CORE
Metadata, citation and similar papers at core.ac.uk
Provided by Research Papers in Economics

Public Education in an Integrated Europe: Studying for Migration and Teaching for Staying?

Panu Poutvaara*
Centre for Economic and Business Research, CESifo and IZA

June 14, 2004

Abstract

Both current and especially new member states of the European Union face incentives to distort the provision of public education away from internationally applicable education towards country-specific skills. This would mean educating too few engineers, economists and doctors, and too many lawyers. Such an outcome could be avoided by introducing graduate taxes or income-contingent loans, collected also from migrants. By giving the providers of internationally applicable education a stake also in efficiency gains earned elsewhere, graduate taxes would encourage member states to invest more in internationally applicable education.

Keywords: graduate taxes, European Union, migration, brain drain and brain gain

JEL Codes: H24, H52, I28, F22

* *Address*: CEBR, Langelinie Alle 17, DK-2100 Copenhagen, Denmark. *E-mail address*: panu.poutvaara@cebr.dk.

1. Introduction

There is wide political consensus inside the European Union that decisions on public education should be left to individual member states. Benefits, however, accrue partly to other member states through migration. As internationally applicable education generates positive externalities to other member states, decentralized decision-making tends to lead into inefficiently low investments in it. Increased mobility of the highly educated generates incentives to scale back public financing, recently exemplified in the introduction of top-up fees in England, and before that by Sweden replacing a system of income-contingent loans, in effect between 1989 and 2001, by ordinary annuity loans. (CSN 2002). Sweden abandoning its income-contingent loan system may reflect the pressures of increased labor mobility; of all of those who graduate from Swedish universities, 15 percent emigrate. (Eklund 1998). Unlike income-contingent loans, annuity loans do not require cooperation from foreign tax authorities. In the Netherlands, students in study programs targeted to international students and typically taught in English are charged full tuition fees, while those in regular programs are not. (Del Rey (2001)) The potential brain drain could have especially dire consequences to the incentives that the new member states face in financing their education after the EU enlargement. Such a concern has so far been largely neglected at the expense of the fear of negative consequences of "welfare tourism" to the current member states.

In this paper, I study the effects of migration on the provision of country-specific and internationally applicable public education with two different tax rules. The first tax rule I analyze is the current European tax constitution in which citizens pay taxes on their wages

only to the country in which they live. With such tax rules, tax revenue from migrants accrues fully to the country to which they have migrated. The alternative tax constitution that I analyze has graduate taxes which are paid to the country which provided education independently of future domicile. I use term graduate tax to denote a tax which is collected from university graduates, without a requirement that tax revenue collected from them would have to equal the costs of providing education. Such graduate taxes give the country which educated migrants a stake also in their productivity gains earned elsewhere. I study both a federation consisting of equally rich member states, corresponding roughly to the old member states of the European Union, as well as a federation between a rich and a poor member state, corresponding to old and new member states of the European Union after the Eastern enlargement.[1]

At the same time as it distorts public investment in education, migration may encourage private investments. Stark et al. (1997), Beine et al. (2001) and Stark and Wang (2002) have shown that emigration may benefit also the source country, in contrast with earlier brain drain literature, pioneered by Grubel and Scott (1966) and Bhagwati and Hamada (1974). Stark et al. (1997) show that when students invest privately in their human capital, some migration from developing countries to developed countries may actually benefit the country of origin. The mechanism is as follows. A possibility to migrate into a richer country increases the expected return to human capital investment in a poor country, thus

[1]I focus on education targeted to young adults. In the spirit of Tiebout (1956), parents valuing education may buy better education for their children by paying higher taxes. Such a mechanism is much weaker in higher education, as young adults may go to a university in a different city, or even country, than in which their parents pay taxes.

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. The empirical analysis by Beine et al. (2001) shows that such a beneficial brain drain cannot be ruled out. Finally, Stark and Wang (2002) show that a possibility of migration to a richer country may serve as a substitute for subsidies for human capital formation, thus potentially benefiting also the country of emigration. These contributions focus on private investment in human capital, and they study the use of migration quotas by less developed countries. My focus is on public provision of education, in the presence of complementary private investment. I also assume that there are no legal restrictions to migration, consistent with the EU principles of free mobility.

Previous literature has identified several ways through which migration with tax competition may result in an inefficient outcome. Justman and Thisse (1997) show that the government that maximizes the utility of immobile residents simply reduces investment in public education.[2] Their model includes only one type of education. Another response is taxing immobile tax bases to finance the education of high-skilled professionals, whose tax burden would be eroded in international tax competition. This would imply regressive redistribution, as shown by Wildasin (2000). It would also seem an unlikely outcome, in

[2]Kehoe, on the other hand, (1989) argues that tax competition may offer a way to avoid the time-consistency problem. Time-consistency problem tends to result in inefficiently low private investments as taxpayers would anticipate that government may increase tax rates ex post. Andersson and Konrad (2003) and Thum and Uebelmesser (2003) suggest that labor mobility could increase investment in education as it serves as a commitment device to low taxation.

case governments have to win political backing of the citizens staying. Poutvaara (2000, 2001) suggests financing income redistribution for students from taxes collected from them, independently of their future domicile. This would allow efficiency-improving income redistribution to survive. This paper has a different focus. Young people have different abilities, and there are several forms of human capital. Different types of education are allowed to have different degrees of international applicability, and education is provided by the government. Also Poutvaara (2004) studies public and private provision of different types of education with different tax rules. This paper differs in three respects. First of all, Poutvaara (2004) assumes that human capital depends only on individual ability and investment in education, while this paper allows human capital to depend also on private investment in effort. Second, Poutvaara (2004) models only a federation of symmetric member states, while this paper models both a symmetric and an asymmetric federation. Third, Poutvaara (2004) allows for externalities, while this paper derives its results in the absence of externalities.

