Brain Drain and Fiscal Competition: a Theoretical Model for Europe[*]

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Abstract

In this paper we study Brain Drain (BD) and Fiscal Competition (FC) in a unified framework for the European Union (EU) specific context. Potential mobility of educated workers can increase the degree of FC through taxation or the provision of public education. An increase in FC can be caused by competition among different jurisdictions that aim to attract educated workers. When the importance of FC increases, then the European States may employ FC as a new policy tool. We propose a simple model in which is possible describe different scenarios: Brain Gain (when BD may increase average productivity in the source economy); Brain Drain (when there is unidirectional flow of highly skilled workers that is welfare-deteriorating in the source economy); Migration Competition (when the regions have not high differences in the productivity and they compete attracting educated workers); Fiscal Competition (when jurisdictions compete either to attract a mobile tax base), This simple model help us to explain several policies implemented by European regions.

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Keywords:
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1 Introduction

In this paper we study Brain Drain (BD hereafter) and Fiscal Competition (FC hereafter) in a unified framework for the European Union (EU hereafter) specific context. We propose a simple model in which is possible describe different scenarios: Brain Gain; Brain Drain (when there is unidirectional flow of highly skilled workers that is welfare-deteriorating in the source economy); Migration Competition (when the regions have not high differences in the productivity and they compete attracting educated workers); Fiscal Competition. These scenarios change for different values of the two key factors: the probability to migrate, π, and the difference in the level of technology η.
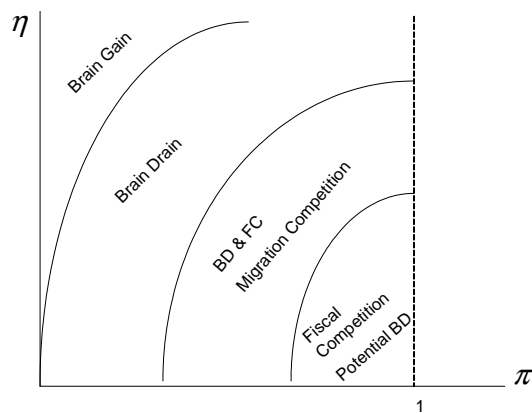
The figure (1) shows these different scenarios

Figure 1:

Furthermore, this simple model help us to explain several policies implemented by European regions.

Let us now define the two key words:

Fiscal Competition emerges because jurisdictions compete either to attract a mobile tax base or to repel mobile beneficiaries of taxation. By "voting with their feet" citizens choose their residence in a community which provides them with their personally optimal combination of fiscal burden and public goods. This migration process compels their communities to realize that they are in a competitive framework.

FC may be horizontal, when it involves governments at the same level (i.e. competition between regions or states in a federal country, or competition between countries within the EU); and vertical, when higher and lower levels of government are competitors (i. e. the "federal" level). In all cases, one cannot presume whether fiscal competition is welfare enhancing or harmful[1].

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[1] In the FC literature the basic point [based on the model of Charles Tiebout's (1956)] is

Brain Drain is an expression of British origin commonly used to describe one of the most sensitive areas in the transfer of technology. It refers to skilled professionals who leave their native lands in order to seek more promising opportunities elsewhere.

In the OECD Report (1987) there are other BD's definitions: "Brain exchange implies a two-way flow of expertise between a sending country and a receiving country. Yet, where the net flow is heavily biased in one direction, the terms "brain gain" or "brain drain" is used. A further term, "brain waste", describes the waste of skills that occurs when highly skilled workers migrate into forms of employment not requiring the application of the skills and experience applied in the former job"[2].

In the EU context, mobility of European citizens is free of institutional constraints so that cultural integration increases the probability to migrate inside the Union. For this reason, workers flows acquired a relevant position in the EU research agenda. The study of the BD is linked with the choice of education for both workers and/or by governments. If education is a public good, educated workers are free to migrate, as a side effect FC can arise. If governments do not coordinate taxation and provision of public goods, then the economy may suffer strong negative externalities. In fact, if the growth of the economies is associated with educated workers, we may record lower taxation, worse income redistribution, and lower provision of public goods. Furthermore, the system may record lower growth.

Although BD and FC are connected through agents mobility, the literature studied them separately due to the complexity of a joint analysis. In particular, previous studies developed two separate branches for BD and FC. The first one focuses on BD in a macroeconomic setup and studies its impact on the growth of different economies. The second one analyses FC using microeconomics tools and focuses on competitive interactions between workers and Jurisdictions. Several studies are focused on externalities stemming out from human capital migration but they are not adequate to simulate the new European framework. In fact, in the past this BD was an unidirectional flow of highly skilled labor from LDCs. More recently, increased integration in the labor markets, especially within the EU, has drawn attention to problems that arise from bi-directional movement of skilled labor between similarly developed countries. Thus, it is necessary to define a new BD typology specific to the European context where the FC can be used as a "new policy tool" by the regions. Furthermore, when we analyze the enlarged EU then we can distinguish two different "clubs" of regions, the former, with higher growth, and the new

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those who move face, not only different taxes rates but different patterns and types of public services, as well. Perhaps even more relevant to the study of migration of the well- educated and well-off countries differ, not only in their average taxes rates and in the size and efficiency of their public services and transfer payments, but also in the distribution of costs and benefits among different groups of taxpayers and beneficiaries.

[2]See Giannoccolo (2004) for a complete survey of the BD.

entrants with lower growth and labour productivity. In this new context a new specification of BD and FC can arise. The former regions can compete to attract the educated workers of the new regions. There exist numerously examples of the FC and the "migration competition" in EU[3].

For example, a recent Swedish policy reduces for three years the tax burden for high level researchers going to Sweden. Similar initiatives are being implemented in Denmark. Furthermore, scrutiny of the work permit system of most European states indicates clearly that professional, managerial and technical constitute the bulk of those accepted: Germany has introduced a "Green Card" system to attract 20,000 IT workers to fill shortages, although there are still difficulties in finding enough potential migrants with the necessary skills. The UK government has also adopted a more positive attitude towards skilled labor migration, making changes to the work permit system which are designed to increase the inflow of a range of skilled occupations, including IT and medical personnel[4]. Finally, much of the discussion of the migration of highly skilled has focused on the potential BD from east to west. Statistics[5] show a migration of scientists from Eastern Europe and the former Soviet Union to Western Europe.

This paper is organized as follows: Section 2 defines assumptions and structure of the model. Section 3 solves the model in an "autarchic context" where there is no migration. Section 4 describes the "mobility case" where there is migration of educated worker among regions. Section 5 concludes with recommendations for further extensions in the future.

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[3]See Giannoccolo (2005) for a complete survey of these BD policies in Europe.

[4]See Salt (2001); Bauer and Zimmermann (1999) Salt, Compton, Densham, Hogarth, and Schmidt, (1999); Dauderstädt (2001); Straubhaar (2000).

[5]See, for example, Wolburg (1996, 1997) and Wolburg & Wolter (1997).

