



CEBR/CESIFO CONFERENCE ON PENSION REFORM

Copenhagen, 11 – 12 June 2005

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Human Capital Investment
and Mobility of Labor**

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Social Security Incentives, Human Capital Investment and Mobility of Labor

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May 2005

Abstract

Migration between countries with earnings-related and flat-rate pay-as-you-go social security systems may pose a problem for either. The possibility of emigration boosts investments in human capital in the country with flat-rate benefits. Correspondingly, those expecting to migrate from the country with earnings-related benefits to a country with flat-rate benefits may reduce their investment in education. When contribution rates are kept fixed, allowing for migration may generate a Pareto-improvement for all current and future generations. This may be accomplished when in the first period with the common labor market, migrants pay their social security contributions to their country of origin.

Keywords: social security, education, migration, earnings-related and flat-rate pensions

JEL Codes: H55, I2, F22

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1. Introduction

Old-age pensions are the single largest government transfer program in the European Union. In 2001, the 15 EU member states spent on average 8.8 percent of their GDP on public old-age pensions (OECD, 2003). Pension policies have traditionally been viewed as a domain of nation-states and, correspondingly, there are wide differences in how benefits are determined. The main division is not only economic but also philosophical. In Continental Europe, like France, Germany, and Italy, pensions are viewed as postponed wage income and their aim is to smooth lifetime consumption. Correspondingly, old-age benefits are linked to past earnings. Often these benefits are called Bismarckian, as they were initially introduced in Germany by Chancellor Bismarck. In the competing tradition, old-age benefits are used to protect the elderly against poverty. Benefits are then rather flat, with the link to past earnings weak or even non-existent. These flat-rate systems are sometimes called Beveridgean, after Lord Beveridge whose report was seminal in establishing the system in the United Kingdom.

European pension systems are mainly organized according to pay-as-you-go (PAYG) principle, implying that the benefits of the current retirees are paid by current workers.¹ Migration then poses pension systems two challenges. First of all, flat-rate social security systems redistribute income intragenerationally. With migration, this generates an adverse selection problem. Beneficiaries from redistribution seek out higher benefits, and net contributors prefer modest or no redistribution. Earnings-related systems, on the other hand, may benefit from the inflow of high-income contributors. The second issue arises from intergenerational redistribution. The average rate of return offered by the PAYG system equals only the growth rate of the economy, which always falls short of the market interest rate. (Aaron 1966) The lower rate of return that the PAYG systems offer can be interpreted as an interest payment on the implicit debt, which was created when older cohorts were paid pensions, even when they had not previously contributed to the system. The intergenerational redistribution component of PAYG social security systems poses the most serious challenge to the countries with earnings-related public pension programs as these have generally considerably higher contribution rates. In 2001, public spending on old-age benefits was in average 6,4 percent of GDP in OECD countries with flat-rate benefits, and 9,4 percent in countries with earnings-related benefits (Disney, 2004; OECD, 2003).

Social security rules and migration possibilities also influence incentives to invest in human capital. An option to migrate to a country with less redistributive social security system increases the expected private return to human capital, thus boosting such investments. When the young people do not know beforehand how mobile they are going to be, also the investments of those who finally remain change. Such uncertainty about one's own future mobility may result from uncertainties related to family formation, future partnership status, and on random events related to employment.

This paper takes a dynamic view of economic integration and the challenges it poses to social security systems of different types. There are two countries, one with earnings-related benefits, and another with flat-rate benefits. The two countries may differ also in social security contribution rates, and both have organized their social security system on a PAYG-basis. At the starting point, there is no migration, corresponding to early days of the European integration with low degree of labor mobility. Then labor becomes mobile, corresponding to tighter integration. The first question is how this affects incentives to invest in human capital and economic well-being in the two countries. The second question

¹Some countries, like the Netherlands, also have a prominent funded part of social security. This paper focuses on PAYG systems.

is whether both social security systems can be maintained after the labor markets have been integrated.

The main findings are the following. Assume first that neither country has a social security system that would be preferred by all citizens, and that migration does not change individual productivity. Then allowing for migration would increase the investment in human capital at the upper echelon of productivity distribution in the country with flat-rate benefits, and decrease investment in human capital at the lower levels of productivity in the country with earnings-related benefits. Thus, allowing migration would increase pre-migration human capital in the country with flat-rate benefits, and reduce investment in human capital in the country with earnings-related benefits. The effects on post-migration human capital then depend on productivity distribution.