My main result is that governments tend to reduce investment in internationally applicable education when its applicability increases, even though such an increase would increase complementary investment by students. A system of graduate taxes leads always into higher welfare and more efficient investment in internationally applicable education than the current system, in which migrants pay all their taxes to their new home country. A less distributing alternative to graduate taxes would be income-contingent loans. Insurance against low incomes could be provided by collecting repayments only from the income above a certain level until the loan and the interest would be repaid. In return for the government absorbing the

downside risk, a student would have to pay an insurance premium. This insurance premium would be added to the debt, and could be a certain fraction of the balance borrowed. Already Friedman and Kuznets (1945) suggested financing professional education by students selling shares in their future earnings. Income-contingent loans would also allow differentiating the prices charged for different degrees. Financing for expensive degrees offering relatively low direct monetary returns but judged to be socially valuable, like arts and humanities, would still call for subsidies from the general tax revenue or cross-subsidies from degrees with relatively cheap production costs but high private returns, like law.

With benevolent governments that I analyze in this paper, there would be no efficiency justification for a system of voluntary risk-sharing contracts between students and governments as opposed to compulsory system of graduate taxes, collected independently of domicile. With voluntary contracts, a problem of adverse selection arises. Avoiding a break-down of voluntary risk-sharing contracts could then require a partial subsidy from the general tax revenue to those who participate.[3] Most likely those with highest expected income would still find it optimal to purchase their education privately. Nonetheless, opting for voluntary contracts on graduate taxes or income-contingent loans is still likely to be an optimal constitutional arrangement in a federation, as opposed to binding nationality-based taxation. In a world where benevolence of governments is not universally guaranteed, constitutional design has to trade-off adverse selection problem and the need to tame Leviathan governments.

[3]Nerlove (1975) analyzes problems associated with financing higher education using income-contingent loans. Focusing on Yale Tuition Postponement Option, implemented in early 70s, he shows that the consequences of income-contingent loans depended crucially on who participated.

A voluntary system would maintain some degree of tax competition, viewed by Brennan and Buchanan (1980) as an essential mechanism through which a federal structure protects citizens against excessive taxation by lower-level governments. Accepting a certain degree of adverse selection would then be optimal, and could be interpreted as a federation's insurance premium against potential abuses by governments.

This paper is organized as follows. Section 2 develops a model of how the government invests in education of its young citizens when the migrants pay their wage taxes only to their country of domicile. This corresponds to the current European tax constitution. Section 3 studies investment behavior with graduate taxes, paid to the country which has financed education independently of future domicile. Results from sections 2 and 3 are more relevant to current EU member states, as these sections study symmetric member states. Sections 2 also analyzes brain drain and brain gain in a federation of identical member states, with two-way migration. Section 4 studies investment in different types of education in an asymmetric federation, focusing on incentives faced by the new member states after the enlargement of the European Union. The results from section 4 allow comparisons with brain drain and brain gain literature, which has focused on one-way migration from poorer to richer country. Section 5 concludes.

2. Common Labor Market with Domicile-based Taxation

2.1. Game Structure

Without loss of generality, assume that there are two member states in a common labor

market, labeled 1 and 2. I analyze a symmetric federation in which production functions, wage tax rates and costs of education are the same in both member states, studying how results would change in a federation of asymmetric member states in section 4.

In the first stage, national governments invest in the education they provide to their citizens. There are two types of education, labeled i and s. These subscripts refer to whether the education is internationally applicable (i) or country-specific (s). Only those with internationally applicable education may migrate. In the second stage, students with ability-intensive internationally applicable education invest privately effort in their education. Such investment cannot be verified by the government. In the third stage, those with internationally applicable education choose in which member state they live and work. In the fourth stage, citizens supply labor and pay taxes in the member state they live in. Government collects wage taxes from the educated to finance exogenous public consumption and public education, and transfers the rest of the tax revenue to the rest of population, like pensioners and the uneducated. In order to focus on the effects of the mobility of labor on investment in education, rather than the effects of migration on tax rates through tax competition, I assume that the tax rate of the educated is a constant t.[4] Government budget constraint is then balanced by adjusting transfers to the rest of the population. When education is publicly provided, students would generally be better off accepting publicly provided education, even if this does not maximize their gross income, than purchasing the other type

[4]Keen and Marchand (1997) use the same assumption when they study the effect of fiscal competition on the composition of public expenditure in the presence of mobile capital. They find that in a non-cooperative equilibrium, public expenditures are biased towards the provision of public inputs at the expense local public goods benefiting immobile residents.

of education themselves. From now on, I assume that it is optimal for all students to accept publicly provided education rather than buying a different education themselves. Without loss of generality, I focus on analyzing member state 1.

2.2. Production

The production function is linear in the two types of human capital. Aggregate production in member state 1 is given by

$$Y_1 = H_i^1 + H_s^1,$$

in which H_k^1, $k \in \{i, s\}$, is the post-migration stock of effective human capital of type k, as defined in the following subsection. Labor markets are competitive, so that gross rates of return to human capital of both types are equal to unity. Income differences then follow from different amounts of human capital.

Citizens differ in their productivity in case they would complete education i, while they have identical productivity in case they would complete education s. Human capital of type i is a joint product of teaching and studying. For a citizen with ability a and individual effort e, individual human capital stock is before eventual migration

$$h_i(a, e) = a + e. \tag{1}$$

Human capital with education of type s is for all individuals normalized to unity:

$$h_s(a) = 1.$$

The monetarized cost of effort e is βe^2. This formulation of an increasing marginal cost guarantees a bounded investment in e. The resource cost for universities of education $k, k \in \{i, s\}$, is c_k. This cost is borne by the government in case of public education. Ability a follows a continuous distribution between 0 and $\overline{a}$, with density function $f(a)$. I assume that $\overline{a} > 1$ and that parameter values are such that government always invests in both types of human capital.