2   The model

The model in this section is a simple version of the model of the BD and human capital formation by Mountford (1997). Differently from standard results, the Mountford's model finds some conditions in which BD generates positive externalities for the regions where some educated workers migrate. We extend Mountford's model in different directions. First, we introduce a government's role in the educational decisions of agents though the introduction of educational subsidies and taxation. Second, we study the specific case in which the mobility of workers is freely allowed (i. e. inside the European Union). These extensions opens the way for a better identification of the negative effect generated by the mutual interaction of FC and BD.

The model analyses an open economy, with only one good produced under constant returns to scale by one factor: efficiency units of labor (L_t): $Y_t = \lambda_t L_t$. There are a continuum of agents within each generation[6]. The education decision is assumed to be a discrete choice: agents can choose either to be educated or not be educated.

Let us assume that the wage rate per efficiency unit of labor is independent of labor supply in time t (and thus of migration levels) and is dependent of the productivity of the labor, or the level of technology λ_t, that is given: $w_t = \lambda_t w$.

The distribution of ability   Individuals possess different levels of latent ability, where e^i denotes the latent ability level of individual i. These latent abilities are assumed to be distributed over the closed interval $[0, E]$ according to the density function $g\left(e^i\right)$, where, by definition,

$$\int_0^E g\left(e^i\right) de_i = 1 \text{ and } g\left(e^i\right) > 0 \; \forall e^i \in [0, E].$$

Let us assume that all generations have latent abilities which are picked up from the same distribution and that the abilities of children are independent from the abilities of their parents.

The growth externality   Let us assume that there is an economy wide growth externality related to the proportion of educated workers in the economy in the previous period s_{t-1}. Thus we model λ_t to be a positive function of the proportion of educated workers in the previous period, that is

$$\lambda_t = \lambda\left(s_{t-1}\right) \text{ where } s_{t-1} = \int_{e_{t-1}^*}^E g\left(e^i\right) de^i \text{ and where } \lambda'\left(s_{t-1}\right) > 0. \quad (1)$$

Let's also assume that $\lambda\left(0\right) = 1$ and that $\lambda\left(1\right)$ is finite.

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[6] For simplicity we normalize the population in each generation to unity. Population growth is excluded.

Education   All agents have the same preferences and access to the same technology, although they do not have the same levels of latent ability.

Agents that invest[7] in education obtain e^i efficiency units of labor, where e^i is the level of the latent ability of agent i. Furthermore let us assume that the agents who do not invest in education have only one efficiency unit of labor and that the cost of education to be fixed at c units of output.

The government influences the education decision of the agents by taxing the educated workers[8] and covering part of their education costs[9]. In presence of government subsidies the cost of education becomes $c - \gamma_t$, where γ_t is the education subsidy defined as the unit of output reimbursed to educated agents in generation t and $\gamma_t \in [0, c]$.

Let us define T_t to be the marginal rate of taxation of educated workers in generation t. Introducing taxation, the wage rate per efficiency unit of labor becomes $w_t^i = \lambda_t w e^i [1 - T_t]$.

Migration   Let us assume that emigration is only permitted for educated agents[10]. We assume that the probability of successful emigration for educated agents born in region J, π_J, is independent of the number of workers who are eligible to emigrate. Let us assume that emigration policy are fully anticipated.

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[7]We assume that agents have the resources to invest in education. In Mountford (1997), the agents have not resources of their own, so they must borrow from the capital market at the world's rate of interest, r^*. The author also introduces an overlapping generations world where the agents live for three periods.

[8]We assume that only the educated workers are taxed. Then we focus our analysis on the taxation reserved to pay the education's subsidies. In this analysis we do not take in account redistribution policies of the governments. Even if a partial redistribution of income derives from the progressive taxation uses to finance the educational costs. If we take in account the redistribution policies we accentuate the negative effects of the FC. According to the literature we will obtain less redistribution and less provision of public good with respect to the efficient value (which could be obtained in the absence of mobility or in the presence of coordination among jurisdictions). In Giannoccolo (2003) we analyzed the negative externalities due to FC and to educated migration and we have analyzed their effect on the redistribution policies and on the supply of education as public good.

[9]These subsidies are given directly to educated. The analysis does not change if we consider an equivalent average education investment of the government (academic and research infrastructures, school places, teachers, etc.).

[10]This hypothesis is compatible with the assumption that there are not mobility costs. The results do not change if we assume that the costs of mobility (transfers' costs, social costs, integration's costs, etc...) are very small for educated workers (closed to zero) and very high for non educated. It is furthermore possible extend the analysis to the case in which there are not educational requirement for emigration but becomes hard distinguish the BD aspects of the workers migration. Among those who do migrate whether domestically or abroad, the highly educated are over-represented, partly because they are more likely to posses skills that are in demand, but also because they are more likely to have contacts in and knowledge about possible places to move. To extent that migration of the highly skilled may to be triggered by different factors, survey data reported by Grubel and Scott (1966, 1976) suggests that job opportunities and challenges are even more important to the highly educated. It is also true that for many such workers, particularly in health care, education, and government-supported fundamental research, the 1990s have seen large cuts in government spending induced by budget pressures. For example the pre tax and post tax distributions of the income have become more unequal in the US relative to Canada. All of these factors may have increased the net attraction of migration for the better-educated. [Helliwell 1999]

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The individual's decision to be educated   In each period t we assume that s_{t-1}^J is given, then we can define

$$\lambda\left(s_{t-1}^J\right) w \equiv a_J. \tag{2}$$

In this model we assume that there is not mobility costs so educated workers decide whether migrate or not in response to different net wage that they receive. Their future wage is related to the taxation/subsidies policies of the governments and to the differences of technology between regions. It is straightforward to verify that the educated workers will prefer to stay in region J if

$$T_{J,t} \leq \eta + (1-\eta)\, T_{I,t}. \tag{3}$$

Where

$$\eta \equiv \frac{a_J - a_I}{a_J}$$

and where the region I is the region that provides to educated agents the higher wage (net of taxation) that is possible obtain in the region where the agents can migrate.

We can therefore distinguish three different states of the world:

Case (1) $T_t^J < \eta + (1-\eta)\, T_t^I$ all educated want migrate in region J.
Case (2) $T_t^J > \eta + (1-\eta)\, T_t^I$ all educated want migrate in region I.
Case (3) $T_t^J = \eta + (1-\eta)\, T_t^I$ there is no migration.

If $T_{J,t} \leq \eta + (1-\eta)\, T_{I,t}$ (case 1 and case 3), then the optimal decision for agent i , born in region J, will be to invest in education if

$$a_J\,(1 - T_{J,t})\, e^i > a_J + c - \gamma_J. \tag{4}$$

Thus, all agents with a latent ability greater than e^* will invest in education, were e^* is uniquely defined by the following equality:

$$e_{J,t}^* = \frac{a_J + c - \gamma_J}{(1 - T_{J,t})\, a_J}. \tag{5}$$

If $T_{J,t} > \eta + (1-\eta)\, T_{I,t}$ (case 2), then the optimal decision for agent i, born in region J, will be to invest in education if

$$\left[(1 - \pi_J)\,(1 - T_{J,t})\, a_J + \pi_J\,(1 - T_{I,t})\, a_I\right] e^i = a_J + c - \gamma_J. \tag{6}$$

Thus, all agents with a latent ability greater than e^* will invest in education, were e^* is uniquely defined by the following equality:

$$e_{J,t}^* = \frac{a_J + c - \gamma_J}{(1 - \pi_J)\,(1 - T_{J,t})\, a_J + \pi_J\,(1 - T_{I,t})\, a_I}. \tag{7}$$

The government. Let us define Ω_t^J a measure of the welfare of the region J derived from the productivity of the agents that in time t are resident in region J[11].

