

# THE HARMONIZATION OF PUBLIC PENSION SCHEMES - PERFECT AND IMPERFECT LABOUR MOBILITY CASES\*

ONDREJ SCHNEIDER

CERGE-EI, Prague, Czech Republic

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## Abstract:

The paper shows that adding social security based on a pay-as-you-go principle (PAYG) prevents countries from successfully harmonizing their individual social security systems. As claimed in the paper, the PAYG systems are extremely complicated to harmonize when the labour force is mobile among jurisdictions. PAYG systems' revenues depend not only on the level of taxes but also on fertility rates and migration flows. In the paper we argue that if agents take into account differences in fertility rates across different countries they may exacerbate the gap in the population growth rates between the individual countries by migration, and thereby cause the PAYG system to collapse in some countries.

The paper shows that even if we relax the assumption of perfect labour mobility, some of the problems countries face during their attempts to harmonize their PAYG based social security systems have no evident solution. We claim that the higher the mobility, the less scope there is left for a government to pursue an independent social policy. In addition, the higher the share of funded social security, the less complications arise from harmonization.

**Key words:** public pension schemes, harmonization policy, pay-as-you-go, migration.

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### **Abstrakt:**

Práce ukazuje, že veřejné penzijní systémy, založené na principu Pay-As-You-Go prakticky znemožňují úspěšnou harmonizaci systémů sociální péče více zemí v situaci, kdy se pracovní síla může mezi těmito státy volně pohybovat. To je způsobeno tím, že ekonomická návratnost systémů PAYG závisí nejen na výši zdanění v dané zemi, ale také na migraci obyvatel. Práce ukazuje, že pokud jsou obyvatelé schopni při svém rozhodování zohlednit rozdíly v populačním růstu jednotlivých zemí, pak mohou migrací zvýraznit tyto rozdíly a přivést tak veřejný důchodový systém v jedné ze zemí ke zhroucení.

Podobný problém vyvstává i v případě nepředvídatelných rozdílů v populačním růstu. V práci je ukázáno, že v situaci, kdy je přirozený populační růst velmi nízký, může ke kolapsu veřejného důchodového systému dojít i při omezené mobilitě pracovní síly. V práci je ukázáno, že vliv na udržitelnost důchodového systému má jak stupeň mobility, tak i velikost dané země. Čím vyšší je mobilita, tím menší existuje prostor pro samostatné fungování veřejného důchodového systému v dané zemi.

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## **I. INTRODUCTION**

European policy-makers and voters alike have been busy for several years with the idea of creating a pan-European zone of free trade, free capital movement and free labour mobility. This process has progressed fairly well in some areas while it has barely started in others. Currently, two main sets of problems have emerged as the major obstacles to achieving a genuinely integrated market in Europe. First, the European Union itself is, at present, struggling with the necessity of solving its internal problems. Examples are numerous: proposed monetary union, power concentrated in the Commission, the slow implementation of the subsidiarity principle, the lack of democratic control. The most daunting proves the need to accommodate courageous political plans for further and fast development, as well as broadening or even deepening of the existent European Union, accompanied by a unification of economic policies of the member-countries. Second, the newly established democracies in Central and Eastern Europe have been requesting access to the western European political and economic structures and, perhaps even more importantly, to their rich markets.

However, the economic reality has proven to be a substantial obstacle to the political will. The further common market functions develop, the more complicated the interplay of the interest of individual countries becomes. As recently as in November 1995 German Finance Minister, Theo Waigel, suggested that countries which want to form a closer monetary union within the current European Union should create a "stability council" which would be responsible for supervising fiscal policies of the members and would even have a right to punish a non-obedient country by refusing its access to the monetary union. This rather harsh request came as a warning that even the most pro-European country of them all is not willing to risk its economic stability for the sake of an ambiguous pan-European union.

From what has been said above, it follows that one of the crucial problems facing not

only the European Union but also all perspective future members, among whom the Czech Republic undoubtedly belongs, is how to harmonize economic policy in the course of the development of a common market. The most widely discussed issue so far has been the necessity to harmonize *monetary policy*. While this focus is evident, this paper argues that it is *fiscal policy* and especially *social security systems* which present far more complicated problems for harmonization.

A successful harmonization of fiscal policies requires the coordination of a complex set of taxes across countries. Countries differ a great deal in their ability to finance their spending programmes from taxes. Some governments fail to keep their finance under control, with budget deficits of more than 16% in Greece in 1994 and almost 10% in Italy. Other countries fare much better; besides Luxembourg it is the Netherlands and Germany which experience the lowest government deficits among the EU members. Moreover, each country has its own starting point, with the level of public debt diverging among the current members of the EU significantly. In Belgium it has reached more than 141% of GDP, while in Germany and in the United Kingdom it hovers around 50% of their respective GDPs. All these differences have a significant impact on individual countries' economic policy - for example, more heavily indebted countries tend to push for higher inflation. Also, countries with a higher share of the informal sector often prefer higher inflation as a form of indirect taxation on the cash-holding informal sector. The harmonization of fiscal policies with such great differences seems to be an extremely challenging task.

In this paper we show that adding social security based on a pay-as-you-go principle (PAYG) brings further complexities, which in fact prevent countries from successfully harmonizing their individual policies. It is well established that a PAYG system is beneficial only if the sum of the rates of growth in per capita wages and population exceed the rate of

interest<sup>1</sup>. It has been repeatedly argued that the current social security systems in European countries have accumulated vast debts, often hidden from the official governmental statistics, and that the PAYG system is welfare-detrimental for those societies with ageing populations and low rates of population growth.<sup>2</sup>

As claimed below, the PAYG system has one more cumbersome attribute: it is extremely complicated to harmonize social security systems of individual countries based on the PAYG systems while allowing for the geographical mobility of workers among jurisdictions. PAYG systems depend not only on the level of taxes but also on fertility rates and migration flows. Countries differ in the former and may try to influence the latter. In the paper we argue that if agents take into account differences in fertility rates across different countries, they may exacerbate the gap in the population growth rates between the individual countries by additional migration, and thereby cause the PAYG system to collapse in some countries.