2.3. Migration

A share γ of internationally applicable education in one member state is applicable in the other member state in case of migration, satisfying $0 \leq \gamma \leq 1$. In order to account for a possibility of mutually beneficial brain exchange, assume that each individual faces an individual-specific random component related to productivity abroad, unknown to government and individual before investment in education but known to the individual before migration. The random component takes a multiplicative form $1 + \varepsilon$, so that ε is uniformly distributed between -0.5 and 0.5. Some individuals would then lose an individual-specific share of their productivity in case they emigrate, while others would benefit from a boost in their productivity abroad. An individual with internationally applicable education would

then emigrate to the other member state if and only if

$$\gamma(1+\varepsilon) > 1. \tag{2}$$

(2) defines the cutoff level of $\varepsilon_i = \frac{1}{\gamma} - 1$, below which citizens with internationally applicable education remain in their original member state. By symmetry, this cutoff level is the same in both member states. For simplicity, I assume that ε is not correlated with individual ability a. By this assumption and the properties of uniform distribution, the share of remaining internationally applicable human capital is given by $F(\varepsilon_i)$.

When there is some migration, $F(\varepsilon_i) = \frac{1}{\gamma} - \frac{1}{2}$ is the share of those with education i who do not migrate. The probability that an individual with education i would emigrate is then

$$p = \frac{3}{2} - \frac{1}{\gamma}. \tag{3}$$

As long as $\gamma > \frac{2}{3}$, there is migration. The probability of migration reaches its peak of 0.5 when $\gamma = 1$. As migration occurs only when the productivity of migrants is higher in the other member state, brain exchange increases the aggregate production. Thanks to mutually beneficial brain exchange, the average productivity of migrants with education i is b times what it would have been if they would have stayed in their member state of origin, in which

b is the product of γ and the average value of $(1+\varepsilon)$ of those who migrate[5]:

$$b = \frac{3}{4}\gamma + \frac{1}{2}. \tag{4}$$

This average gain is the same for migrants from both member states.

2.4. Education with Domicile-based Taxation

By (1), (3) and (4), a student of ability a chooses with education of type i private effort e to maximize

$$(1-p)(1-t)(a+e) + p(1-t)b(a+e) - \beta e^2,$$

resulting in optimal effort choice

$$e = \frac{(1-t)(1-p+pb)}{2\beta}.$$

With effective human capital being separable in private ability and effort, students of all ability levels choose the same effort.[6] Inserting (3) and (4) results in

$$e = \frac{(1-t)(\frac{9\gamma}{8} + \frac{1}{2\gamma} - \frac{1}{2})}{2\beta}. \tag{5}$$

[5]With ε being uniformly distributed between -0.5 and 0.5, the highest value of $1+\varepsilon$ is $\frac{3}{2}$, while the lowest value with migration is $1+\varepsilon_i^1 = \frac{1}{\gamma}$.

[6]Separability of effort and ability allows also to derive results in the special case $\beta \to \infty$, resulting in students not investing privately in effort, and all human capital being determined solely by the type of education and ability. If ability and effort would be multiplicative, then most able students would also invest most in effort.

I assume that the government is able to screen the students with highest ability to participate in ability-intensive education i. It is always optimal to do so, as productivity with country-specific education does not depend on ability. I denote the cutoff level of ability chosen by government $j, j \in \{1,2\}$, by $\widehat{a}_j$, below which citizens are educated in the field s and above which in the field i. Thus, the stock of human capital s in member state 1 is

$$H_s^1 = F(\widehat{a}_1),$$

and the pre-migration stock of human capital i is in member state j, $j \in \{1,2\}$:

$$\widetilde{H}_i^j = \int_{\widehat{a}_j}^1 f(a)ada + [1 - F(\widehat{a}_j)] \frac{(1-t)(1-p+pb)}{2\beta}.$$

The first term on the right-hand side reports that part of education i which depends on individual ability, and the second term is that part that is determined by individual effort. Post-migration internationally applicable human capital in member state 1 consists of share $(1-p)$ of domestically created human capital and human capital of those who have immigrated from member state 2:

$$H_i^1 = (1-p)\widetilde{H}_i^1 + pb\widetilde{H}_i^2.$$

Government in each member state collects wage taxes at rate t from the educated to finance exogenous public consumption G and public education, and returns the rest of the

tax revenue to the owners of the other factors of production, like the uneducated. The transfer in member state 1 is T_1. The government budget constraint reads as

$$t(H_s^1 + H_i^1) = G + c_s F(\widehat{a}_1) + c_i(1 - F(\widehat{a}_1)) + T_1. \tag{6}$$

The left-hand side gives wage tax revenue from the educated, while the right-hand side reports the expenditures, budget being balanced by endogenous T_1. Utility of the educated and of the recipients of transfers is linear in their consumption. I assume that the government sets equal weight to the consumption of the educated who stay and to the consumption of the recipients of lump-sum transfers, but that the government does not care about the effort costs of students with internationally applicable education. There are two alternative ways to interpret this. One is that the government maximizes the gross domestic product available for consumption, net of costs of education. Another interpretation is that effort spent by students on studying generates positive externalities. Therefore, it is not pure waste from social perspective. In case these externalities would equal private costs, these terms would cancel out for a utilitarian government. To avoid having to include any externalities in the production function, I adopt the interpretation that the government simply maximizes production. A crucial question when analyzing publicly provided education with migration is to determine how each government appreciates the utility of those of its citizens who emigrate.[7] I assume that the weight on those citizens is α, $0 \leq \alpha \leq 1$. This formulation has

[7]There is no need to specify how the government values the utility of immigrants, as immigrants have already received education from the other country when they arrive.

two polar cases: with $\alpha = 0$ each government cares only for its citizens who do not emigrate, and with $\alpha = 1$ the emigrants count with the same weight as citizens who stay. The social welfare function of the government of member state 1 is

$$SWF_1 = (1-t)H_s^1 + (1-p)(1-t)\widetilde{H}_i^1 + \alpha p(1-t)b\widetilde{H}_i^1 + T_1.$$