If $T_{J,t} \leq \eta + (1 - \eta) T_{I,t}$ (case 1 and case 3), we define

$$\Omega_{J,t}^1 \equiv s_{J,t} \left[A_{J,t}^1 - c \right] + (1 - s_{J,t}) \, a_J. \tag{8}$$

Where

$$A_{J,t}^1 \equiv a_J \int_{e_{J,t}^*}^{E} de_i + \frac{s_{IJ,t}}{s_{J,t}} \sum_{I=1, I \neq J}^{N} \pi_I \, a_I \int_{e_{I,t}^*}^{E} de_i \tag{9}$$

where $s_{J,t}$ is the number of agents which are educated in region J at time t and work in region J at $t+1$; $s_{IJ,t}$ is the number of agents which are educated in region I at time t and work in region J at time $t+1$. The first term on the right hand side of (8) denotes the total production (net of education's costs) of region J due to the presence of educated workers. The second term corresponds to the total productivity of region J independently from the presence of educated workers.

For each time t the government J maximizes the $\Omega_{J,t}^1$ subject to a balance constraint for each generation t. Furthermore, let us assume that the government decides independently by the positive externality of education of generation t for the future generations and that the balance constraint is binding.

So we have,

$$\gamma_J \left(s_{J,t} \right) = \left(s_{J,t} \right) A_{J,t}^1 T_{J,t} \tag{10}$$

For region I, we define

$$\Omega_{I,t}^1 \equiv s_{I,t} \left[A_{I,t}^1 - c - a_I \right] + a_I. \tag{11}$$

Where

$$A_{I,t}^1 \equiv (1 - \pi_I) \, a_I \int_{e_{I,t}^*}^{E} de_i. \tag{12}$$

The balance constraint is

$$\gamma_I \left(s_{I,t} \right) = \left(s_{I,t} \right) A_{I,t}^1 T_{I,t}. \tag{13}$$

If $T_{J,t} > \eta + (1 - \eta) T_{I,t}$ (case 2), we have the symmetric case.

In the next sections we analyze different specifications of the model: Autarchic case and Mobility case.

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[11] This is a non-standard function of social welfare. It is a measure of the region's gain derived from the productivity of each generation, net of the educational costs. It allows to compare the different scenarios analyzed in this model and to capture the educational decisions of the government. In the next chapter the figure (2) gives a graphic intuition of Ω_t^J. It is possible extend this static simplification of the model by defining a social welfare function that take in account the externalities linked to the education.

3   Autarchic Case ($\pi = 0$) and Role of the Government

In this section we solve the model in an "autarchic context" where there is not migration between regions. Let us resume the timing of the model.

1st Step   The government decides T_t and γ_t and influences the private cost of education. Each agent i decides whether to invest in education or not according to their latent ability e^i. Agents who invest in education receive γ_t and pay $c - \gamma_t$.

2nd Step   The educated agents pay T_t to their government and repay the debt.

It is possible to solve the government maximization problem through the Backward Induction method (BI hereafter)[12]. First we solve the maximization problem of the agents and then we solve the maximization problem of government. The agent's decision is given by equation (5)

$$e_{J,t}^{*A} = \frac{a_J + c - \gamma_J}{(1 - T_{J,t})\, a_J}. \tag{14}$$

Let us analyze the government's decision. When there is not migration (Autarchic case), we define $\Omega_{J,t}^A$

$$\Omega_{J,t}^A \equiv s_{J,t}\left[A_{J,t}^A - c - a_J\right] + a_J. \tag{15}$$

Where

$$A_{J,t}^A \equiv a_J \int_{e_{J,t}^*}^{E} de_i. \tag{16}$$

For each time t the government J maximizes the $\Omega_{J,t}^A$ subject to a balance constraint for each generation t. Furthermore, let us assume that the balance constraint is binding.

So we have

$$\gamma_J\left(s_{J,t}\right) = \left(s_{J,t}\right) A_{J,t}^A T_{J,t}. \tag{17}$$

The maximization program for the government is

$$\underset{T_{J,t}}{Max} : \Omega_{J,t}^A. \tag{18}$$

The optimal value of the taxation T_t^{*J} (and indirectly, by the equation 17, the optimal value of the subsidies to educated) is

$$T_{J,t}^{*A} = 1 + \frac{E - e_{J,t}^{*A}}{E - 2e_{J,t}^{*A}}, \tag{19}$$

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[12] See the Appendix for all the computation of this autarchic case.

where

$$0 < T_{J,t}^{*A} < 1 \text{ if } e_{J,t}^{*A} > \frac{E}{2}. \tag{20}$$

We can resume this first result with the following proposition.

Proposition 1 *When the number educated it is not high $\left(e_t^{*gJ} > \frac{1}{2}E\right)$, then exists a positive optimal level of taxation and, consequently, a positive level of educational subsidies. This optimal level is $T_{J,t}^{*A} = 1 + \frac{E - e_{J,t}^{*A}}{E - 2e_{J,t}^{*A}}$.*

3.1 Role of government and effects on the region's growth

To understand better the role of the government on the educational decisions of the agents, we have to compare how the welfare changes in presence of positive subsidies to education. In figure (2) we show graphically these changes.
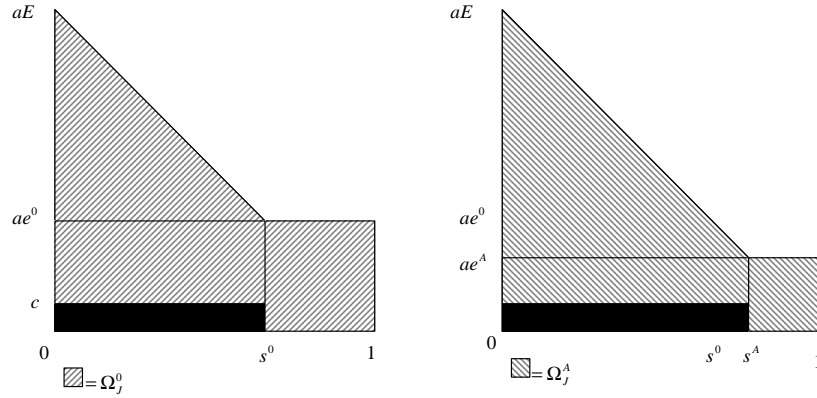

Figure 2: Autarchic case. Role of the educational subsidies on the welfare and on the number of educated workers.