The importance of this aspect will be heightened when the reforming countries from Central and Eastern Europe seek membership in the European Union. The experience of the EU points to a much higher migration from poorer countries (especially Ireland, Portugal and Greece). The overall flows of labour have been directed mainly from Southern to Northern Europe, when around 3% of the population of the South moved during the 70s and 80s to the North.<sup>3</sup> It is estimated that about 10% of the population might be prepared to migrate in response to wage differences alone.<sup>4</sup> The share of people employed in other EU state varies significantly, reaching 23% in Ireland and more than 10% in Portugal and Denmark, but being only 2% in

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<sup>1</sup> See Aaron [1966].

<sup>2</sup> See for instance Herd, Van den Noord [1993], Kotlikoff [1995] or Raffelhuschen [1993].

<sup>3</sup> See CEPR [1992], page 86.

<sup>4</sup> *ibid*, pages 86-87.

Germany and in The Netherlands<sup>5</sup>. On average, however, about 50% of the EU's citizens expressed willingness to work in other EU state (willing to move are most often the Irish, Britons and Portugese, the least prepared to leave their countries were Germans and Greeks). In the case of poorer East European countries, the corresponding shares would very likely be much higher.

The European Union therefore faces a challenging task to harmonize its diverging social security systems before it expands eastward and, at the same time, the prospective newcomers have to adapt their social security systems to the EU's developing one. This simultaneous evolution is unlikely to proceed without problems and obstacles. The paper shows that some of the problems countries face during their attempts to harmonize their PAYG based social security systems have no evident solution. We show that the size of a country's population and the mobility of its labour force have an impact on the sustainability of its social security system. We claim that the higher the mobility, the less scope there is left for a government to pursue an independent social policy. In addition, the higher the share of funded social security, the fewer complications arise from harmonization.

The paper is organized as follows. The second section contains a brief overview of different attitudes towards the problems of fiscal harmonization. Section III introduces public pension systems financed on a PAYG basis and shows the consequences of different institutional settings for the harmonization of social security, assuming perfect mobility of the labour force. The fourth section demonstrates the impact of restricted labour mobility. To conclude, the last section stresses the main arguments and proposes some policy recommendations.

## **II. MODELS OF HARMONIZATION - AN OVERVIEW**

Several streams of literature on the subject of fiscal harmonization have emerged,

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<sup>5</sup> See *European Economy* (1995).

especially since the beginning of the 1990s, as the European Community transformed itself into the European Union which has been proposed as the first step in the direction of a federalization of Europe. This section briefly deals with three attitudes to the problem of social security harmonization which have earned the most attention in the last years.

### **A. Public choice attitude**

As we have just seen, a number of problems remain to be solved within the framework of the existing European integration process. Nevertheless, the plans for further integration of the European Union have already been laid down and politicians seem to be firmly determined to introduce a form of monetary union by the end of the century. Why such seemingly inappropriate haste when even the Maastricht treaty conditions have not yet been fully implemented?

The literature has been focused mainly on different actors in the process of European economic integration and on their interests. It has been shown<sup>6</sup> that while voters see the EU mainly as an instrument for market integration, the political representatives also pursue political reasons. The European Union's structure provides politicians with numerous opportunities which they may lack at a national level.<sup>7</sup>

The European structures increase the negotiating power of politicians, and may also provide a useful excuse for unpopular policies or an instrument for bypassing national parliaments. We should not forget the vested interests of the European bureaucracy which is an enthusiastic supporter of further centralization. The last point, which might at least partially explain the ostensible discrepancy between rather pessimistic public perceptions and the sanguine

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<sup>6</sup> See Vaubel [1993].

<sup>7</sup> An excellent survey of the public choice literature can be found in Vaubel [1994].



mood of politicians, is the lack of democratic control within the EU, where the central administration is not subject to direct electoral control and the elected European Parliament has only limited power.

Summing up, the public choice literature reminds us that integration is at least partly driven by the rent-seeking bureaucracy and that the central administration tries to seize decision rights which would be better served at a lower level. The centre also seeks to maximize its budget and thus the revenues over which it has command. Therefore, when we are constructing a harmonized system of social security on the European level, we have to keep in mind that it will be implemented in an imperfect way with all the consequences for economic (in)efficiency.

## **B. Positive static models**

The next step towards a more formalized analysis of social security systems is represented by positive models of integration. While the public choice approach takes into account political motivation, this stream of literature is characterized mainly by its focus on the positive aspects of an integration of social security systems. Nevertheless, as the models still attempt to capture some aspects of a decision making process, they do employ characteristics of political power distribution in a country.

The model by Lejour and Verbon<sup>8</sup> describes the effects of an integration of two countries' (A and B) social security systems under the assumption of free labour mobility. In this static model each country is inhabited by two groups of workers ( $i = 1, 2$ ) with low and high-risk of being laid-off. The two groups of workers are further characterized by their influence on the decision-making function and by their mobility. The utility function of both groups is then represented by the expression:

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<sup>8</sup> See Lejour, Verbon [1994].

$$E(U_i^K) = (1 - \lambda_i)U((1 - \tau^K)w^K) + \lambda_i U(\eta^K w^K), \quad i=1,2 \quad K=A,B \quad (1)$$

U represents the utility of the net wage and benefit level,  $\lambda_i$  is the probability of being laid off for the group  $i$ ,  $\tau^K$  is the taxation rate in the country  $K$  and  $\eta^K$  is the benefit rate in the country  $K$ .

The authors show that the outcome of integration depends on assumptions about the relative mobility of the two groups of workers and on their political clout. If it is the high-risk group which is more mobile, then the integration of social security systems undoubtedly leads to a downward pressure on the level of the social security contributions and benefits. If low-risk workers are more mobile, the outcome depends on the political power of both groups. The high-risk group benefits from the inflow of low-risk workers (the composition of workers paying social security contributions improves) while the low-risk workers dislike it (a higher supply of low-risk workers pushes their wages down). If the decision making is dominated by the high-risk group, then the outcome is again a drop in the tax rate. If the low-risk group has a stronger political influence, the integration might result in pressure to increase the tax rate and thus discourage immigration of low-risk workers from the second country.

The model, very simplified for our purposes, illustrates extreme complications facing countries that strive to harmonize their social security systems. The model also elucidates the scope for "tax competition" in the presence of social security systems financed by a PAYG mechanism. It, nevertheless, fails to provide a dynamic framework, which would enable us to take into account the changing age profile of European countries.