The first two terms give the after-tax income of the educated who stay, the third term is the social valuation of the utility of the educated who emigrate, the fourth term is the lump-sum transfer for the rest of the population. The social welfare function consists of two components, those determined by the own policy variable $\widehat{a}_1$ and those determined by $\widehat{a}_2$. The latter part, namely $tpb\widetilde{H}_s^2$, measures positive fiscal externalities in the form of tax revenue, arising from the education provided in the other member state. With such a decomposition and inserting (6), social welfare function reads as

$$SWF_1 = H_s^1 + \left[1 - p + \alpha pb(1-t)\right]\widetilde{H}_i^1 + tpb\widetilde{H}_i^2 - c_s F(\widehat{a}_1) - c_i(1 - F(\widehat{a}_1)).$$

Noticing that immigrated human capital is independent of domestic education policy, the first-order condition of domestic policy for member state 1 is given by

$$1 - c_s = \left[1 - p + \alpha pb(1-t)\right]\left[\frac{(1-p+pb)(1-t)}{2\beta} + \widehat{a}_1^{DT}\right] - c_i.$$

The left-hand side gives the social surplus from providing education s, and the right-hand

side gives the social surplus from providing education i. The cut-off level for ability is then

$$\widehat{a}_1^{DT} = \frac{1 - c_s + c_i}{1 - p + \alpha pb(1-t)} - \frac{(1 - p + pb)(1-t)}{2\beta}. \tag{7}$$

Comparative statics yield that investment in education i is increasing in c_s and α and decreasing in c_i and β. Only when $\gamma > 2/3$, there is migration. If $\gamma \leq 2/3$, $p = 0$ and (7) would simplify to $\widehat{a}_1^{DT} = 1 - c_s + c_i - (1-t)/(2\beta)$. Assume from now on that $\gamma > 2/3$. Inserting (3) and (4) into (7) then yields

$$\widehat{a}_1^{DT} = \frac{1 - c_s + c_i}{\frac{1}{\gamma} - \frac{1}{2} + \alpha(\frac{9\gamma}{8} - \frac{1}{2\gamma})(1-t)} - \frac{(-\frac{1}{2} + \frac{1}{2\gamma} + \frac{9\gamma}{8})(1-t)}{2\beta}. \tag{8}$$

Whether public investment in internationally applicable education is larger with or without migration, depends to a large extent on tax rates and on the social valuation of income accruing to emigrants. If tax rates are very high, then social valuation of the after-tax income of emigrants is low, and governments reduce investment in internationally applicable education when the probability of migration increases. Even in the presence of complementary private effort, it always holds:

Proposition 1 *Governments with $\alpha = 0$ always reduce investment in internationally applicable education when its applicability increases.*

Proof. See Appendix. ■

An increase in international applicability of human capital encourages private investment

in it. Recent work on the economics of the brain drain, most notably Stark et al. (1997) and Stark and Wang (2002), show that a positive probability of migration encourages private investments in human capital. Given that private and public investments are complementary, this would leave the effect of an increased international applicability of education i on public investment in it a priori unclear. On one hand, brain drain effect would push the government to reduce public investment in it, while brain gain effect would render investing in it more attractive. Remarkably, I find that brain gain effect always dominates as concerns public investment, provided that the government cares only about its citizens staying. Due to the presence of brain gain effect, however, aggregate stock of internationally applicable human capital may either increase or decrease when its international applicability increases:

Proposition 2 *When education is provided by governments with $\alpha = 0$, an increase in the applicability of internationally applicable education may result in either larger or smaller pre-migration stock of it.*

Proof. See Appendix. ■

Proposition 2 suggests that in addition to the cost of private effort, β, also ability distribution plays an important role in determining, whether an increase in international applicability of the internationally applicable human capital increases or decreases its formation. The intuition is as follows. If the density of abilities around the marginal ability to be given internationally applicable education is very low, then the negative effect at the extensive margin from reduced public provision is small, and positive effect from increased private effort at the intensive margin dominates. If, on the other hand, density of abilities around

$\widehat{a}_j(\gamma)$ is high, then an increase in minimum ability above which the government provides internationally applicable education excludes a large number of students, and the extensive margin may dominate.

Importantly, an increased mobility of labor need not always reduce total resources used to finance education. Whether this is the case or not depends on which type of education is more expensive. Also when internationally applicable education is less expensive, an increased probability of migration reduces individual government's incentives to invest in it.

When government attaches the same weight on emigrants as on citizens staying, increased mobility may lead to either larger or smaller investment in internationally applicable education. On the one hand, efficiency gains from brain exchange for emigrants encourage governments to invest more in the internationally applicable education. On the other hand, governments are pushed towards less investment because they lose tax revenue from emigrants.

Proposition 3 *Governments with a sufficiently high α may increase investment in internationally applicable education when its applicability increases, provided that t is not too high. Ceteris paribus, a decrease in β widens scope for the government to increase investment in i when γ increases.*

Proof. To prove existence, set $t = 0$, $c_s = c_i$, and $\alpha = 1$ in (8). Then differentiating it yields $\partial \widehat{a}_1^{DT}/\partial\gamma > 0$ by $\gamma \geq 2/3$. Without restrictions on the value of t, c_s, or c_i, $\partial^2 \widehat{a}_1^{DT}/\partial\gamma\partial\beta > 0$ in (8). ■

The latter finding relates to results by Stark et al. (1997) and Stark et al. (2002): a positive probability of migration encourages private investments in human capital. My results arise in a common labor market of two symmetric countries. Previous literature on brain drain and brain gain has focused on migration from a less developed country to a more developed country. (See Stark et al. 1997, Beine et al. (2001) and Stark and Wang (2002)

In my model, private investment is the more important the smaller β is. In case β becomes prohibitively large, students only receive human capital depending on their ability. This would eliminate the beneficial incentive effect from increased expected rate of return on human capital abroad to increased private investment in effort. However, even when β is prohibitively large, an increased probability of emigration may encourage governments valuing the utility of emigrants highly to increase investment in internationally applicable education. This requires that the expatriates earn a higher net wage abroad than their gross wage domestically. The government would also have to be willing to tax the remaining population to finance the utility gains of expatriates. This is not likely if the government has to win approval from the remaining population. Therefore, it seems more likely that increased labor mobility would induce the government to change the mix of education provided towards those fields that benefit the remaining population, even when the government values the utility of emigrants.