In absence of government subsidies equation (5) becomes

$$e_{J,t}^{*0} = \frac{a_J + c}{a_J}. \tag{21}$$

Comparing expression (14) and (21) we have that $e_{J,t}^{*0} > e_{J,t}^{*A}$ if

$$e_{J,t}^{*A} < E - 1 - \frac{c}{a_J} \tag{22}$$

By expression (20) we have that if

$$\frac{E}{2} < e_{J,t}^{*A} < E - 1 - \frac{c}{a_J} \qquad (23)$$

then the number of educated workers in presence of government subsidies is higher than in absence of subsidies. When the educational costs increase, then the conditions to have a positive role of government, decrease.

In figure (3) are shown the effects of taxation on the individual income of the agents. In presence of subsidies we have a redistributive role of the government that increases the educational costs to agents with greater latent ability and decreases the costs to agents with lower ability.
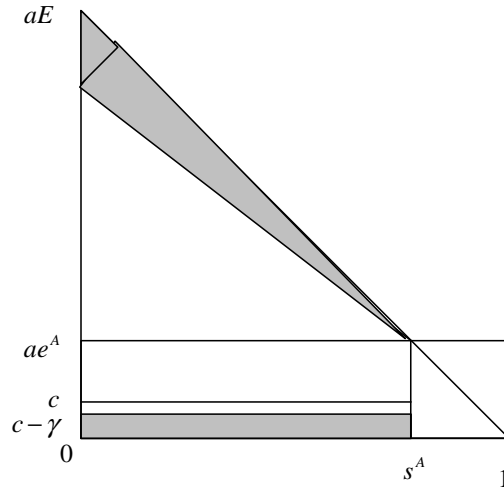

Figure 3: Effects of taxation on the individual income of the agents

Dynamics and steady state productivity The only dynamics in the model derive from the growth externality. From equation (1) it is clear that the proportion of workers who are educated at time t is an increasing function of the proportion of workers who were educated at time $t-1$, that is

$$s_t = \psi\left(s_{t-1}\right). \qquad (24)$$

Since

$$\frac{\partial e_t^*}{\partial s_{t-1}} = \frac{\lambda'\left(s_{t-1}^J\right)\left(c - \gamma_{J,t}\right)}{\lambda^2\left(s_{t-1}^J\right) w\left[1 - T_{J,t}\right]}, \qquad (25)$$

thus

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$$\frac{\partial s_t}{\partial s_{t-1}} = g\left(e_t^{*J}\right) \frac{\lambda'\left(s_{t-1}^J\right)\left(c - \gamma_{J,t}\right)}{\lambda^2\left(s_{t-1}^J\right)w\left[1 - T_{J,t}\right]}. \tag{26}$$

Let us assume that E is high enough so that the most able worker will always chooses to be educated even if no one was educated in the previous period. Since we know that agent i with $e^i = 0$ will never chooses to be educated, then this implies that there must exist at least one steady state equilibrium for s_t, which we denote as $\bar{s}$. Whether this is a unique steady state depends on the properties of the function $\lambda_t = \lambda\left(s_{t-1}\right)$. If this function has convex regions, representing "critical masses" of educated people in the economy, then there may be multiple steady states. The unique Steady State case is depicted in figure (4).
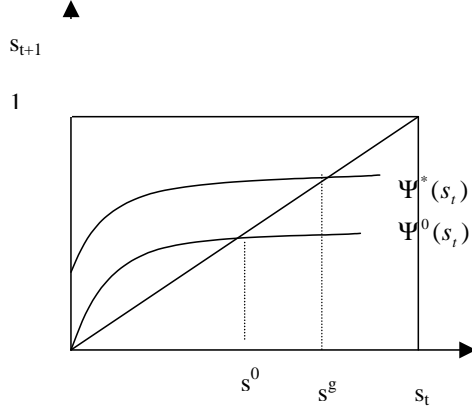

Figure 4: $\Psi^*\left(s_t\right)$ indicates the proportion of educated agents in autarkic case, when there is not migration and there are government's subsidies. $\Psi^0\left(s_t\right)$ indicates the proportion of educated agents in autarkic case, when there is not migration and there are not government's subsidies to educated.

We can resume these results with the following proposition.

Proposition 2 *The number of educated workers increases respect the case with zero educational subsidies if and only if $\frac{E}{2} < e_{J,t}^{*A} < E - 1 - \frac{c}{a_J}$.*

Corollary 1 The increase in the number of educated identifies a redistributive role of the government that decreases the educational costs for the worker with lower latent abilities. The higher the educational costs, the lower conditions to have a positive role of government.

Corollary 2 The increase in the number of educated workers implies an increase in the welfare and in the growth of the economy respect the case with zero educational subsidies.

These results are an improvement of the case analyzed by Mounford. The introduction of subsidies and taxes implies, given the conditions in propositions 1 and 2, an increase in the number of educated workers and, consequently, an higher growth.

4   Mobility Case $(0 < \pi < 1)$

Let us introduce in the model educated workers mobility. The timing of the model is the same of the Autarchic case. The only difference is that, in the second step, educated agents decide whether to migrate or not. They pay T_t to the government of the region in which they work. It is possible to solve the government maximization problem through the BI method[13].

As in the previous sections we distinguish three different states of the world:

Case 1: $T_{J,t} < \eta + (1 - \eta) T_{I,t}$, all educated want migrate in region J.

First, all agents with a latent ability greater than e^* will invest in education, were e^* is uniquely defined by the equation (5): $e_{J,t}^* = \frac{a_J + c - \gamma_J}{(1 - T_{J,t}) a_J}$.

Second, the government of region J maximizes $\Omega_{J,t}^1$ given by equation (8). Thus, the optimal value of the taxation $T_{J,t}^{*1}$ (and indirectly, by the equation (10), the optimal value of the subsidies to educated) is

$$T_{J,t}^{*1} = 1 + \frac{E - e_{J,t}^{*1}}{\left(E - 2e_{J,t}^{*1}\right) + \frac{s_{I,J,t}}{s_{J,t}} \sum_{I=1, I \neq J}^{N} \pi_I \left(E - e_{I,t}^{*1}\right)}. \tag{27}$$

The government of region J maximizes $\Omega_{I,t}^1$ given by equation (11). Thus, the optimal value of the taxation $T_{I,t}^{*1}$ (and indirectly, by the equation 13, the optimal value of the subsidies to educated) is

$$T_{I,t}^{*1} = 1 + \frac{e_{I,t}^{*1}}{\left(E - 2e_{I,t}^{*1}\right)} + \left(\frac{\pi_J}{1 - \pi_I}\right) \left(\frac{a_J}{a_I}\right) \frac{(1 - T_{J,t}^{*1})}{\left(E - 2e_{I,t}^{*1}\right)}. \tag{28}$$

According to economic intuition, when $\pi_J = \pi_I = 0$, then $T_{J,t}^{*1} = T_{I,t}^{*1} = T_{J,t}^{*A}$.

Case 2 : $T_{J,t} > \eta + (1 - \eta) T_{I,t}$, all educated want migrate in region I. We have the symmetric case.