### **C. Dynamic models**

The final stream of literature focuses not only on inter-regional but also on inter-temporal

aspects of the integration of social security systems. For this, overlapping-generations models have been employed, as they best capture the intertemporal aspects. Brunner and Wickstrom<sup>9</sup> analyzed an overlapping generations model where a PAYG pension system was the outcome of majority voting. They claim that when pensions are positively related to the payments, it is possible to establish a positive level of the pension system contributions and benefits, even if people vote every period. Homburg and Richter, in a relatively simple framework, show that if the labour force can freely migrate, the coordination of social security systems is not sufficient for achieving an effective allocation of labour<sup>10</sup>. They show that once the population growth rates differ across countries, the PAYG systems become unstable and there is no stationary equilibrium. They also suggest that only a full unification of social security in all member-countries would satisfy the efficiency conditions. The authors employ two crucial simplifications in the paper: first they assume perfect and costless labour mobility, second, they also assume a perfect foresight of the future population changes. However, as we show in this paper, a relaxation of this assumption does not significantly affect the results.

The assumption of perfect labour mobility is challenged by Breyer and Kolmar<sup>11</sup>, who established a model with imperfect labour mobility. They show that if mobility is restricted to the extent that it is not able to offset differences in fertility rates, then the full unification of social security systems might be unnecessary. In our paper we show that the harmonization would be insufficient in all but rather unrealistic cases. Moreover, Breyer and Homburg's results depend crucially on the assumption that people are not able to observe differences in fertility rates **before** they migrate. In this paper we relax this assumption and find unambiguous results which affirm

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<sup>9</sup> See Brunner and Wickstrom [1993].

<sup>10</sup> See Homburg and Richter [1993].

<sup>11</sup> See Breyer, Kolmar [1995].

the impossibility of a harmonization of the public pension schemes.

The main result of the literature which adopts the dynamic approach is the confirmation of the funded pension systems' superiority over the PAYG system, as far as the integration issue is concerned. It has been argued, and we will affirm this, that during the development of the common market, the choice of countries that want to maintain economic efficiency and do not want to limit freedom of movement is rather limited. One choice is the full unification of the social security systems based on the PAYG principle - a fairly unrealistic suggestion, given the current divergence of the social security systems in European countries and the great inertia which these systems create in a society. Another option is to give greater weight to the funded systems within individual countries, for these systems cause no problems in the coordination of the social security systems. We argue that it is indeed this way that the European countries should adopt.

### **III. PUBLIC PENSION SCHEMES WITH PERFECT LABOUR MOBILITY**

In this section we focus on the problems of coordination of public pension schemes in a union of several countries with free and perfect mobility of labour. We discuss the merits of a social security system financed by taxes on a PAYG basis. We use a modification of the model used by Homburg and Richter [1993]. For the sake of simplicity, we ignore the problem of public debts and their coordination - which is, given the current divergent level of public debt in European countries, a strong simplification - and assume that public pension schemes are, in all countries, fully financed by contributions. By doing this, we disregard problems of the harmonization of debt described by Homburg and Richter in their paper, and thus create a more favourable situation for coordination than the one existing in reality. Nevertheless, we claim that even under these conditions, the coordination of public pension schemes with free labour

mobility is all but impossible. The first part of this section briefly re-establishes Homburg and Richter's results. The following three parts apply the result of the model and discuss the consequences of different institutional arrangements of the social security systems during unification. There, on the contrary to Homburg and Richter who suppose a known population growth, we introduce a notion of an uncertain population growth and show that even under this assumption, a mere harmonization of social security payments is not sufficient for achieving the effective allocation of labour.

### A. The model

The analysis in this section uses the following model adopted from Homburg and Richter [1993]. Each country  $i$  is characterized by a competitive economy with a neoclassical production function  $Y$ :

$$Y = F_t^i(N_t^i, K_t^i), \quad (2)$$

where  $Y$  represents output,  $N$  labour input, which equals the number of young households, and  $K$  represents capital input<sup>12</sup>. Production functions for all countries are strictly monotonically increasing and strictly concave and they do not change over time.

We assume only two generations, each living for two periods. When young, in period  $t$ , workers earn wage  $w_t$ , consume  $c_t$ , save  $s_t$  and pay contributions to the social security system  $b_t$ . When old, in period  $t+1$ , generation  $t$  finances consumption  $c_{t+1}$  from savings  $s_t(r_{t+1}+1)$  and from pensions provided by the PAYG system  $p_{t+1}$ . We further assume that households are homogeneous in their preferences: their utility function is strictly increasing and concave in

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<sup>12</sup> We assume no depreciation of capital; the marginal rate of substitution between the current and future consumption is thus exactly equal to the interest rate.

arguments. Households maximize utility  $U$ :

$$\begin{aligned} & \max U(c_t^1, c_{t+1}^2) \\ \text{s.t. } & c_t^1 + s_t = w_t^i - b_t^i, \\ & c_{t+1}^2 = (1 + r_{t+1})s_t + p_{t+1}^i. \end{aligned} \quad (3)$$

The public pension scheme is based on the PAYG principle, thus pensions<sup>13</sup> are financed by the contributions of the next generation. The level of pensions in this model is determined by the rate of population growth  $n_{t+1}^i$ :

$$p_{t+1}^i = \frac{N_{t+1}^i}{N_t^i} b_t^i = (1 + n_{t+1}^i) b_t^i. \quad (4)$$

Substituting (4) to the constraints of maximization (3) gives the condition for total lifetime consumption which depends on the location of a worker:<sup>14</sup>

$$c_t^1 + \frac{c_{t+1}^2}{(1 + r_{t+1})} = w_t^i + \frac{n_{t+1}^i - r_{t+1}}{(1 + r_{t+1})} b_t^i. \quad (5)$$

where  $w^i$  is the wage rate, determined by the marginal productivity of labour and  $r_{t+1}$  is the interest rate, determined by the marginal productivity of capital.

The second term on the right-hand side of equation (5) represents an implicit PAYG transfer. Its level determines whether the PAYG scheme is beneficial for the generation  $t$  or not. If the rate of population growth  $n_{t+1}^i$  is lower than interest rate  $r_{t+1}$ , as nowadays it usually is, then

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<sup>13</sup> The terms "pension system" and "social security system" are used as substitutes in this paper. In other words, we do not assume any other form of social security than pensions paid to the elderly. The model could be easily expanded if we assumed that the share of the "old" generation included not only the elderly, but also unemployed or handicapped people.