3. Federation with Graduate Taxes

Assume next that emigrants pay graduate taxes to the government which initially educated them. The net present value of graduate tax payments depends on future income flow.

While there could be an exempted income below which the graduate tax is not collected, I focus on the case in which a graduate tax is an equal share of income for all educated. The graduate tax rate in both member states is t_g. The general wage tax rate with graduate taxes is t_w, so that $t_w = t - t_g$. As the aggregate tax rate is the same as in an economy with only domicile-based taxation, migration rules derived in section 2.3 still apply. Also individual effort invested in education i is the same as with only domicile-based taxation. I also assume that graduate tax revenue is added into and public education financed out of general tax revenue, instead of assuming a separate budget run to finance education out of graduate tax revenue. This formulation allows government to still subsidize part of public education out of general tax revenue. Such subsidization might be needed to alleviate the adverse selection problem when students are allowed to opt out of graduate taxes and finance their education directly themselves.

Pre-migration stock of human capital i is in member state j, $j \in \{1, 2\}$:

$$\widetilde{H}_i^{jGT} = \int_{\widehat{a}_j^{GT}}^{1} f(a)adap + \left[1 - F(\widehat{a}_j^{GT})\right] \frac{(1-t)(1-p+pb)}{2\beta}.$$

Member state 1 has post-migration stock of internationally applicable human capital

$$H_i^{1GT} = (1-p)\widetilde{H}_i^{1GT} + pb\widetilde{H}_i^{2GT},$$

and a stock $H_s^{1GT} = F(\widehat{a}_1^{GT})$ of country-specific human capital. The government budget

constraint reads as

$$t_w(H_s^{1GT} + H_i^{1GT}) + t_g(H_s^{1GT} + (1 - p + pb)\widetilde{H}_i^{1GT}) = G + c_s F(\widehat{a}_1^{GT}) + c_i(1 - F(\widehat{a}_1^{GT})) + T_1^{GT}.$$

There are two differences compared to equilibrium with only domicile-based taxes. First of all, each member state now receives graduate taxes also from emigrants. Secondly, they can levy only the ordinary wage tax rate t_w on immigrants. Citizens still face tax rate $t = t_w + t_g$ in both member states. The government of member state 1 maximizes

$$SWF_1^{GT} = (1 - t)H_s^{1GT} + (1 - p)(1 - t)\widetilde{H}_i^{1GT} + \alpha p(1 - t)b\widetilde{H}_i^{1GT} + T_1^{GT}.$$

Insert next T_1^{GT} from the government budget constraint and notice that immigrated human capital is independent of domestic education policy. The first-order condition yields

$$\widehat{a}_1^{GT} = \frac{1 - c_s + c_i}{1 - p + \alpha pb(1 - t) + t_g pb} - \frac{(1 - p + pb)(1 - t)}{2\beta}. \tag{9}$$

Graduate taxes always encourage more investment in internationally applicable education:

Proposition 4 *Governments invest more in internationally applicable education with graduate taxes than with only domicile-based taxation. Investment in internationally applicable education is increasing in the graduate tax rate.*

Proof. The nominator of the first terms of (7) and (9) is the same, while the denominator

in the latter one exceeds that in the first one by $t_g pb$. The second term is the same. When $t_g > 0$, $\widehat{a}_1^{GT} < \widehat{a}_1$. Furthermore, $\partial \widehat{a}_1^{GT} / \partial t_g < 0$. ■

Notice that this result is independent of the weight assigned to emigrants, and of the relative importance of private investment in effort. Whether governments invest more or less in internationally applicable education with graduate taxes than without migration again depends on the conflicting effects: efficiency gains of brain exchange encourages such investments, while the incentives of keeping wage tax revenues in the home country discourages them.

A central result is then:

Proposition 5 *Allowing member states to levy graduate taxes is welfare improving.*

Proof. See Appendix. ■

While I have so far assumed member states to be identical, graduate taxes are actually the more desirable as opposed to complete harmonization the more member states would differ. A system with national graduate taxes would respect the subsidiarity principle. Member states could adopt different degrees of public participation in education. Depending on political preferences, member states could opt for a compulsory graduate tax with wider income redistribution, or, alternatively, for voluntary contracts in which students would have to commit to paying a graduate tax in the future in exchange for public financing of education, or opt out and pay their education themselves.

The implementation of graduate taxes (or income-contingent loans) requires that all member states of the federation collect tax revenue or loan repayment also for the other

member states. This would call for a creation of a European tax payer identity number, as well as exchanging information between member states. A European tax payer identification number could be constructed from existing national social security numbers by adding a country code in front of them, and deciding that the social security number received at birth with its initial country code would serve as the European tax payer identification number also in case of changing nationality.