Case 3 : $T_{J,t} = \eta + (1 - \eta) T_{I,t}$, there is no migration and the optimal value of the taxation is the same that we will demonstrate in the next section (full mobility case).

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[13] See the Appendix for all the computation.

4.1 Full mobility case $(\pi = 1)$

Let us examine the case in which $\pi = 1$, all educated workers are eligible to migrate. We solve the government maximization problem through the BI method.

The optimal decision for agent i, born in region J, is to invest in education if

$$\arg\max \{[1 - T_{J,t}] \, a_J; [1 - T_{I,t}] \, a_I\} \, e^i > a_J + c - \gamma_J \qquad (29)$$

Thus, all agents with a latent ability greater than $e^*_{J,t}$ invest in education, were e^* is uniquely defined by the following equality:

$$e^*_{J,t} = \frac{a_J + c - \gamma_J}{\arg\max \{[1 - T_{J,t}] \, a_J; [1 - T_{I,t}] \, a_I\}}. \qquad (30)$$

Also in this case we can distinguish three different states of the world.

Given the risk to loose all the educated workers, each government decides the level of T that is compatible to stay in case three. Otherwise the region not only looses all his educated workers but also subsidizes the education of workers that, migrating, will not refund these investment by paying taxes.

In case three, $T_{J,t} = \eta + (1 - \eta) \, T_{I,t}$, there is no migration and the optimal value of the taxation is different if $a^J \gtrless a^I$. Let us analyse these sub-cases.

- If $a^J > a^I$, then the governments maximizes

$$\Omega^1_{J,t} \equiv s_{J,t} \left[A^1_{J,t} - c - a_J \right] + a_J \text{ and } \Omega^1_{I,t} \equiv (1 - s_{I,t}) \, a_I. \qquad (31)$$

Where

$$A^1_{J,t} \equiv a_J \int_{e^*_{J,t}}^{E} de_i + \frac{s_{IJ,t}}{s_{J,t}} \sum_{I=1, I \neq J}^{N} \pi_I \, a_I \int_{e^A_{I,t}}^{E} de_i \qquad (32)$$

and the balance constraints are

$$\gamma_J \, (s_{J,t}) = (s_{J,t}) \, A^1_{J,t} \text{ and } \gamma_I = 0 \qquad (33)$$

Thus, the optimal values of the taxation (and indirectly, by the balance constraints, the optimal values of the subsidies to educated) are

$$T^{*1}_{J,t} = \eta^* \text{and } T^{*1}_{I,t} = 0. \qquad (34)$$

Where $\eta^* = \eta - \varepsilon$, and $\lim \varepsilon \to 0$.

- If $a^J < a^I$, then we have the symmetric case:

$$T_{J,t} = 0 \text{ and } T_{I,t} = \frac{a_I - a_J}{a_I} - \varepsilon, \text{ where } \lim \varepsilon \to 0 \qquad (35)$$

- If $a^J = a^I$, then the solution is

$$T_{J,t} = 0 \text{ and } T_{I,t} = 0 \tag{36}$$

The region that have higher level of technology (so higher number of educated workers in the previous period) decides the higher level of taxation sufficient to attract the educated workers of the other region. In this case the other regions settle zero taxes (and, consequently, zero subsidies). When the countries have the same level of technology, then there are no tax and no subsidies in all regions.

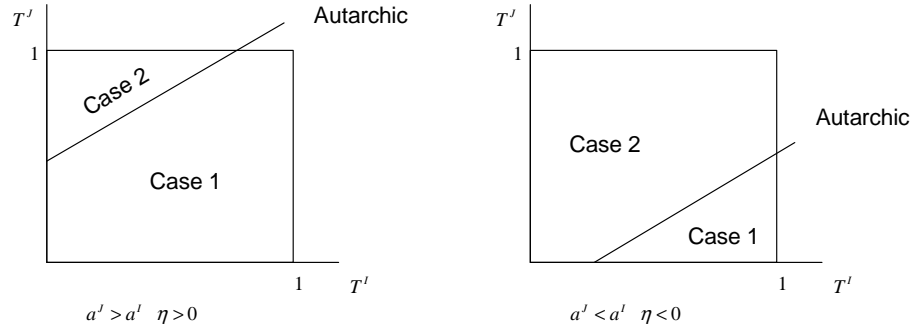In figure (5) we show graphically these cases.

Figure 5:

The following proposition summarizes the results obtained in this section.

Proposition 3 *In presence of full mobility of educated agents, the only NE is zero taxation (and, consequently, zero subsidies) when the regions have the same initial technology ($a^J = a^I$). When the countries are asymmetric ($a^J > a^I \Rightarrow \eta > 0$), then the only NE is $\left[T_{J,t}^{*1} = \eta^*, \ T_{I,t}^{*1} = 0\right]$. Where η^* is the higher level of taxation sufficient to attract all the educated workers of the other region $[\eta^* = \eta - \varepsilon, \ and \ lim \ \varepsilon \to 0]$.*

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4.2 Brain Drain or Brain Gain?

To understand better the role of the migration on the regions' growth let us analyze if there are circumstances in which the presence of migration increase the number of educated workers in both the regions and so increases the growth of these countries.

Mountford (1997) shows that when migration is not a certainty, a BD may increase average productivity and equality in the source economy even though average productivity is a positive function of the past average levels of human capital in an economy. Similar results are in Stark and Wang (2002), Stark et al. (1997) and Stark (2004). Following Mountford, we define the circumstances in which there is Brain Gain and there is taxation and subsidies to education.

Let us analyze the case (1): $T_{J,t} < \eta + (1 - \eta) T_{I,t}$, all educated want migrate in region J.

The region J does not lose his educated workers and attracts educated ones of the other regions. So, to analyze the possibility of "gain" from the migration (Brain Gain) we study the sending countries.

The average proportion of educated people in the economy I is given by the following identity

$$s_{I,t} = \frac{(1 - \pi_I) \int_{e^*_{I,t}}^{E} g\left(e^i\right) de^i}{1 - \pi_I \int_{e^*_{I,t}}^{E} g\left(e^i\right) de}.$$ (37)

If $\pi = 1$ then the source economy loses all his educated workers and $s_t^N = 0$. If $\pi = 0$ then there is not migration inside the union. Thus, a sufficient condition for the existence of a positive level of BD such that the source economy benefits in terms of productivity is that $\frac{ds_{I,t}}{d\pi} > 0$ when $\pi = 0$. The optimal level of π will be given where $\frac{ds_{I,t}}{d\pi} = 0$. Differentiating equation (37) we obtain

$$\frac{ds_{I,t}}{d\pi} = \frac{\partial s_{I,t}}{\partial \pi} + \frac{\partial s_{I,t}}{\partial e^*_{I,t}} \frac{\partial e^*_{I,t}}{\partial \pi},$$ (38)

where

$$\frac{\partial s_{I,t}}{\partial \pi} = -\frac{\int_{e^*_{I,t}}^{E} g\left(e^i\right) de^i \left[1 - \int_{e^*_{I,t}}^{E} g\left(e^i\right) de\right]}{\left[1 - \pi_I \int_{e^*_{I,t}}^{E} g\left(e^i\right) de\right]^2} < 0$$ (39)

$$\frac{\partial s_{I,t}}{\partial e^*_{I,t}} = -\frac{(1 - \pi_I) g\left(e^*_{I,t}\right)}{\left[1 - \pi_I \int_{e^*_{I,t}}^{E} g\left(e^i\right) de\right]^2}$$ (40)

$$\frac{\partial e^*_{I,t}}{\partial \pi} = -\frac{\{a_I + c - \gamma_J\} \left[(1 - T_{J,t}) a_J - (1 - T_{I,t}) a_I\right]}{\left[(1 - \pi_I)(1 - T_{I,t}) a_I + \pi_I (1 - T_{J,t}) a_J\right]^2} < 0.$$ (41)

Setting $\pi_I = 0$ and noting that $\int_{e^*_{I,t}}^{E} g\left(e^i\right) de^i \left[1 - \int_{e^*_{I,t}}^{E} g\left(e^i\right) de\right]$ is at most a quarter, we obtain the results summarized by the following proposition.