<sup>14</sup> Note that private savings do not alter life time consumption, for they only redistribute income over one's lifetime.

the PAYG system would decrease the lifetime consumption of the generation  $t$ .

However, in our model of full labour mobility, workers have an easy option: they can move out of the country, which levies detrimental social security contributions on them. As people leave the country, the consumption prospects of the remaining population  $N_{t+1}^i$  worsen still as the return on the PAYG system becomes even more negative. The opposite is true when  $n_{t+1}^i > r_{t+1}$ , then a country becomes more and more populated. It is obvious that the only steady solution is a kind of golden rule growth, that is when the population growth rate and the interest rate are equal:  $n_{t+1}^i = r_{t+1}$ . We can thus simplify equation (5) as follows:

$$c_t^1 + \frac{c_{t+1}^2}{(1+r_{t+1})} = w_t^i + \frac{n_{t+1}^i - r_{t+1}}{(1+r_{t+1})} b_t^i = w_t^i. \quad (6)$$

When we introduce two jurisdictions  $i$  and  $j$  to the model, the stable inter-regional equilibrium can be achieved if both jurisdictions follow the stable path:

$$w_t^i + \frac{n_{t+1}^i - r_{t+1}}{1+r_{t+1}} b_t^i = w_t^j + \frac{n_{t+1}^j - r_{t+1}}{1+r_{t+1}} b_t^j. \quad (7)$$

The condition of efficient allocation of labour requires the wages in both countries to be equal<sup>15</sup>.

We can write the final condition for an efficient allocation of labour:

$$(n_{t+1}^i - r_{t+1}) b_t^i = (n_{t+1}^j - r_{t+1}) b_t^j. \quad (8)$$

where population growth  $n_{t+1}^i$  is a function of the level of social security premium in the previous period  $b_t^i$ .

While the results stated above are well established, we will extend their implications

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<sup>15</sup> Remember that we assume free movement of labour and capital in this model.

further and discuss three potential institutional arrangements and their impact on the efficiency of the labour force allocation.

### **B. Fixed and constant transfers $b_i$**

The first and least realistic and applicable case is to establish a fixed level of social security payments on the same level for all country-members. In such a case  $b_t^i = b_t^j = b^*$  which in fact means a unified social security system. The condition (8) is then simplified to a simple equality  $n^i = n^j$ . Thus, in the presence of unified social security transfers, the population growth in all member-countries in equilibrium has to be the same. However, keeping in mind our assumption of zero total population growth  $\prod (n^i + 1) = 1$ , we again conclude that then the population growth in all countries would have to be equal to zero. With no population growth, i.e. with  $n_{t+1}^i$  equal zero for all  $t$  and all countries  $i$ , it is sufficient for an effective allocation of labour to harmonize transfers  $b_t^i$ <sup>16</sup>.

### **C. Fixed level of national transfers**

The more realistic case would be to have different levels of social payments in individual countries (and thus a different level of social protection), but fixed in time. Without a loss of generality, we assume  $b_i < b_j$ . From equation (8) follows:

$$n_t^i > n_t^j \text{ for all } t. \quad (9)$$

The condition (9) cannot be satisfied in a closed union with a fixed population. There, country

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<sup>16</sup> This results is similar to one obtained by Breyer and Kolmar [1995]. They showed that differences in the fertility rate can be arbitrated away by migration such that  $n_{t+1}^i$  would be the same for all the countries. The authors use the assumption of consistent beliefs of all individuals about the constant and equal population growth rates. Assuming that the total population growth is zero, they thus only validated the afore-mentioned conclusion that with zero population growth, the harmonization of transfers  $b_t^i$  is sufficient.



$j$  with a higher level of social security payments would either be eventually deserted, or, more plausibly, all her citizens would opt out of her social security system. The only level of  $b_t^i$  which satisfies (8) is thus  $b_t^i=0$ .

The main critique of this argument is the certainty with which it calculates the *future* population growth  $n_{t+1}^i$ . Nevertheless, it can be shown that even if we allow for uncertainty and employ the rational expectations assumption, we obtain the same result. Consider the following situation: social security payments are fixed (or people perceive them as fixed) in individual countries at a different level. Then people will relocate in respective countries with respect to condition (8) and to their expectations of  $N_{t+1}^i$ . If their expectations are perfect, the country with a higher level of  $b^i$  will instantly be punished by a lower population growth and the above reasoning applies. However, if the first-period migration does not satisfy condition (8), then we have two groups of countries. The first group, where the rate of population growth  $n_t^i$  is higher than the interest rate  $r_t$ , is the winner: the social security system increases the lifetime income of workers. The second, where the interest rate is higher than the rate of population growth, is the loser: social security diminishes the lifetime income.

The winning group of countries would, nevertheless, face a daunting task: to keep their population from leaving in the next period which would bring about a necessity of an even more drastic reduction of the social security returns in the next period.<sup>17</sup> To achieve this, they would need to keep their  $b^i$  lower than the second group. The second group of countries at the same time needs to boost its population growth as well; thus, it would need to cut its  $b^i$  level. However, we have precluded all adjustments of social security benefits, therefore, the losing group of countries is doomed to lose all of its population. The winning group will then comprise

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<sup>17</sup> Remember that the social security returns depend on the ratio of the population in the present and in the future. The larger the population now, the larger it must be in the next period in order to avoid a negative return.

of all the union's population and will be unable to keep its rate of population growth above the interest rate either.

When we assume that all the governments are rational and have perfect foresight, we can conclude that the governments would rationally set the level of  $b_t^i=0$  at the outset.

#### D. Variable transfers $b^i$

The most realistic setting allows countries to change their social security premium in each period. We assume the discreet time path: in period  $t$  governments first decide on the level of  $b_t^i$ , then people compare the benefit they can get by migrating. In period  $t+1$  governments first adjust the level of  $b_{t+1}^i$  in order to balance their budgets, and then people again migrate, etc.