4. Asymmetric Federation

Assume next that a federation consists of two asymmetric states. Member state 1 is as earlier, while productivity in member state 2 differs from that in state 1 by coefficient x, $x < 1$, with production function in state 2 being

$$Y_2 = xH_s^2 + xH_i^2.$$

Assume that also the government's costs of providing education are a multiplicative x of those in state 1. This captures the stylized fact that as a significant part of the costs of providing education are wage costs, an increase in the general level of productivity also causes an increase in the cost of providing education. To capture the gap in living standards, migration can go in only one direction, from member state 2 to member state 1. Wage tax rate is the same t in both member states. A citizen then migrates from member state 2 if

$\gamma(1+\varepsilon) > x$. This allows to solve as the share of human capital i not migrating from state 2

$$F_2(\varepsilon_2) = \max(\frac{x}{\gamma} - \frac{1}{2}, 0),$$

giving as the probability of emigration from state 2

$$p_2 = \min(\frac{3}{2} - \frac{x}{\gamma}, 1). \tag{10}$$

To guarantee that there is some migration but that not everyone with education i migrates from member state 2, I assume that $3\gamma - 2x > 0$ and $2x - \gamma > 0$, implying that $\frac{2x}{3} < \gamma < 2x$. The average productivity of one unit of human capital i of migrants from member state 2 is[8]

$$m = \frac{3\gamma}{4} + \frac{x}{2} \tag{11}$$

A student receiving education i in member state 2 would then choose effort e to maximize

$$(1 - p_2)(1 - t)x(a + e_2) + p_2(1 - t)m(a + e_2) - \beta e_2^2,$$

resulting in optimal effort choice in member state 2 (after inserting (10) and (11))

$$e_2 = \frac{(1 - t)(\frac{9\gamma}{8} - \frac{x}{2} + \frac{x^2}{2\gamma})}{2\beta}. \tag{12}$$

[8]The highest productivity of one unit of pre-migration human capital from member state 2 in member state 1 is 1.5γ, and the lowest x.

Comparing (5) and (12) yields that investment in effort by students receiving education i in member state 2 is increasing in x and in γ. Parallel to the analysis of a symmetric federation,

Proposition 6 *Government of member state 2 with $\alpha = 0$ always reduces investment in internationally applicable education when its applicability increases.*

Proof. See Appendix. ■

This proposition shows that even as brain gain from the possibility of migration intensifies, government of the poorer member state still reduces its investment in internationally applicable human capital, as its applicability increases. Interestingly,

Proposition 7 *An increased probability of emigration from member state 2 to member state 1, resulting from an increase in γ or a decrease in x, may either increase or decrease welfare in member state 1 with only domicile-based taxation.*

Proof. See Appendix. ■

To summarize, the welfare effects of international applicability may be non-monotonic. Also the member state benefiting from immigration may be hurt if its attractiveness increases too much, relative to the other member state. The reason why an increase in the mobility of labor from poorer to richer member state may decrease welfare in the richer member state hinges on the policy response of the government in the poorer member state. If a further increase in the probability of emigration results in the government of the poorer member

state to switch to offering country-specific education, the richer member state suffers also as it no longer receives immigrants and the tax revenue they would offer. Finally,

Proposition 8 *Member state 2 invests more in internationally applicable education with graduate taxes than under only domicile-based taxation.*

Proof. See Appendix. ■

Note that the insight of Proposition 5 holds also in an asymmetric federation. By Proposition 8, the introduction of graduate taxes in the new member states could offer a triple dividend, benefiting the emigrants, those left behind in the new member states and the old member states alike.

5. Conclusion

In this paper, I show that decentralized decision-making on public education encourages the member states of the European Union to distort the provision of public education away from internationally applicable education, towards country-specific skills. If governments focus on the utility of those citizens (and voters) who stay, then they reduce the provision of internationally applicable education even when students would increase complementary private investment in effort. My analysis thus suggests that the brain drain effect would dominate brain gain, at the extensive margin of government deciding to how many students it provides internationally applicable education. At the intensive margin of students deciding on their complementary private investment in effort, an increase in international applicability results in more effort. The net effect can then go in either way. Brain gain effect is more likely

to dominate when the density of students around the cutoff level of ability above which the government provides internationally applicable education is low. The higher such density, and the more expensive private effort is, the more likely it is that the negative effect at the extensive margin exceeds the positive effect at the intensive margin.

Whether the behavioral responses at the intensive margin by students or at the extensive margin by governments dominate, behavioral responses at the extensive margin lead into inefficiently low number of students receiving internationally applicable education. As a remedy, I suggest introducing graduate taxes or income-contingent loans, paid according to the same rules independently of future domicile. Giving member states a stake in efficiency gains also earned elsewhere would encourage governments to invest more in human capital benefiting also the other member states. The enlargement of the European Union increases potential benefits of establishing graduate tax contracts or income-contingent loans. With current tax rules, incentives of citizens and those of governments would diverge. Students would find incentives to study for migration, thanks to higher expected earnings elsewhere. Governments, on the other hand, would face incentives to educate students to stay, by offering them too little internationally applicable human capital, and too many country-specific skills.

A system of graduate taxes or income-contingent loans should be based on voluntary contracts, in order to protect citizens against the possibility of excessive taxation by rent-seeking governments. Even though some students would opt out, this would not threaten the system. By paying their own education, those opting out would not impose any burden on those signing the contract. Voluntary contracts would also enjoy a greater legitimacy

than subjecting citizens, even in case of permanent emigration, to an inescapable tax burden on the basis of where they were born. Rather than replacing market mechanism, voluntary contracts would supplement it. In both new and old member states, graduate taxes or income-contingent loans would also replace current efficiency-reducing incentives to restrict inflow of students from other states, identified by Del Rey (2001), by efficiency-improving incentives to provide internationally applicable education, capable also of attracting students from other member states. Thus, such a reform would favor the emergence of a genuine and competitive European market for higher education.

Appendix.

Proof of Proposition 1.