Assume next that the two countries have the same social security contribution rate, and that all citizens have the same innate ability. Then allowing for migration poses a challenge only to the country with flat-rate benefits. This country would lose workers immediately after allowing for migration, at the same time as it would still face obligations towards its elderly beneficiaries. The most striking finding is that this need not pose a problem in the dynamic context, provided that the countries cooperate in the first period of free mobility. In the steady-state, gains from migration tend to accrue to the current and future young cohorts in the country with flat-rate benefits, leaving the current and future young in the country with earnings-related benefits equally well off as without migration. The problem of financing the promised flat-rate benefits in the period during which borders are opened can be secured by transferring social security contributions that migrants make during this first period to their initial home country. In subsequent periods, such a transfer institution is not warranted to generate an intergenerational Pareto improvement.

This paper is organized as follows. Section 2 reviews literature. Section 3 develops the model. Section 4 presents the results concerning investment in human capital and migration. Section 5 analyzes welfare effects. Section 6 concludes.

2. Literature Review

European social insurance and public pension systems create considerable incentives to migrate. Wildasin (1999) uses data on public pension contributions and benefits to estimate the change in the present value of lifetime wealth for “representative workers” in seven EU countries, finding that migrants may experience changes in public pension wealth, up to 25 percent of lifetime wealth. Homburg and Richter (1993) and Breyer and Kolmar (2002) analyze the efficiency of national pension systems when labor is mobile, assuming that social security contributions are lump-sum and proceeds are divided to pensioners as uniform benefits. Kolmar (2001) presents a model of optimal intergenerational redistribution with two countries and endogenous fertility, allowing pension benefits to depend on the number of children. None of these contributions analyzes migration between countries with earnings-related and flat-rate benefits. The effects of migration on competition between Bismarckian and Beveridgean social insurance systems has been analyzed by Cremer and Pestieau (2003). They focus on intergenerational redistribution, instead of pensions. All of these earlier contributions take productivity as given, while this paper endogenizes it.

Most closely related to this paper, Kolmar (forthcoming) analyzes migration between two countries, one with flat-rate and another with an earnings-related system. In his contribution, each country contains high-skilled and low-skilled individuals. The size of these two groups and their wages grow at exogenous country-specific rates. In this paper, the population size and productivity do not grow over time. Instead of focusing on differences arising from technological differences, this paper assumes that the two countries are identical

in their production technology and pre-migration population, and instead endogenizes the productivity in each country. With endogenous skill formation, total production capacity in the two countries generally differs, even if they would have the same underlying technology and skill distribution.

The effects of social security incentives on human capital investment have received surprisingly little attention. Lau and Poutvaara (2001) present a theoretical model of the effects of social security incentives on human capital investment, in the absence of migration and with a zero interest rate. Jensen et al. (2004) present a computational general equilibrium model of human capital formation, labor supply and retirement, under alternative social security rules. They find that social security rules have a considerable impact on retirement behavior and welfare. Even low-productivity workers would prefer earnings-related benefits, if productivity differences are sufficiently low. Neither Lau and Poutvaara (2001) nor Jensen et al. (2004) include mobility or uncertainty.

There is an extensive literature on the effects of the mobility of labor on investment in education. Grubel and Scott (1966) and Bhagwati and Hamada (1974) highlight the losses that emigration imposes on source countries. Contrary to their results, Stark et al. (1997) show that some migration from developing countries to developed countries may actually benefit the country of origin. A possibility to migrate to a richer country increases the expected return to human capital investment in a poor country, thus encouraging private investment. Even with part of high-skilled workers migrating, this initial brain gain may dominate, so that the less developed country can end up with a higher average level of human capital per worker with migration than without it. Stark et al. (1997) study the use of migration quotas by less developed countries. This paper assumes that there are no legal restrictions to migration, consistent with the EU principles of free mobility.

Justman and Thisse (1997) show that a government that maximizes the utility of immobile residents reduces investment in public education when the educated become mobile. Wildasin (2000) compares publicly and privately financed education and taxes collected to finance public education, if any. Poutvaara (2004a, 2004b) shows that governments tend to reduce their investment in internationally applicable education as a response to migration. None of these papers include social security.