Workers will migrate into the country  $i$  in period  $t$  only if they expect higher returns on their pension contributions :

$$N_t^i b_t^i (1+r_{t+1}) \leq N_{t+1}^i p_{t+1}^i \quad (10)$$

where pensions for  $N_t$  pensioners in period  $t+1$  are fully financed from contributions of  $N_{t+1}$  workers:

$$N_t^i p_{t+1}^i = N_{t+1}^i b_{t+1}^i, \quad (11)$$

and therefore we can substitute (11) to (10) and write:

$$b_t^i (1+r_{t+1}) \leq b_{t+1}^i (1+n_{t+1}^i). \quad (12)$$

We can extend the same reasoning for more periods, and for  $T=k$  we get:

$$b_0^i \leq b_k^i \frac{(1+n_1^i)(1+n_2^i)\dots(1+n_k^i)}{(1+r_1)(1+r_2)\dots(1+r_k)} = b_k^i \frac{\prod_{j=1}^k (1+n_j^i)}{\prod_{j=1}^k (1+r_j)} \quad (13)$$

Assuming zero population growth over the long horizon, we can for  $k$  sufficiently large substitute for the product:

$$\prod_{j=1}^k (1+n_j) = 1, \\ \text{thus: } b_0^i \leq b_k^i \frac{1}{\prod_{j=1}^k (1+r_j)} \quad (14)$$

Since we assume a positive interest rate  $r$ , we again get the sole initial level of social security payments that satisfies (14) as  $b_0^i = 0$ .

Summarizing, we have argued that the social security system, described by model (3), (4) and (5), achieves the inter-temporal and inter-regional efficient allocation of labour, only if the social security payments  $b_t^i$  are fixed and constant in all the countries  $i$ , and the population growth is the same in all the countries. As this case is rather unlikely, we have argued that if we either allow countries to differ in their social security payments or to change their level in time, the only solution which satisfies the efficiency conditions is  $b_t^i = 0$ .

#### IV. PUBLIC PENSION SCHEMES - IMPERFECT MOBILITY

In this section we attempt to make the model more realistic and we add an important characteristic of the real world, namely the imperfect mobility of labour. The scope of the labour mobility imperfectness has been subject to much discussion. Nevertheless, it is widely assumed that the inter-European migration has been rather limited, comparing it, for example, with the

mobility of labour in the United States. It is the cultural and, above all, language differences across the European countries that protect Europeans from moving freely across the continent.

The data describing the migration flows within the EU are summarized in Table 1.<sup>18</sup> The shares of the EU's citizens working in another EU country enormously vary among countries. The most eager migrants are the Irish, followed by the Danish and Portuguese. On the other side, Germans and Dutch rarely work abroad. Even this scattered evidence might suggest that social security factors do play a role in deciding whether to work abroad. Germany and the Netherlands have two of the most comprehensive social security systems in Europe, which certainly cannot be said about Portugal or Ireland. Perhaps even more important is the high share of people who consider working abroad. The highest share is again found in Portugal, this time followed by two major European countries: Britain and France. Only Germans appear to be bound to their native country. The most often cited reason for not working abroad are difficulties with commuting or travelling, language and cultural differences. It is assumed that the inter-European migration will play an even more significant role in a future enlargement of the EU eastward as the economic motives of workers from new member states will be much stronger.

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<sup>18</sup> The data describe shares of people employed in the other EU's states. The number of people with citizenship in another EU country is estimated by the Eurostat at more than 5 million.

Table 1: Employment and Migration Within the EU

	Employment abroad	Willing to work abroad	Reasons for not working in other EU state		
			Travelling	Language	Cultural
Belgium	9	34	9	10	4
Denmark	10	52	9	4	1
Germany	2	28	55	71	37
Greece	6	31	11	11	4
Spain	8	48	10	10	1
France	6	50	5	8	2
Ireland	23	41	52	40	26
Italy	5	49	58	46	35
Netherlands	2	45	27	6	2
Portugal	11	56	29	39	32
Britain	6	57	12	13	3
EU Total	5	44	30	32	18

Source: *European Economy No.3*, 1995, European Commission.

Models incorporating the imperfect mobility of labour are probably able to offer a deeper insight into the problem of international migration. The imperfect mobility may be modelled in several ways: as non-negative mobility costs,<sup>19</sup> or, as in our case, by assuming that not the whole population is willing (or able) to move, even if productivity and wages are higher elsewhere. We illustrate how different levels of mobility influence a country's ability to establish and maintain its own independent social security system. We also argue that even the harmonized social security payments  $b^i$  are not sufficient for achieving an effective allocation of labour with

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<sup>19</sup> This approach is discussed in Lejour, Verbon [1994]. The authors use one-period static model with variable productivity of workers.

positive migration flows.

## A. The model

First, we have to change our model (3) to introduce migration flows. For the sake of simplicity (and without loss of generality), we assume that the described area of labour mobility consists only of two countries, say the EU and the CR<sup>20</sup>.

The efficient allocation of labour has to satisfy the condition of maximizing the total production in both countries:

$$\begin{aligned}
 \max \quad & F^{EU}(N_t^{EU}, K_t^{EU}) + F^{CR}(N_t^{CR}, K_t^{CR}) \\
 \text{s.t.} \quad & N^{TOTAL} = N_t^{EU} + N_t^{CR} \\
 & N_t^{EU} \geq (1 - \alpha^{EU}) N_t^{*EU} \\
 & N_t^{CR} \geq (1 - \alpha^{CR}) N_t^{*CR}
 \end{aligned} \tag{15}$$

$N_t^{*EU}$  and  $N_t^{*CR}$  in equation (15) stand for the population of the two "countries" *before* migration takes place. We also introduce different fertility rates  $\beta^{EU}$  and  $\beta^{CR}$ :

$$\begin{aligned}
 N_{t+1}^{*EU} &= N_t^{EU} \beta^{EU}, \\
 N_{t+1}^{*CR} &= N_t^{CR} \beta^{CR}.
 \end{aligned} \tag{16}$$

The setting of the model is thus quite similar to the model discussed in section III.D: each region enters period  $t$  with a population of size  $N_t^i$ . The population size then changes in accordance with the fertility rate  $\beta^i$  to  $N_{t+1}^{*i} = N_t^i \beta^i$ . Only now does the migration take place, and people relocate according to their preferences. In this aspect our model differs from the model of Breyer and Kolmar [1995], who assumed that people do not observe fertility rates before they

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<sup>20</sup> The abbreviation EU could stand for the European Union and CR for example for the Czech Republic.

migrate.