Proposition 4 *If there are strong differences on the wage per efficiency unit of labor and there are imperfect mobility of educated workers, then a positive optimal level of BD emigration arise if* $g\left(e_{I,t}^*\right) \frac{\{a_I + c - \gamma_J\}[(1-T_{J,t})a_J - (1-T_{I,t})a_I]}{[(1-T_{I,t})a_I]^2} > \frac{1}{4}$ *and* $0 < T_{I,t} \leq T_{I,t}^{*A}$.

This proposition states that the source economy can benefit from the BD if there are a sufficient number of people who would be entitled to invest in education. The introduction of taxes and subsidies implies two different results. Differently the Mountford's model, the subsidies increase the number of educated workers and so decrease the probability for the new entry to be in the "optimal BD conditions". Furthermore, the taxes increase the wage differentials between the entry region and the others and so increase the probability to gain from the BD.

As Mountford (1997), let us consider the case of uniformly distributed abilities

$$g\left(e^i\right) = \frac{1}{E}, \tag{42}$$

$$\int_{e_{I,t}^*}^{E} g\left(e^i\right) de^i = 1 - \frac{e_{I,t}^*}{E}, \tag{43}$$

$$\frac{ds_{I,t}}{d\pi} > 0 \text{ iff } (1 - \pi_I)\frac{(1 - T_{J,t})a_J - (1 - T_{I,t})a_I}{(1 - \pi_I)(1 - T_{I,t})a_I + \pi_I(1 - T_{J,t})a_J} > \left(1 - \frac{e_{I,t}^*}{E}\right). \tag{44}$$

Thus, a BD will increase the proportion of educated people in the economy if π_I is low, if $(1 - T_{J,t})a_J$ is very high relative to $(1 - T_{I,t})a_I$ and if the proportion of educated people in the economy was previously low.

Equation (44) implies that when abilities are distributed uniformly, and if $(1 - T_{J,t})a_J$ is large enough, then there is a positive level of π_I such that next period productivity increases in the source economy.

As in Mountford (1997), in presence of an optimal migration policy under a BD, the return function $s_t = \psi(s_{t-1})$ is everywhere above the return function compared with the case of no emigration. Thus clearly an optimal emigration policy will increase the short and long run productivity in the source economy. Finally, if there are multiple steady state equilibria then a temporary emigration policy might lift a source economy from a low to a high education steady state.

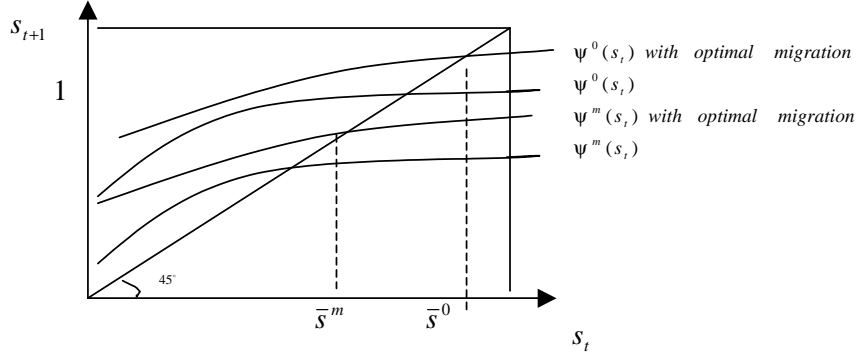The figure (6) depicts these results

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Figure 6: depicts the dynamics of the economy when there is a unique steady state equilibrium for the case where there is not migration and when there is optimal emigration (Ψ^0 is the case with optimal taxation and Ψ^m is the case without taxation).

5   Conclusion

In this paper we study Brain Drain and Fiscal Competition in a unified framework for the EU specific context.

We define a simple version of the model of Mountford (1997) that we improve by introducing a direct role of the government in the education decisions. More precisely, the presence of subsidies to education costs and of taxation to educated workers influences the individual education decision of the agents. Propositions (1) and (2) show the conditions that imply a positive role of the government in the education decisions.

Section 5 describes the mobility case where there is migration of educated workers. Different scenarios are possible when we introduce migration. These scenarios (figure 1) change for different values of the two key factors: the probability to migrate, π, and the difference in the level of technology η.

Brain Gain When region J is more productive than region I and the probability to migrate π is low, then we are in the scenario described by Mountford (1997). BD may increase average productivity and equality in the source economy (Brain Gain). In the European context this scenario can be possible when new entrant in EU is less productive than the former ones. In this scenario the optimal policies of the EU institutions is no action.

Brain Drain The differences among regions are so high that the region with highest productivity can attract educated workers from the others regions without change the optimal package of services and tax rates. This scenario is normally studied by BD literature that often refers to the unidirectional flow of highly skilled labor from Lower Developed Countries

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(LDCs). This literature has explained the lower provision of human capital as a "negative fiscal externalities" due to migration[14]. The possibility that the welfare of those remaining in the LDCs could be reduced by an outflow of educated manpower had been recognized in the literature as well. From the work of Grubel and Scott, Berry and Soligo, and Harry Johnson in the 1960s, the main conclusion was that welfare of non-migrants would fall only if the migrants' contribution to national output were greater than their income (or consumption in a static model). For a number of reasons the literature believes that the conditions for a BD to be welfare-deteriorating are often verified. Furthermore there are different studies about the BD[15] and considerable attention has been given to a proposal of Bhagwati's for a "brain drain tax" which would reduce the incentives for such a migration to take place[16]. In this scenario the optimal policies of the EU institutions is to introduce a "brain drain tax" to compensate the new entrant.

Migration Competition In this case, the regions have not high differences in the productivity and they compete attracting educated workers (migration competitions). There are several "Brain Drain Competition" policies implemented in Europe. In Giannoccolo (2005) there is an exhaustive survey of these policies. Furthermore, the tables in appendix give us an overview of mechanisms to attract foreign research graduates in Europe. The key strategies and mechanisms found are: making the academic system more open and flexible; improving the regulatory conditions particularly on immigration; better sign-posting and information at national level; dedicated grants for foreign researchers; adapting income situations to market forces; providing tax reductions specifically for researchers and knowledge workers; more active international marketing and support for international researchers. It is possible divide these policies in seven macro–groups: immigration policies, incentives to the researchers and their family, grants and scholarships, tax and salaries, investment in Research, marketing and recruiting policies, studies and analysis of the immigration policies of the others countries.