Previous literature on fiscal federalism has usually assumed that different governments act strategically with respect to each other, and engage in non-cooperative behavior. In economics terms, this amounts to finding Cournot-Nash equilibrium if the countries set their policies simultaneously, or assuming one government to be a Stackelberg leader and another follower. This literature has provided important new insights, but assuming non-cooperative behavior between different governments may fail to capture empirically relevant patterns of cooperation. For example, the member states of the European Union negotiate simultaneously on several issues, thus reducing the incentives of individual governments to behave non-cooperatively in any single issue. This suggests that the scope for maintaining different systems of social insurance may be wider than previous literature has assumed, as governments do not necessarily engage in active steps that would undermine the systems of social protection in other countries. However, even such a cooperative approach on the part of governments could fail to secure the financial sustainability of different systems. The focus of this paper is on whether different pension systems could be maintained with mobile labor, provided that governments do not take active steps to compete for taxpayers by cutting benefits or social security contribution rates.

3. The Model

Two countries, labelled A and B, form a common labor market at the beginning of period 1. Both countries are populated by overlapping generations of citizens who become educated and work. Each citizen lives for two periods, becoming educated, possibly migrating and working in the first period and being retired and collecting social security benefits in the second period. Citizens become educated in their country of birth at the beginning of the first period of their life. They learn whether they are mobile or not after completing education. That the actual realization of mobility is disclosed only after completing education may reflect, for example, realized language and cultural skills, social networks, and family formation. The probability of being mobile is p , and those mobile can migrate costlessly. Any shocks to the value of p are revealed at the beginning of the period, before investments in education are made. The main shock analyzed is the formation of a common labor market, before which the probability p is zero. After the common labor market is formed, it has a positive value.

The two countries differ in their social security system. In country A, social security system is earnings-related. Workers pay in every period t social security contributions at rate τ_A , and receive in the following period as social security benefits a fraction x_{t+1} of their previous earnings. This fraction is determined endogenously to balance the government budget. In country B, the social security contribution rate is τ_B and social security benefits to the elderly are flat-rate, and of size b_t in period t . All workers receive pension benefits from the country where they worked. This implies that the results would hold whether the retired stay in the country where they worked, or return to their home country. In both countries, social security system is organized on a PAYG basis.

Citizens may differ in their productivity. Human capital is a joint product of innate ability and studying. For a citizen with ability a and individual effort e_t in period t , the individual human capital stock is

$$h(a, e_t) = a + e_t. \quad (1)$$

The monetarized cost of effort e_t is e_t^2 . This formulation of an increasing marginal cost guarantees a bounded investment in e . Ability a follows the same distribution in both member states. The innate ability is distributed between zero and \bar{a} , with density function $f(a)$. The utility of the educated is in both periods linear in their consumption, net of the monetarized effort cost of investment in education. The individuals have access to perfect capital markets at the internationally determined interest rate r , corresponding also to individual discount rate. The pre-migration young population to become educated is of the same size in A and B, and normalized to one.

Both countries are small open economies, facing a time-invariant world interest rate r . Production in period t in country i depends on the effective supply of labor services, denoted by $L_{i,t}$, and of physical capital $K_{i,t}$. Note that as capital is perfectly mobile, the stock of physical capital does not depend on domestic saving. Total production in the economy is given by Cobb-Douglas production function $Y_{i,t} = AL_{i,t}^\alpha K_{i,t}^{1-\alpha}$. Without loss of generality, capital does not depreciate. All markets are competitive, and therefore profit maximization implies that

$$w_{i,t} = \alpha AL_{i,t}^{\alpha-1} K_{i,t}^{1-\alpha}, r = (1 - \alpha) AL_{i,t}^\alpha K_{i,t}^{-\alpha}.$$

The expression for r follows from international mobility of capital. Solving for $K_{i,t}$ and inserting it into the expression for $w_{i,t}$ yields

$$w_{i,t} = \alpha \left(\frac{1 - \alpha}{r} \right)^{\frac{1-\alpha}{\alpha}} A^{\frac{1}{\alpha}}.$$

Even though the production technology combines the effective labor supply and physical capital, the wage rate for a unit of effective labor does not depend on the total labor supply. This is due to the international mobility of physical capital. This time-invariant wage rate is from now on normalized to unity.