We believe that it is more realistic to assume that people know the fertility rate prior to their decisions and take this difference into their consideration. Our model also allows for a more straightforward interpretation. However, as will be shown later, we are able to prove that the migration would likely bring about a collapse of the PAYG system even if we assume that people take fertility rates as exogenous and do not build them into their considerations.

Let us look first at the level of migration  $\alpha^{CR}$  which is necessary to offset the difference in fertility rates. For that, migration must be able to equalize any differences in population growth caused by the fertility rates. We, therefore, require that the ratio of populations in period  $t+1$  and period  $t$  would be the same in both "countries":

$$\begin{aligned} \frac{N_t^{EU} \beta^{EU} + N_t^{CR} \beta^{CR} \alpha^{CR}}{N_t^{EU}} &= \frac{N_t^{CR} \beta^{CR} (1 - \alpha^{CR})}{N_t^{CR}} \\ \beta^{EU} + \beta^{CR} \alpha^{CR} \frac{N_t^{CR}}{N_t^{EU}} &= \beta^{CR} (1 - \alpha^{CR}) \\ \alpha^{CR} &= \frac{\beta^{CR} - \beta^{EU}}{\beta^{CR} (1 + \frac{N_t^{CR}}{N_t^{EU}})}. \end{aligned} \tag{17}$$

We observe that the level of "necessary" migration crucially depends on the difference in the fertility rates and on the relative size of two countries. If we assume that the fertility rate in an imaginary CR is 1% and in a EU only 0.5% and that the EU is as thirty-five times as populous as the CR, we would need the share of the mobile population in the CR to achieve almost one half (namely 49%) for equalization. As we saw in Table 1, this share broadly reflects the shares of population in the EU countries who have already moved or are willing to move. Should we reverse the flow of migration (from a larger to a smaller country), the share  $\alpha$

decreases substantially. This exercise illustrates the scope of possible migration flows involved in the analysis, but it also shows that the preparedness of the people to seek employment abroad and subsequently undermine the national social security systems must not be underestimated.

## B. The Efficient Allocation and Feasibility of PAYG

The efficient allocation of labour again requires, as in the previous section, the maximization of total output  $F^{EU}+F^{CR}$ , subject to the constraints expressed in the model (15). The Kuhn-Tucker conditions of the problem are:

$$\begin{aligned}
\frac{\partial F^{EU}}{\partial N_t^{EU}} - \lambda + \varphi^{EU} &= 0, \\
\frac{\partial F^{CR}}{\partial N_t^{CR}} - \lambda + \varphi^{CR} &= 0, \\
N_t^{TOTAL} - N_t^{EU} - N_t^{CR} &= 0, \\
\varphi^{EU}(N_t^{EU} - (1 - \alpha^{EU})\beta^{EU}N_{t-1}^{EU}) &\geq 0, \\
\varphi^{CR}(N_t^{CR} - (1 - \alpha^{CR})\beta^{CR}N_{t-1}^{CR}) &\geq 0.
\end{aligned} \tag{18}$$

The third condition (the sum of countries' populations must not exceed the total population) is always binding, but since the migration in both directions (from EU to CR and vice versa) would be inefficient in our model with homogeneous labour, we assume that only one multiplier, say  $\varphi^{CR}$ , is greater than zero. We thus suppose that migration takes place in only one direction: from the CR to the EU. When we assume an efficient labour allocation **within** countries, and thus wages set at the level of the marginal product of labour, we get, as a logical extension, the condition of higher wages in the receiving jurisdiction:  $w^{EU} > w^{CR}$ .

### 1. Fertility rates observed before migration

When we assume that people know the fertility rates  $\beta^i$  **before** they decide on their



allocation during their working lifetime, we compare their life-time incomes in both countries. The incomes consist of wages  $w$  in the first period reduced by the social security contributions  $b$ , plus the discounted value of the social security benefits. The value of benefits depends on the population growth rate in the respective countries  $N_{t+1}/N_t$ . When we enumerate the population in period  $t+1$  as the result of both the fertility  $\beta$  and migration  $\alpha$  factors we get:<sup>21</sup>

$$\begin{aligned} N_{t+1}^{EU} &= \beta^{EU} N_t^{EU} + \alpha^{CR} \beta^{CR} N_t^{CR}, \\ N_{t+1}^{CR} &= \beta^{CR} N_t^{CR} - \alpha^{CR} \beta^{CR} N_t^{CR} \end{aligned} \quad (19)$$

Applying these equations, we get the following condition for the effective allocation of labour:

$$\begin{aligned} w^{EU} - b^{EU} + b^{EU} \left( \frac{N_{t+1}^{EU}}{N_{t+1}^{*EU} R_{t+1}} \right) &= w^{CR} - b^{CR} + b^{CR} \left( \frac{N_{t+1}^{CR}}{N_{t+1}^{*CR} R_{t+1}} \right) \\ w^{EU} - b^{EU} + b^{EU} \left( \frac{\beta^{EU} N_t^{EU} + \alpha^{CR} \beta^{CR} N_t^{CR}}{\beta^{EU} N_t^{EU} R_{t+1}} \right) &= \\ &= w^{CR} - b^{CR} + b^{CR} \left( \frac{\beta^{CR} N_t^{CR} - \alpha^{CR} \beta^{CR} N_t^{CR}}{\beta^{CR} N_t^{CR} R_{t+1}} \right) \end{aligned} \quad (20)$$

Solving (20), we obtain a condition for migration which would equalize the differences in net wages:

$$\alpha^{CR} = R_{t+1} \frac{-(w^{EU} - b^{EU} + \frac{b^{EU}}{R_{t+1}}) + (w^{CR} - b^{CR} + \frac{b^{CR}}{R_{t+1}})}{b^{EU} \frac{N_{t+1}^{*EU}}{N_{t+1}^{*CR}} + b^{CR}} \quad (21)$$

From equation (21) it follows that the migration flows which would offset higher wages

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<sup>21</sup> Note that we assume positive migration flows from the CR to the EU only. The share of mobile population  $\alpha^{CR}$ , therefore, decreases the future population in the CR and increases the EU's population.

in the EU would have to have been negative. In other words,  $\alpha^{CR}$  would have to be negative when  $w^{EU} > w^{CR}$ , even if social security payments  $b^i$  were fully harmonized. However, in the optimization (18) we assumed  $\alpha^{CR} > 0$ . Therefore, we have proven that a perfectly free and costless migration of the labour force would, in the presence of a PAYG system, inevitably lead to a destabilization even if the payments were harmonized across the countries. Workers would be moving in the direction of higher wages (in our case from the CR to the EU) and the social security system in the CR would collapse.