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[14] Berry and Soligo (1969), for example, show that, as far as the production of human capital (i.e. schooling and professional or academic education) is subsidized, the emigration country loses human capital when people with human capital leave their origin. Consequently (and according to the theory of public goods) the production of human capital in the emigration countries is too low in comparison to a world without migration. Bhagwati (1976a) shows the existence of a negative fiscal externality on the emigration country, if education is publicly subsidized. If the economy wide education is expanded in response to emigration the governmental deficit increases ceteris paribus. Furthermore educational subsidies can be regarded as an investment of the old generation into their pension which is lost in case of permanent emigration (Grubel & Scott, 1977).

[15] See Bhagwati and Hamada (1974); Bhagwati and Rodriguez (1975a; 1975b); McCulloch and Yellen (1975); Blomqvis (1986); Bodenhofer (1967); Sjaastad (1962); Rodriguez (1975); Romans (1974); Edding and Bodenhofer (1966); Johnson (1965); Kesselman (2000).

[16] Bhagwati and Dellafar (1973), Bhagwati (1975,1976a, 1976b) and Hamada (1977).

Fiscal Competition The probability to migrate is high (or closed to one) and the countries have the same productivity (or very closed). Then there is "potential Brain Drain" and Fiscal Competition. The possibility to loose all the educated workers implies that the countries reduce the investment in education (race to bottom). In the European context this scenario is possible among the former regions of EU. In this scenario the optimal policies of the EU institutions is to coordinate all the regions and define a target in the investment in education and research. This coordination is the target of the "Lisbon Strategy". For example, the subsequent Spring European Councils (Lisbon 2000, Stockholm 2001, Barcelona 2002 and Brussels in 2003) have endorsed the ERA (European Research Area) and set a series of objectives inviting the Commission and the Member States to take due account of the possible shortage of human resources in R&D as well as of the importance of enhancing the training and mobility of researchers. Breimer of LERU [League of European Research Universities], says: "At Lisbon in 2000, the EU set its own challenge: to compete. What this means is that Brain Drain should work in both directions — we should make ourselves attractive to the U.S., too. If Europe follows the lead of its most innovative institutions, it can do just that, and it will have a ready audience: Europeans who have moved abroad would love to come home". Claiming that the "Brain Drain should work in both directions", the European Commission suggests, from one side, to invest more in research (3% of GDP) and, from the other side, to implement policies and strategies to reverse the Brain Drain and "make the Europe attractive to the researchers from the rest of the world".

Extensions of the model

The model presented in this paper can be extended in order to analyze different economic and political analyses.

1. We can introduce a "mobility cost" for the educated workers. This cost can be not only referred to the pecuniary costs directly linked to the migration (transport, new house, etc.) but also it can be referred to the "non pecuniary cost" indirectly linked to the migration (live in a new nation, different language, etc.). The introduction of this costs do not change the main results obtained in this paper but there are some important results:

   - The more are the "mobility cost", the lower is the role of FC.
   - While the "pecuniary cost" are normally similar between the different regions, on the contrary the "non pecuniary costs" can be very different and they can be directly influenced by the policies of the government. These differences may increase or decrease eventually technology's differences and so the FC and BD externalities. Furthermore, by decreasing these costs, the government of the former region inside the EU can try to attract the educated workers of the new entry (migration competition).

2. We can introduce a "enlarged role of the government". In this paper we have analyzed a government which do not take in account redistribution income policies. If we consider a new version of the social welfare function that the government want maximize then we have other important results:

- The FC implies not only lower provision of public good but also lower income redistribution. This results, in according to the FC literature, is due to the fact that each government decreases the tax in order to attract the educated worker and so it must decrease the income redistribution.

- If we analyze the redistribution policies, then we must take in account also the "non educated" migrations. The risk to attract many non educated workers implies lower income redistribution and so increase the negative externalities of the FC.

6 Appendix

Autarchic Case The maximization program for the government is

$$\underset{T_{J,t}}{Max} : \Omega_{J,t}^A$$

$$\text{sub to } \gamma_J\left(s_{J,t}\right) = \left(s_{J,t}\right)A_{J,t}^A T_{J,t}.$$

The First Order Condition is

$$Foc(T_{J,t}) : \frac{\partial s_{J,t}}{\partial T_{J,t}}\left[a_J\int_{e_{J,t}^{*A}(T_{J,t})}^{E} de_{i,t} - c - a_J\right] + s_{J,t}\left(-a_J\frac{\partial e_{J,t}^*}{\partial T_{J,t}}\right) = 0.$$

By $\frac{\partial s_{J,t}}{\partial T_{J,t}} = -\frac{\partial e_{J,t}^{*A}}{\partial T_{J,t}}g\left(e_{J,t}^{*A}\right)$ and by the optimal value of $e_{J,t}^{*A}$ equation the FOC becomes

$$-a_J\frac{\partial e_{J,t}^{*A}}{\partial T_{J,t}}\left\{g\left(e_{J,t}^{*A}\right)\left[\int_{e_{J,t}^{*A}(T_{J,t})}^{E} de_{i,t}\left(1 - T_{J,t}\right) - \left(1 - T_{J,t}\right)e_{J,t}^{*A}\right] + s_{J,t}\right\} = 0$$

The optimal value of the taxation $T_{J,t}^{*A}$ is

$$T_{J,t}^{*A} = 1 + \frac{\left[E - e_{J,t}^{*A}\right]}{\left[E - 2e_{J,t}^{*A}\right]}$$

Where $0 < T_{J,t}^{*A} < 1$ if $e_{J,t}^{*A} > \frac{E}{2}$.

Mobility Case Let us solve the Mobility Case by the BI method.

Case 1: $T_{J,t} < \eta + (1 - \eta)T_{I,t}$, all educated want migrate in region J.

First, let us analyse the region J. All agents with a latent ability greater than e^* will invest in education, were e^* is uniquely defined by the equation (5): $e_{J,t}^* = \frac{a_J + c - \gamma_J}{(1 - T_{J,t})a_J}$.

Second, the government of region J maximizes $\Omega_{J,t}^1$ given by equation (8). Thus, the optimal value of the taxation $T_{J,t}^{*1}$ (and indirectly, by the equation (10).