Importantly, pre-migration cohort sizes remain the same in each country even with migration. One interpretation for this is that migration is concentrated among those citizens without children. If this is the case, then those who become mobile would be a subset of citizens without children. Populations of both countries could still remain constant. Alternatively, we could think that migration is only temporary, and that citizens then receive pension benefits from both countries in relation to how long they have worked in each country. In that case, they would return to their home country before their children enter school. Either interpretation would result in qualitatively similar results. The remainder of the paper is written under the implicit assumption that migrants are a subset of those citizens without children, but all the results would hold also if migration would be temporary and citizens would then receive pension benefits from both countries in relation to how long they have spent in each country.

4. Social Security and Investment in Education

4.1 No migration

In country A, citizen with ability a chooses private investment in effort to maximize his or her lifetime disposable income, solving

$$\max_{e_t} \left(-e_t^2 + (1 - \tau_A)(a + e_t) + \frac{x_{t+1}^e(a + e_t)}{1 + r} \right).$$

Here x_{t+1}^e denotes the expected replacement rate in the following period. This results in private investment in effort

$$e_t = \frac{1 - \tau_A}{2} + \frac{x_{t+1}^e}{2(1 + r)}.$$

In a steady-state equilibrium, $x_{t+1}^e = x_t$ and also e_t is constant and independent of ability. In period t , the budget balance of the social security system then reads as

$$\tau_A \int_0^{\bar{a}} (a + e_t) f(a) da = x_t \int_0^{\bar{a}} (a + e_{t-1}) f(a) da.$$

The left-hand side reports social security contributions and the right-hand side benefits, as a function of past earnings. Given that $e_t = e_{t-1}$ with constant τ_A and $x_{t+1}^e = x_t$, the social security budget is balanced only when $x_t = \tau_A$. The equilibrium private investment in education is then

$$e_t = \frac{1}{2} - \frac{r\tau_A}{2(1 + r)}.$$

Correspondingly, private investment in education in country B solves

$$\max_{e_t} \left(-e_t^2 + (1 - \tau_B)(a + e_t) + \frac{b_{t+1}^e}{1 + r} \right),$$

resulting in private investment in effort $e_t = (1 - \tau_B)/2$. Note that as country B has lump-sum benefits, only the social security contribution rate but not the lump-sum benefit

affects investment in education. The government budget constraint yields in the steady-state without migration

$$b_t = \tau_B \int_0^{\bar{a}} \left(a + \frac{1 - \tau_B}{2} \right) f(a) da.$$

4.2 Common labor market

Mobile citizens choose the member state to maximize the net present value of their remaining lifetime disposable income. Given perfect capital markets, this also maximizes their utility. Therefore, a mobile citizen migrates from member state A to B if and only if

$$(1 - \tau_B)(a + e_t) + \frac{b_{t+1}^e}{1 + r} > (1 - \tau_A + \frac{x_{t+1}^e}{1 + r})(a + e_t). \quad (2)$$

Correspondingly, a mobile citizen migrates from member state B to A if and only if

$$(1 - \tau_A + \frac{x_{t+1}^e}{1 + r})(a + e_t) > (1 - \tau_B)(a + e_t) + \frac{b_{t+1}^e}{1 + r}. \quad (3)$$

When deciding on their investment in education, citizens form expectations on whether they would like to migrate, in case they become mobile. For example, a citizen with low ability may always prefer a member state with lump-sum benefits. For those planning always to stay in their home country, investment in education is as when migration is not possible. It remains to characterize investments in case a citizen plans to migrate, if feasible. The maximization problem of a citizen who would like to migrate from country A to country B reads as

$$\max_{e_t} \left(-e_t^2 + (1 - p)(1 - \tau_A + \frac{x_{t+1}^e}{1 + r})(a + e_t) + p(1 - \tau_B)(a + e_t) + \frac{pb_{t+1}^e}{1 + r} \right),$$

resulting in an optimal investment

$$e_t^A = \frac{(1 - p)(1 - \tau_A + \frac{x_{t+1}^e}{1 + r}) + p(1 - \tau_B)}{2}. \quad (4)$$

A potential migrant from country B to country A optimizes

$$\max_{e_t} \left(-e_t^2 + p(1 - \tau_A + \frac{x_{t+1}^e}{1 + r})(a + e_t) + (1 - p)(1 - \tau_B)(a + e_t) + \frac{pb_{t+1}^e}{1 + r} \right),$$

with solution

$$e_t^B = \frac{p(1 - \tau_A + \frac{x_{t+1}^e}{1 + r}) + (1 - p)(1 - \tau_B)}{2}. \quad (5)$$