The same conclusion follows from examining the two following equations, which state the necessary conditions for two PAYG systems to be simultaneously attractive for respective populations in the EU and CR. First we express the feasibility condition for the PAYG in the EU:

$$\frac{b^{EU}}{R_{t+1}} + \frac{b^{EU}\alpha^{CR}}{R_{t+1}} \frac{\beta^{CR}N_t^{CR}}{\beta^{EU}N_t^{EU}} \geq b^{EU}$$

$$1 + \alpha^{CR} \frac{\beta^{CR}N_t^{CR}}{\beta^{EU}N_t^{EU}} \geq R_{t+1}$$
(22)

Similarly, the feasibility condition for the PAYG in the CR is as follows:

$$\frac{b^{CR}}{R_{t+1}} - \frac{b^{CR}\alpha^{CR}}{R_{t+1}} \geq b^{CR}$$

$$1 - \alpha^{CR} \geq R_{t+1}$$
(23)

These two conditions together yield the following two conditions for  $\alpha^{CR}$ :

$$\alpha^{CR} \geq \frac{r_{t+1}}{const} \quad \wedge \quad \alpha^{CR} < -r_{t+1}$$

$$\text{where } const = \frac{\beta^{EU}N_t^{EU}}{\beta^{CR}N_t^{CR}} \geq 0.$$
(24)

As it is clearly seen from the last equation (24),  $\alpha^{\text{CR}}$  cannot satisfy both the PAYG conditions in the EU and CR. Therefore, we have proven that the harmonization (setting the same level of social security payments  $b^i$  in both countries) of two PAYG systems in a model with observable fertility rates is not a sufficient condition for the effective allocation of labour. The only level of the social security payments which does not cause an ineffective allocation of labour is thus zero,  $b^{\text{CR}}=b^{\text{EU}}=0$ . We have shown that this conclusion is not affected even by a relaxation of the assumption of perfect foresight. It means, in other words, that the PAYG systems of social security are inherently incapable of harmonization in an environment of high labour mobility. The model suggests that the respective PAYG systems should be abolished before the labour mobility is liberalized (or before it becomes widespread) and replaced by funded systems.

## 2. *Fertility rates observed after migration*

In this section we only briefly explain how our model changes when we introduce the notion that people are unaware of different fertility rates before they migrate. By this we probably underestimate the ability of people to rationally take into account all the knowledge available to them. Nevertheless, we claim that the harmonization of different PAYG systems is extremely difficult even under this assumption.

The assumption that people do not know fertility rates  $\beta^i$  before they decide on their allocation during their working lifetime changes condition (20) for the effective allocation of labour as follows:

$$\begin{aligned}
w^{EU} - b^{EU} + b^{EU} \left( \frac{N_t^{EU}}{N_t^{EU} R_{t+1}} \right) &= w^{CR} - b^{CR} + b^{CR} \left( \frac{N_t^{CR}}{N_t^{CR} R_{t+1}} \right) \\
w^{EU} - b^{EU} + b^{EU} \left( \frac{\beta^{EU} N_t^{EU} + \alpha^{CR} \beta^{CR} N_t^{CR}}{N_t^{EU} R_{t+1}} \right) &= \\
= w^{CR} - b^{CR} + b^{CR} \left( \frac{\beta^{CR} N_t^{CR} - \alpha^{CR} \beta^{CR} N_t^{CR}}{N_t^{CR} R_{t+1}} \right) &
\end{aligned} \tag{25}$$

While the solution of this equation is rather complicated, we focus on an equivalent condition of the PAYG sustainability in both countries:

$$\begin{aligned}
\frac{b^{EU} \beta^{EU}}{R_{t+1}} + \frac{\beta^{CR} b^{EU} \alpha^{CR} N_t^{EU}}{R_{t+1} N_t^{CR}} &\geq b^{EU} \\
\beta^{EU} + \beta^{CR} \alpha^{CR} \frac{N_t^{CR}}{N_t^{EU}} &\geq R_{t+1}, \\
\frac{b^{CR} \beta^{CR}}{R_{t+1}} - \frac{\beta^{CR} b^{CR} \alpha^{CR}}{R_{t+1}} &\geq b^{CR} \\
\beta^{CR} (1 - \alpha^{CR}) &\geq R_{t+1}
\end{aligned} \tag{26}$$

Finally, we derive the condition for the migration flows:

$$\alpha^{CR} \geq \frac{R_{t+1} - \beta^{EU}}{\beta^{CR} \frac{N_t^{CR}}{N_t^{EU}}}, \quad \alpha^{CR} \leq \frac{\beta^{CR} - R_{t+1}}{\beta^{CR}} \tag{27}$$

We now have to determine under which assumptions equation (27) can be satisfied. First, assume, as is most likely, that the fertility rates in both countries are lower than the interest rate, namely:  $R_{t+1} > \beta^i > 0$ ,  $i = EU, CR$ . Then it follows that there is no  $\alpha^{CR}$  which would satisfy both conditions in (27). The condition for the EU requires  $\alpha^{CR}$  to be positive, while  $\alpha^{CR}$ , satisfying

the condition for the CR, must be negative.

If either one of the fertility rates, or both of them, is higher than the interest rate, then it is theoretically possible to establish the level of migration  $\alpha^{CR}$  which would satisfy both conditions in equation (27). Nevertheless, as far as our subject is the European Union and the Czech Republic (or any other small European country), that experience at best a low population growth, we can conclude that even under the condition of rather ignorant workers, we have found no other way how different PAYG systems could be harmonized among countries experiencing zero or very low population growth.

### C. The labour mobility and limits of the state's ability to choose social security

In this section we show the impact of the labour force mobility on the ability of a state to choose and maintain its independent social security system. We argue that the higher the share of the mobile population and the more equal the size of the two countries, the less discretion the government has.

