PAYG-systems must be coordinated such that the region-specific contribution rate have to be (a) in a certain interval or (b) equal to a fixed fraction of the other country's contribution rate or (c) consolidated. This result is due to the fact that the equilibrium requirements depend on equilibrium productivities post migration. These productivities can not be observed a-priori. Thus, consolidation of the PAYG-systems or conversion to fully funded systems are the only measures giving a guarantee that the new equilibrium will be efficient. The usual remark on the possibility to convert the systems in a Pareto-improving way applies.

In contrast to the case of unrestricted migration, the harmonization of premium payments is either a too strong or a too weak instrument for an efficient allocation of labor. Thus, the efficiency results for the two polar cases of no and unrestricted migration do not carry over to the intermediary case of partial mobility.

A need for coordination of social standards in the European Union is seen

only to establish free mobility of workers within the EU (Art. 48 EWGV). It is now common sense within the EU that there is no need for harmonization or consolidation in order to reach this goal. If mobility of labor is not seen as a fundamental value but as a necessary pre-requisite to reach an efficient allocation of ressources within the Union, there are plausible cases where at least coordination of public pension systems is necessary. Some cases even indicate that the need for consolidation of systems can not be excluded in order to reach this goal. If mobility of labor is seen as a necessary pre-requisite of personal freedom, we can conclude that for PAYG-financed social-security systems, freedom and efficiency are conflicting targets. In general, they are only compatible if PAYG-financed pension systems are consolidated or converted to fully-funded systems within the European Union.

6 References

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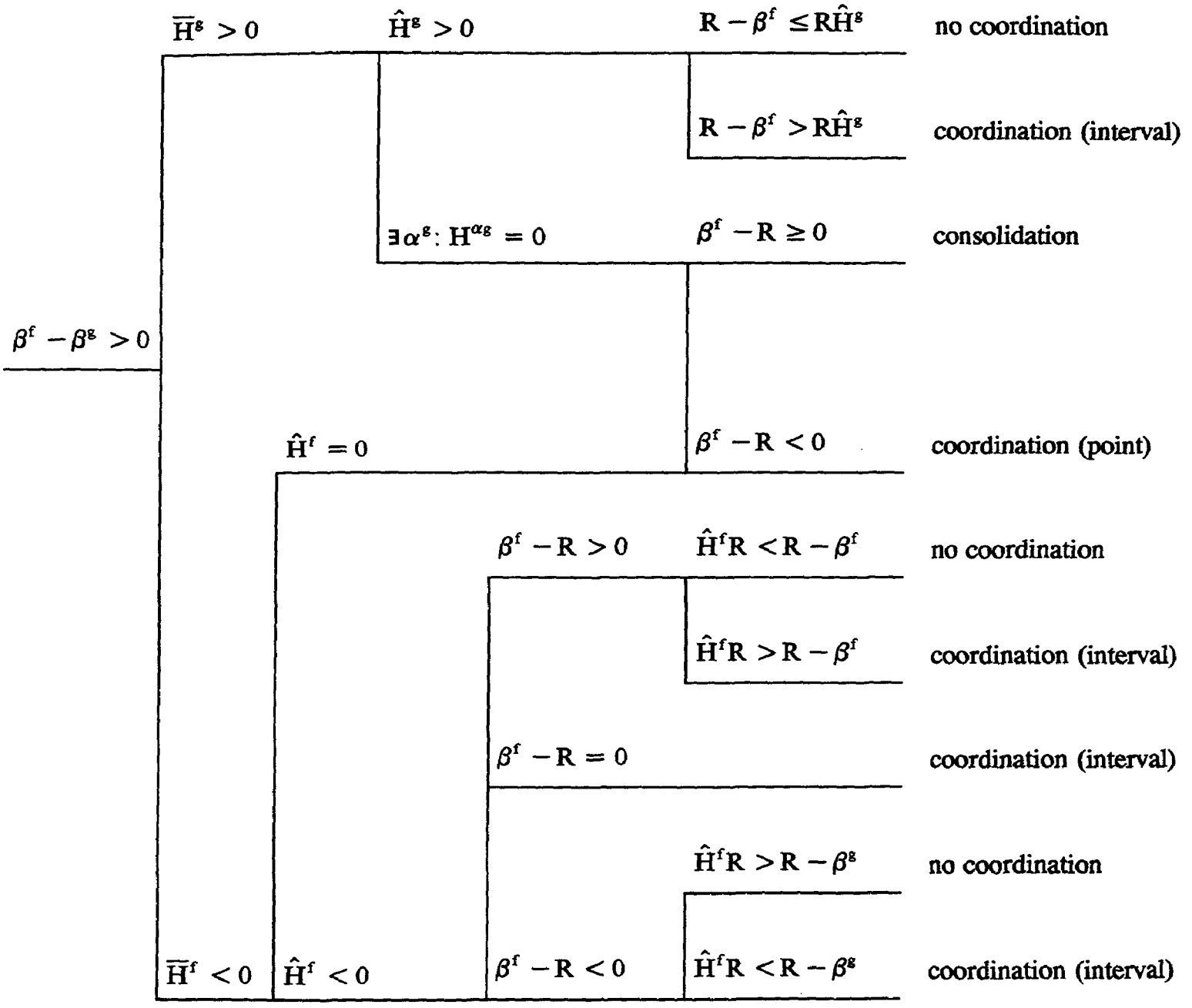
Figure 1:


$\overline{H}^g > 0$
$\hat{H}^g > 0$
$R - \beta^f \leq R\hat{H}^g$
no coordination
$R - \beta^f > R\hat{H}^g$
coordination (interval)
$\exists \alpha^g: H^{\alpha g} = 0$
$\beta^f - R \geq 0$
consolidation
$\beta^f - \beta^g > 0$
$\hat{H}^f = 0$
$\beta^f - R < 0$
coordination (point)
$\beta^f - R > 0$
$\hat{H}^f R < R - \beta^f$
no coordination
$\hat{H}^f R > R - \beta^f$
coordination (interval)
$\beta^f - R = 0$
coordination (interval)
$\hat{H}^f R > R - \beta^g$
no coordination
$\overline{H}^f < 0$
$\hat{H}^f < 0$
$\beta^f - R < 0$
$\hat{H}^f R < R - \beta^g$
coordination (interval)