(2), (3), (4) and (5) yield

Proposition 1 *With $x_{t+1}^e = \tau_A$, there is migration from country A to country B if and only if*

$$b_{t+1}^e > [(1 + r)\tau_B - r\tau_A] e_t^A$$

and from country B to country A if and only if

$$b_{t+1}^e < [(1 + r)\tau_B - r\tau_A] (\bar{a} + e_t^B).$$

The first (second) condition in Proposition 1 states that a citizen with the lowest (highest) ability has a higher lifetime income in the country with flat-rate (earnings-related) benefits. Proposition 1 implies that a necessary, though not sufficient, condition for having steady-state migration from country B to A is

$$\frac{r\tau_A}{1+r} < \tau_B. \quad (6)$$

This corresponds to a requirement that the effective tax burden caused by social security contribution rate has to be higher in the country with flat-rate benefits. Notice that this may be the case even when the contribution rate is lower with flat-rate system. If (6) is violated, then everyone would prefer to migrate from country A to B. We can also show that

Proposition 2 *An increase in p decreases investment in education in country A and increases it in country B, provided that there is initially migration.*

Proof. Notice first that as the change in p is a shock revealed at the beginning of a period, the probability of being mobile is the same for current and all future generations. This implies that the value of the old-age benefits in a flat-rate system and replacement rate in an earnings-related system that the current young generation expects to face are the same as that which will be faced by subsequent generations. Denote the period of the shock by t . Then, $x_{t+1}^e = x_{t+1+i}^e$ and $b_{t+1}^e = b_{t+1+i}^e \forall i \in \mathbb{N}$. In the country with flat-rate benefits, it also holds that $b_t = b_{t+1}^e$ as investment in education and migration decisions reach their steady-state values immediately. In the country with earnings-related benefits, it need not be that x_t would equal x_{t+1}^e . The reason for this asymmetry is that x_t depends on investments in education made in the previous period. By (4), $\partial e_t^A / \partial p < 0$ and by (5), $\partial e_t^B / \partial p > 0$, for those willing to migrate. Notice that those above a determined by (2) in country A and those with a below the threshold given by (3) in country B do not migrate, and thus do not change their investment in education. The thresholds, however, change. ■

It is not surprising that allowing for migration may pose severe problems for flat-rate systems. More interestingly, we find that migration may challenge a large earnings-related system more severely than a flat-rate system, provided that the latter is sufficiently small. If (6) is not satisfied, then all citizens would prefer living in country B.

5. Welfare Effects of Migration

5.1 Effects on steady-state generations

We can separate between two qualitatively different migration patterns. With population exchange, a fraction of citizens from either country would prefer to migrate to the other country. With unilateral migration, only citizens from one country want to emigrate.

Population exchange requires that the high-ability citizens want to migrate from country B to country A, and low-ability citizens want to migrate from A to B. A necessary condition for population exchange is that (6) holds. This implies that citizens invest more in their education the higher the probability that they would reside in country A. As a result, allowing for migration resulting in population exchange discourages investment in education among low-ability people in country A, and encourages it in country B among high-ability people. The welfare effects on steady-state cohorts are given by

Proposition 3 *Migration resulting in population exchange increases the welfare of high-ability types in country B and low-ability types in country A. The utility of low-ability types in country B may change in either way.*

Proof. In the Appendix. ■

A priori, one could expect that population exchange would always hurt low-ability types of the country with flat-rate benefits. After all, population exchange means an outflow of net contributors, and an inflow of those expected to benefit from income redistribution. The most surprising finding of proposition 3 is that the effects of migration on the welfare of low-ability types in country B may go in either way. They face two conflicting effects. The above mentioned effect, an outflow of net contributors and an inflow of other low-ability types, could be labelled a *redistribution effect*. It reduces the welfare of low-ability types in country B. However, there is also a *human capital effect*. The possibility of migration to a country with earnings-related benefits encourages investment in education by high-ability types. At the same time, the immigrating low-ability types have invested more in human capital as they have taken into account also the possibility that they would not have become mobile. This human capital effect may, under some parameter combinations, overweight redistribution effect.