Setting $\alpha = 0$ in (8), differentiate

$$\frac{\partial \widehat{a}_1^{DT}}{\partial \gamma} = \frac{1 - c_s + c_i}{(\frac{1}{\gamma} - \frac{1}{2})^2 \gamma^2} + \left(- \frac{(-\frac{1}{2\gamma^2} + \frac{9}{8})(1-t)}{2\beta} \right). \tag{A1}$$

The first term is positive, and the second negative. Notice that when both types of education are provided, social surplus from providing education s has to exceed that from providing education i with $a = 0$. That is, $1 - c_s > (1-p)e - c_i$. By (3) and (5), this implies that

$$\frac{2\beta(1 - c_s + c_i)}{(\frac{1}{\gamma} - \frac{1}{2})(1-t)} > -\frac{1}{2} + \frac{1}{2\gamma} + \frac{9\gamma}{8}. \tag{A2}$$

The right-hand side of (A1) is positive if

$$\frac{2\beta(1-c_s+c_i)}{(\frac{1}{\gamma}-\frac{1}{2})(1-t)} > (-\frac{1}{2\gamma^2}+\frac{9}{8})(\frac{1}{\gamma}-\frac{1}{2})\gamma^2.$$

By (A2), this holds if $\frac{9\gamma^2}{16}+\frac{1}{\gamma}-\frac{3}{4}>0$. This condition always holds as $\gamma \leq 1$.

Proof of Proposition 2.

It is useful to write the stock of internationally applicable human capital explicitly as a function of γ :

$$\widetilde{H}_i^j = \int_{\widehat{a}_j(\gamma)}^1 f(a)ada + [1-F(\widehat{a}_j(\gamma))]\,\frac{(-\frac{1}{2}+\frac{1}{2\gamma}+\frac{9\gamma}{8})(1-t)}{2\beta}.$$

Differentiation with respect to γ yields

$$\begin{aligned}\frac{\partial \widetilde{H}_i^j}{\partial \gamma} &= \left[-\widehat{a}_j(\gamma)-\frac{(-\frac{1}{2}+\frac{1}{2\gamma}+\frac{9\gamma}{8})(1-t)}{2\beta}\right] f(\widehat{a}_j(\gamma))\frac{\partial \widehat{a}_j(\gamma)}{\partial \gamma} \\ &\quad + [1-F(\widehat{a}_j(\gamma))]\,\frac{(-\frac{1}{2\gamma^2}+\frac{9}{8})(1-t)}{2\beta} \\ &= -\frac{1-c_s+c_i}{\frac{1}{\gamma}-\frac{1}{2}} f(\widehat{a}_j(\gamma))\frac{\partial \widehat{a}_j(\gamma)}{\partial \gamma} + [1-F(\widehat{a}_j(\gamma))]\,\frac{(-\frac{1}{2\gamma^2}+\frac{9}{8})(1-t)}{2\beta}.\end{aligned}$$

The last line uses (8). The first term is negative as $\partial \widehat{a}_j(\gamma)/\partial\gamma > 0$ by Proposition 1. The second term is positive by $\gamma > 2/3$. If $f(\widehat{a}_j(\gamma)) \to 0$, the first term vanishes. Then the second term dominates, and $\partial \widetilde{H}_i^j/\partial\gamma > 0$. If $\beta \to \infty$, then $\partial \widetilde{H}_i^j/\partial\gamma = \widehat{a}_j(\gamma)\,[\partial \widehat{a}_j(\gamma)/\partial\gamma] < 0$ by Proposition 1.

Proof of Proposition 5.

Welfare effects of education policy of either member state can be divided into internalized effects and externalities on the other member state. By Proposition 4, $\widehat{a}_1^{GT} < \widehat{a}_1^{DT}$ (and $\widehat{a}_2^{GT} < \widehat{a}_2^{DT}$). By revealed preferences, internalized social welfare has to be at least as high with $\widehat{a}_1^{GT}$ as member state 1 could still have chosen $\widehat{a}_1^{DT}$ but did not, and similarly for member state 2. As internationally applicable education also creates positive fiscal externalities in the other member state, both member states create larger positive externalities on the other member state, at the same time as they achieve at least as large internalized social welfare.

Proof of Proposition 6.

Pre-migration human capital of type i in the member state 2 is

$$\widetilde{H}_i^2 = \int_{\widehat{a}_2}^{1} f(a)ada + [1 - F(\widehat{a}_2)] \frac{(1-t)(\frac{9\gamma}{8} - \frac{x}{2} + \frac{x^2}{2\gamma})}{2\beta}.$$

Government budget constraint is

$$t(xH_s^2 + x(1-p_2)\widetilde{H}_i^2) = G_2 + xc_sF(\widehat{a}_2) + xc_i\left[1 - F(\widehat{a}_2)\right] + T_2,$$

and social welfare function is

$$SWF_2 = (1-t)xH_s^2 + (1-p_2)(1-t)x\widetilde{H}_i^2 + \alpha p_2 m(1-t)\widetilde{H}_i^2 + T_2.$$

The cutoff level of ability is then

$$\widehat{a}_2^{DT} = \frac{(1 - c_s + c_i)x}{(1 - p_2)x + \alpha p_2 m(1 - t)} - \frac{(1 - t)((1 - p_2)x + p_2 m)}{2\beta}$$

Inserting (10) and (12) results in

$$\widehat{a}_2^{DT} = \frac{1 - c_s + c_i}{\frac{x}{\gamma} - \frac{1}{2} + \alpha(1 - t)\left(\frac{9\gamma}{8x} - \frac{x}{2\gamma}\right)} - \frac{(1 - t)(\frac{9\gamma}{8} - \frac{x}{2} + \frac{x^2}{2\gamma})}{2\beta}. \tag{A3}$$

With $\alpha = 0$,

$$\frac{\partial \widehat{a}_2^{DT}}{\partial \gamma} = \frac{(1 - c_s + c_i)x}{\left(\frac{x}{\gamma} - \frac{1}{2}\right)^2 \gamma^2} - \frac{(1 - t)(\frac{9}{8} - \frac{x^2}{2\gamma^2})}{2\beta} \tag{A4}$$

Notice that when both types of education are provided, social surplus from providing education s has to exceed that from providing education i with $a = 0$. That is, $x - xc_s > (1 - p_2)e_2 - xc_i$. By (10) and (12), this implies that

$$\frac{2\beta(1 - c_s + c_i)}{(\frac{x}{\gamma} - \frac{1}{2})(1 - t)} > \frac{9\gamma}{8x} - \frac{1}{2} + \frac{x}{2\gamma}. \tag{A5}$$