Consider model (20) where we can determine the relative level of social security payments  $b^{CR}/b^{EU}$ . Assume first that both countries allocate their respective labour force efficiently, i.e. wages in both countries are equal to the marginal product of labour, which given the free mobility of capital would bring wages in both countries to the same level. Then equation (20) can be rewritten as follows:

$$\frac{b^{CR}}{b^{EU}} = \frac{\frac{\beta^{EU}N_t^{EU} + \beta^{CR}\alpha^{CR}N_t^{CR} - \beta^{EU}N_t^{EU}R_{t+1}}{\beta^{EU}N_t^{EU}R_{t+1}}}{\frac{\beta^{CR}N_t^{CR} - \beta^{CR}\alpha^{CR}N_t^{CR} - \beta^{CR}N_t^{CR}R_{t+1}}{\beta^{CR}N_t^{CR}R_{t+1}}} \quad (28)$$

This seemingly complicated expression can be simplified to the following condition:

$$\frac{b^{CR}}{b^{EU}} = \frac{1 - R_{t+1} + \alpha^{CR} \frac{\beta^{CR} N_t^{CR}}{\beta^{EU} N_t^{EU}}}{1 - R_{t+1} - \alpha^{CR}} \quad (29)$$

Figure 1 best describes what this condition means for a country trying to establish its own social security system while allowing its labour force to freely migrate. The relative size of the two countries<sup>22</sup> is placed on the horizontal axis, and on the vertical the relative social security payments in the two countries. The function describes all combinations of the relative social security payments of the CR and its relative size which are consistent with an effective inter-regional allocation of labour. We immediately see that the social security payments  $b^{CR}$  would have to be negative in order to achieve an efficient allocation of labour in a substantial section of the graph. As we suppose only positive payments  $b^i > 0$ , we confirm our argument made in the previous section that the coordination of the social policy is impossible even when social security payments are harmonized in all member countries.

We can, furthermore, observe a simple relationship between the share of the mobile population  $\alpha$  and the ability of the CR's government to choose the level of social security payments  $b^{CR}$ . First, consider an extreme case. When labour mobility is impossible or forbidden ( $\alpha^{CR}$  equal or close to zero), then the ratio of social security payments  $b^{CR}/b^{EU}$  can be set rather freely: the expression determining the level  $b^{CR}=0$  approaches infinity ( $r/\alpha \rightarrow \infty$ ) and the level  $b^{CR}/b^{EU}$  is initially equal to one.<sup>23</sup> However, as the level of labour mobility  $\alpha^{CR}$  increases, the

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<sup>22</sup> Since we now develop our former model with observed fertility rates, we get the relative size of the two countries after a change in population. If we followed the latter model, with the non-observable fertility rate, we would get the ratio of populations before a population change.

<sup>23</sup> For  $\alpha^{CR}=0$ , the following holds:

$$\frac{r_{t+1}}{r + \alpha^{CR}} = 1$$

scope for setting the level of social security payments independently is getting narrower. Finally, in the extreme case when labour mobility is perfect ( $\alpha^{CR}=1$ ), the country has very limited room for setting the level of its social security payments.

Generally speaking, we observe that labour mobility tends to limit the government's freedom to alternate the level of social security payments in a country. The model predicts that the relative size of the two countries is of importance as well. The smaller the CR relative to the EU, the easier it is for a country to maintain some form of social security "uniqueness" without causing an inefficient allocation of labour. In our model it is caused by the inability of a small country to impose an efficient allocation of labour in both countries. Even if differences in labour productivity are great, relatively small migration flows from the CR would not significantly affect conditions on the EU's labour market. Two curves on Figure 1 illustrate our point; note that  $\alpha'$  is greater than  $\alpha$ .

## V. CONCLUSION

In this paper we have analyzed the effects of the unification of public pension systems financed on the PAYG basis. We have focused on a potentially inefficient allocation of labour, which may be caused by allowing households to choose repeatedly between public pension systems. We have examined two cases: perfect and imperfect labour mobility.

First, we have argued that under perfect labour mobility, it is possible to achieve both the inter-temporal and inter-regional efficient allocation of labour only if the level of social security payments is identical and fixed in time in all countries and if the population growth is the same in all of the countries. As this case is rather unrealistic, we have argued that if we either allow countries to differ in their level of social security payments or, if we allow them to change

this level in time, the only level of social security payments which satisfies the efficiency conditions is zero.

Second, we have proven that if we assume that fertility rates are observable before households decide upon their relocation, then harmonization (setting the same level of social security payments  $b^i$  in both countries) of two PAYG systems is not a sufficient condition for the effective allocation of labour even in the case of imperfect labour mobility. It has been shown that the only level of social security payments which do not cause an ineffective allocation of labour in this setting is zero. Further, even if we relaxed our assumption of observable fertility rates, we have shown extreme complications with the harmonization of different PAYG systems. We have seen that if the countries in question experience very low population growths, it is impossible to merge their pensions systems without detrimental effects on the efficiency of labour.

Third, we have argued that labour mobility tends to limit the government's freedom to maintain an independent social security system without causing an inefficient allocation of labour.

Obviously, the model could be generalized in several ways. We could, for instance, introduce  $T$  types of households with different productivity levels and different wages in equilibrium instead of a homogeneous labour force. We would then get, instead of only one condition for inter-regional efficiency (4),  $T$  conditions. Nevertheless, social security transfers would induce the same inefficiency across individual groups as they did in the case of an homogeneous labour force. We could elaborate the role of government, which in our model plays only a redistributive role by transferring funds from the young generation to the old. Nevertheless, we believe that these adaptations would not significantly alter our results.

The main result of our analysis can be summarized as follows: the higher the level of



divergence of social protection in countries embarking on unification, the greater the possibility that the mere coordination of social policies will not secure an efficient allocation of labour. It has been shown that PAYG pension systems could avert labour from an efficient allocation.

A recommendation would be two-fold. First, these problems can be solved by creating one unified social security system over all member-countries. However, as the current level of social protection differs extensively in European countries and unification would be extremely costly, this alternative is not very plausible.

Another option is to give greater weight to the funded systems within individual countries, for these systems cause no problems for coordinating the social security systems. This solution has several virtues besides its ease of harmonization. It is probably the best response to the fiscal problems of all European social security systems which are under great strain due to the persistent ageing of the European population. It also promises to improve the prospect of future growth rates, as it serves as an incentive for higher savings. It would be a great success and a small irony if the looming problems with harmonization were to bring about the much needed complete overhaul of the European social security systems.

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