With unilateral migration, we find that

Proposition 4 *If all citizens want to migrate from B to A, then allowing for migration improves the steady-state welfare of the initial citizens in B and leaves the steady-state welfare of the initial citizens in A unchanged.*

Proof. If also the lowest-ability citizens want to migrate from B to A, then it has to be that the redistributive gain that they receive from flat-rate system is insufficient to compensate for the efficiency loss, caused by such a system. Steady-state welfare of citizens in A is unchanged. ■

5.2 Effects on transition generations

The previous section showed that allowing for migration may improve the welfare of steady-state generations in both countries, even when the two countries have identical production technologies. However, an intergenerational Pareto-improvement would require that also the welfare of the transition generation is improved in both countries, or at least left unchanged. This section analyzes whether this can be the case. For simplicity, we assume that the two countries have identical social security contribution rates so that $\tau_A = \tau_B = \tau$. Also, we assume that the citizens are of identical abilities, a being normalized to zero. In the absence of migration, flat-rate benefits are then

$$b = \frac{\tau(1 - \tau)}{2}. \quad (7)$$

After the common labor market is formed:

Proposition 5 *With homogeneous populations and $\tau_A = \tau_B$, all citizens of country B would prefer to migrate to country A.*

Proof. (6) rules out migration from A to B. By Proposition 1, there is migration from B to A. This translates to the whole population's willingness to migrate, given that all citizens are ex ante identical. ■

By Proposition 4, allowing for migration improves the welfare of steady-state generations in country B, and leaves their utility unchanged in A. Having an intertemporal welfare improvement would then require that during the transition period, country B is able to

collect the same social security tax revenue as it would have without migration, given by (7). By (5), social security tax revenue is in country B

$$TR_B = \tau(1-p) \frac{p(1 - \frac{r\tau}{1+r}) + (1-p)(1-\tau)}{2}. \quad (8)$$

Allowing for migration has two opposite effects on the social security tax revenue in the member state B. First, the possibility of migration increases investment in education, thus increasing the pre-migration stock of human capital. Second, part of this stock is lost through realized migration. Net effect is then given by

$$\frac{\partial}{\partial p} TR_B = \frac{\tau}{2} \left[(1-2p) \left(1 - \frac{r\tau}{1+r}\right) - 2(1-p)(1-\tau) \right].$$

A condition for this being non-negative is

$$\tau \geq \frac{1+r}{2+r-2p}.$$

This condition requires a tax rate above $\tau = \frac{1}{2}$, which would already maximize social security tax revenue in a closed economy, corresponding to the peak of a Laffer curve. In that case, reducing τ would generate a Pareto-improvement already in a closed economy.

However, allowing for migration could generate an intergenerational Pareto-improvement also when $\tau \leq \frac{1}{2}$, provided that it is coupled with a cross-country transfer in the first period during which migration is allowed:

Proposition 6 *Allowing for migration may generate an intertemporal Pareto-improvement, provided that during the first period with which migration is allowed, the migrants pay their social security contributions to their country of origin.*

Proof. By proposition 4, the current and future young generations in B gain from allowing for migration, and current and future young generations in A are left as well off. Also, their investment in education does not change. The only question is whether the pension benefits of the current old generation in country B can be paid. They can, provided that the social security contributions by the first cohort of migrants from B to A are transferred to B. To see this, notice that allowing for migration increases investment in education and $\tau_A = \tau_B = \tau$. ■

Even if everyone would like to emigrate from the country with the flat-rate social security system, allowing migration may still generate an intertemporal Pareto-improvement for citizens of both countries. This effect would not arise in the absence of endogenous human capital formation. It is related to the brain gain effect in the development economics literature, where it is found that allowing migration with migration quotas may stimulate human capital formation sufficiently, to increase post-migration human capital also in the source country. In the case of different social security systems, however, such a brain gain arises also in the absence of migration quotas and productivity differentials between the two countries. Given that the investment in human capital does not change in country A, both countries would benefit from surplus in the PAYG system following the introduction of the common labor market, provided that country B does.

6. Conclusion

This paper derived some expected and some rather surprising results on the effects of allowing migration between countries with different social security systems. As expected, there is some cutoff productivity level above which citizens prefer earnings-related systems, and below which they would rather have flat benefits. This cutoff level may also be associated with a corner solution, with all citizens preferring one of the competing systems. Also, it turned out that the possibility of migration from flat-rate system to an earnings-related system stimulates human capital formation. Conversely, those willing to migrate to a country with flat-rate benefits may reduce their investment in education. This undesired effect suggests that when countries with different social security systems are integrated, it might be productivity-enhancing to introduce certain asymmetries into the rules concerning switching from one system to another. More specifically, requiring migrants from a country with earnings-related benefits to one with flat-rate benefits to still stay in the social security system of their initial home country could boost investment in human capital, provided that earnings-related system is not associated with a considerably higher social security contribution rate. Any such asymmetries, however, would run against the principles of non-discrimination.