The right-hand side of (A4) is positive if

$$\frac{2\beta(1 - c_s + c_i)}{(\frac{x}{\gamma} - \frac{1}{2})(1 - t)} > (\frac{9}{8x} - \frac{x}{2\gamma^2})(\frac{x}{\gamma} - \frac{1}{2})\gamma^2.$$

By (A5), this holds if

$$\begin{aligned} -\frac{1}{2}+\frac{x}{2\gamma}+\frac{9\gamma}{8x} &> (-\frac{x}{2}+\frac{9\gamma^2}{8x})(\frac{x}{\gamma}-\frac{1}{2}) \\ \frac{9\gamma^2}{16x}+\frac{x+x^2}{2\gamma}+\frac{9\gamma}{8}\left(\frac{1}{x}-1\right)-\frac{1}{2}-\frac{x}{4} &> 0. \end{aligned}$$

Assume first that $\gamma \geq x$. Then this condition is always satisfied if

$$\frac{9x}{16}+\frac{x+x^2}{2}+\frac{9}{8}(1-x)-\frac{1}{2}-\frac{x}{4}>0,$$

which always holds. Assume next that $\gamma < x$. Also then the condition is satisfied as $\frac{9\gamma^2}{16x}+\frac{9\gamma}{8}\left(\frac{1}{x}-1\right)>0$ and $\frac{x+x^2}{2\gamma}-\frac{1}{2}-\frac{x}{4}>0$.

Proof of Proposition 7.

Assume first that the probability of migration is zero. Then an increase clearly benefits the other member state as it receives tax revenue from immigrants. If, however, the probability of migration increases to one and α is sufficiently low, then the government of member state 2 stops investment in internationally applicable education. Thus, an increase in the γ (or a decrease in x) improves welfare in the member state 1 when migration is sufficiently small, but reduces welfare in member state 1 when migration is sufficiently large.

Proof of Proposition 8

Parallel to the proof of Proposition 4, cutoff level with graduate taxes can be shown to be

$$\widehat{a}_2^{DT} = \frac{(1 - c_s + c_i)x}{(1-p_2)x + \alpha p_2 m(1-t) + t_g p_2 m(1-t)} - \frac{(1-t)((1-p_2)x + p_2 m)}{2\beta}.$$

$\widehat{a}_2^{DT}$ and $\widehat{a}_2^{GT}$ in differ by an additional positive term $t_g p_2 m(1-t)$ in the denominator of $\widehat{a}_2^{GT}$, implying a lower cutoff level of ability.

References

[1] Andersson, F., and K.A. Konrad. (2003). Globalization and Risky Human-Capital Investment. *International Tax and Public Finance* 10, 211-228.

[2] Beine, M., F. Docquier, and H. Rapoport. (2001). Brain Drain and Economic Growth: Theory and Evidence. *Journal of Development Economics* 64, 275-289.

[3] Bhagwati, J., and K. Hamada. (1974). The Brain-Drain, International Integration of Markets for Professionals and Unemployment. *Journal of Development Economics* 1, 19-42.

[4] Brennan, G., and J.M. Buchanan. (1980). *The Power to Tax: Analytical Foundations of a Fiscal Constitution*. Cambridge University Press.

[5] CSN Faktablad 2002. http://www.csn.se/

[6] Del Rey, E. (2001). Economic Integration and Public Provision of Education. *Empirica* 28, 203-218.

[7] Eklund, K. (1998). *Jakten på den försvinnande skatten.* In Swedish. SNS Förlag, Stockholm.

[8] Friedman, M. and S. Kuznets. (1945). *Income from Individual Professional Practise.* NBER.

[9] Grubel, H.B. and A.D. Scott. (1966). The International Flow of Human Capital. *American Economic Review* 56, 268-274.

[10] Justman, M., and J. Thisse. (1997). Implications of the Mobility of Skilled Labor for Local Public Funding of Higher Education. *Economics Letters* 55, 409-412.

[11] Keen, M., and M. Marchand. (1997). Fiscal Competition and the Pattern of Public Spending. *Journal of Development Economics* 66, 33-53.

[12] Kehoe, P.J. (1989). Policy Cooperation among Benevolent Governments May Be Undesirable. *Review of Economic Studies* 56, 289-296.

[13] Nerlove, M. (1975). Some Problems in the Use of Income-contingent Loans for Finance of Higher Education. *Journal of Political Economy* 83, 157-184.

[14] Poutvaara, P. (2000). Education, Mobility of Labour, and Tax Competition. *International Tax and Public Finance* 7, 699-719.

[15] Poutvaara, P. (2001). Alternative Tax Constitutions and Risky Education in a Federation. *Regional Science and Urban Economics* 31, 355-377.

[16] Poutvaara, P. (2004). Educating Europe: Should Public Education be Financed with Graduate Taxes or Income-Contingent Loans? Forthcoming in *CESifo Economic Studies*.

[17] Stark, O., C. Helmenstein, and A. Prskawetz. (1997). A Brain Gain with a Brain Drain. *Economics Letters* 55, 227-234.

[18] Stark, O., and Y. Wang. (2002). Inducing Human Capital Formation: Migration as a Substitute for Subsidies. *Journal of Public Economics* 86, 29-46.

[19] Thum, C. and S. Uebelmesser. (2003). Mobility and the Role of Education as a Commitment Device. *International Tax and Public Finance* 10, 549-564.

[20] Tiebout, C.M. (1956). A Pure Theory of Local Expenditures. *Journal of Political Economy* 64, 416-424.

[21] Wildasin, D. E. (2000). Labor Market Integration, Investment in Risky Human Capital, and Fiscal Competition. *American Economic Review* 90 (1), 73-95.