Allowing for free migration may, but need not, pose problems for either system. Perhaps the most surprising result is that allowing for migration could generate an intertemporal Pareto-improvement even in absence of any productivity differences between the two countries, and the two countries having identical social security contribution rates. This requires that the first cohort of migrants pays their social security contributions to their country of origin, even if they would receive benefits from their new home country. Intuitively, this transfer mechanism reflects the role of the PAYG social security as implicit government debt. When migration is allowed, a fraction of current and future human capital migrates to the country with earnings-related benefits. This reduces the current and future tax base, as well as the number of beneficiaries in future. However, the current number of beneficiaries is determined by history. Therefore, the country with flat-rate benefits ends up under duress in the first period with a common labor market. This problem can be solved by transferring tax payments of the first generation of migrants. Note that such a transfer institution is neither warranted nor feasible in a Pareto-improving manner in subsequent periods. In order to service the implicit debt accumulated in the first period it receives migrants, the country with an earnings-related system needs all tax revenue from its immigrants in subsequent periods.

Appendix. Proof of Proposition 3.

In any steady-state equilibrium, $x_t = \tau_A$. Therefore, the welfare of high-ability types residing in country A does not change as a result of allowing migration. If high-ability types from B want to emigrate to A, then their utility must increase by revealed preferences. Similarly, note that when low-ability types from A want to emigrate to B, then their utility must increase by revealed preferences.

To prove that the welfare of low-ability types living in B may change in either direction, simplify the analysis by assuming that there are two ability types, l and h . The innate ability of type l is zero, and that of type h is a_h . The share of type h is q . If there is no migration,

$$e_{A,t} = \frac{1}{2} - \frac{r\tau_A}{2(1+r)}$$

and

$$e_{B,t} = \frac{1 - \tau_B}{2}.$$

Furthermore,

$$b_t = \tau_B \left(qa_h + \frac{1 - \tau_B}{2} \right),$$

resulting in utility for low-ability types of

$$\frac{(1 - \tau_B)^2}{4} + \frac{\tau_B}{1 + r} \left(qa_h + \frac{1 - \tau_B}{2} \right)$$

With migration, the low-ability types in country A choose, provided that they are going to migrate,

$$e_t = \frac{(1 - p)(1 - \frac{r\tau_A}{1+r}) + p(1 - \tau_B)}{2}$$

and the high-ability types in country B choose, provided that they are going to migrate

$$e_t = \frac{p(1 - \frac{r\tau_A}{1+r}) + (1 - p)(1 - \tau_B)}{2}.$$

In an equilibrium with population exchange,

$$\begin{aligned} (1 + p - 2pq)b_t &= \tau_B(1 - q)\frac{(1 - \tau_B)}{2} \\ + \tau_B(1 - p)q\left(a_h + \frac{p(1 - \frac{r\tau_A}{1+r}) + (1 - p)(1 - \tau_B)}{2}\right) & \\ + \tau_B p(1 - q)\frac{(1 - p)(1 - \frac{r\tau_A}{1+r}) + p(1 - \tau_B)}{2}. & \end{aligned} \quad (9)$$

The left-hand side tells total social security expenditures. Total population of the retirees consists of $1 - q$ native low-ability types, $q(1 - p)$ native high-ability types who remained and $p(1 - q)$ low-ability immigrants. The first term on the right-hand side of (9) is the revenue from the low-ability types who all stay, the second term is the tax revenue from the high-ability types who stay and the third term is the tax revenue from low-ability types who migrate from A.

We can next calculate the utilities of high and low-ability types in a closed economy and in a common labor market, subject to their plans on whether to migrate. Assume that $a_h = 0.12$, $q = 0.22$, $\tau_A = \tau_B = 0.21$ and $r = 1$. Then allowing for migration with $p = 0.18$ results in population exchange, increasing the utility of low-ability types also in country B. Assume next otherwise identical parameter values, but $a = 0.14$. Now allowing for migration causes low-ability types in country B to lose.

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