The First Order Condition is

$$Foc(T_{J,t}) : \frac{\partial s_{J,t}}{\partial T_{J,t}}\left[A_{J,t}^1 - c - a_J\right] + s_{J,t}\left(-a_J\frac{\partial e_{J,t}^*}{\partial T_{J,t}}\right) = 0.$$

By $\frac{\partial s_{J,t}}{\partial T_{J,t}} = -\frac{\partial e_{J,t}^*}{\partial T_{J,t}}g\left(e_{J,t}^*\right)$

$$-\frac{\partial e_{J,t}^*}{\partial T_{J,t}}\left\{g\left(e_{J,t}^*\right)\left[A_{J,t}^1 - c - a_J + a_J\int_{e_{J,t}^*(T_{J,t})}^{E} de_{i,t}\right]\right\} = 0$$

and by the optimal value of $e_{J,t}^*$ equation the FOC becomes

$$\left(1 - T_{J,t}^{*1}\right)\left(E - 2e_{J,t}^*\right) - \frac{s_{I,J,t}}{s_{J,t}} \sum_{I=1,I\neq J}^{N} \pi_I \left(E - e_{I,t}^{*1}\right) = E - e_{J,t}^{*1}$$

or

$$T_{J,t}^{*1} = 1 + \frac{E - e_{J,t}^*}{\left(E - 2e_{J,t}^*\right) + \frac{s_{I,J,t}}{s_{J,t}} \sum_{I=1,I\neq J}^{N} \pi_I \left(E - e_{I,t}^{*1}\right)}.$$

Second, let us analyse the region I. All agents with a latent ability greater than e^* will invest in education, were e^* is uniquely defined by the equation (45):

$$e_{I,t}^* = \frac{a_J + c - \gamma_I}{\left(1 - \pi_I\right)\left(1 - T_{I,t}\right)a_I + \pi_J \left(1 - T_{J,t}\right)a_J} \tag{45}$$

.

Second, the government of region I maximizes $\Omega_{I,t}^1$ given by equation (11). Thus, the optimal value of the taxation $T_{I,t}^{*1}$ (and indirectly, by the equation (13).

The First Order Condition is

$$Foc(T_{I,t}) : \frac{\partial s_{I,t}}{\partial T_{I,t}}\left[A_{I,t}^1 - c - a_I\right] + s_{J,t}\left(-\left(1 - \pi_I\right)a_I \frac{\partial e_{I,t}^*}{\partial T_{I,t}}\right) = 0.$$

By $\frac{\partial s_{I,t}}{\partial T_{J,t}} = -\frac{\partial e_{I,t}^*}{\partial T_{J,t}} g\left(e_{I,t}^*\right)$

$$-\frac{\partial e_{I,t}^*}{\partial T_{I,t}}\left\{g\left(e_{I,t}^*\right)\left[A_{I,t}^1 - c - a_I + \left(1 - \pi_I\right)a_I \int_{e_{I,t}^*}^{E} de_{i,t}\right]\right\} = 0$$

and by the optimal value of $e_{I,t}^*$ equation the FOC becomes

$$\left[\left(1 - \pi_I\right)\left(1 - T_{I,t}\right)a_I + \pi_J\left(1 - T_{J,t}\right)a_J\right]e_{I,t}^* + \gamma_I = 0$$

or

$$\left(1 - \pi_I\right)\left(1 - T_{I,t}\right)\left(E - 2e_{I,t}^*\right) = -\pi_J\left(1 - T_{J,t}\right)\left(\frac{a_J}{a_I}\right)e_{I,t}^* - \left(1 - \pi_I\right)e_{I,t}^*$$

or

$$T_{I,t}^{*1} = 1 + \frac{e_{I,t}^{*1}}{\left(E - 2e_{I,t}^{*1}\right)} + \left(\frac{\pi_J}{1 - \pi_I}\right)\left(\frac{a_J}{a_I}\right)\frac{\left(1 - T_{J,t}^{*1}\right)}{\left(E - 2e_{I,t}^{*1}\right)}.$$

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7 Tables

Overview of mechanisms to attract foreign research graduates in Europe

MECHANISM	DESCRIPTION	COUNTRY
Immigration policies	Particular scientific visa procedure for third country researchers and a work permit is automatically issued for spouses	France, Germany
	Increase the speed of processing visa applications for student and researchers	Denmark, UK
	Flexible administrative arrangements for researchers	Finland
	Special measures to facilitate the entry of skilled workers in current demand Denmark introduced fast tracking of IT skilled persons as part of 'job-card' . German 'IT-specialists Temporary Relief Programme' – "green " cards A 5-year programme to attract IT and biotech persons to Ireland The UK permit system has responded successfully to bring in health and medical services workers The Netherlands and Belgium continue with restrictive employment policy, although there are special considerations for highly skilled workers that are in demand (e.g. IT)	Belgium, Denmark, Germany, Greece, Ireland, Netherlands, Portugal, UK
	Provision of a continuos visa in place of having to renew permits every years	UK
	Allowing applications for researchers to be made in the French Embassy in their home country (eliminating the need to go through the International Immigration office) reduces time for applications and the possibility of rejection	France
	Providing the researcher with an agent (who will moderate administrative procedures once the Embassy has permitted the researcher to obtain the visa)	France

Figure 7:

MECHANISM	DESCRIPTION	COUNTRY
Incentives to the researchers and their family	All researchers' children have the right by law to day-care	Finland, Sweden
	Replacement costs for researchers on sabbaticals are covered	Belgium
	Some countries provide easier access to fast-track language courses Greece provides language courses to the family In Germany, the Alexander von Humboldt Foundation and the German Academic Exchange Service provide support for language courses before the start of the fellowships they finance In Luxembourg and Finland, special language and cultural support is offered to accompanying children both in the foreign and mother tongues	Germany, Greece, Luxembourg, Finland, Belgium
	The researcher's family is taken into account when granting funding for stays abroad	Finland
	A work permit is automatically issued for spouses of the researchers	France, Germany
	Foreign researchers can benefit from reduced fees, subsidised accommodation and guesthouses mostly for short stays.	Finland
	The Kastler Foundation provides personalised assistance to researchers from abroad.	France
	Free accommodation and travel payment for visiting professors for up to 1 year	Finland
	In the new Greek programme for temporary employment of foreign researchers, moving costs for the family are also covered	Greece
Grants and scholarships	the UK spends £ 62 million on foreign students compared to £254 million on home students, which is a ratio of nearly 1:4.	UK
	There are prolific numbers of transnational mobility schemes Portugal has increased the number of mobility fellowships for incoming foreign researchers by 50% from 1994 to 1999 Finland has bilateral research exchange schemes with many of the candidate countries Almost 50% of Luxembourg's national research grants are allocated to non-nationals Scholarships to foreign scientists who establish research groups in Germany	Germany, Portugal Luxembourg, Finland
	The Kosmos Award, a prize of DM 750,000 is given to establish a group of young researchers in Germany	Germany
	For short term study visits for research students	Finland , Netherlands
	Research Grants / Fellowship	UK, France, Denmark, UK

Figure 8:

MECHANISM	DESCRIPTION	COUNTRY
Tax and salaries	The UK governments plans to increase the salaries of post-doctorates by 25% and increase funding for hiring of university professors.	UK
	Austria is moving towards a system where researchers in the public sector are no longer civil servants and are therefore not part of the specific civil service pension system.	Austria
	Providing tax reductions specifically for researchers and knowledge workers Outstanding researcher tax reduction for up 3 years from 40% to 25% (Denmark, Sweden) Speciality workers compensated with a rebate of 30% of total earned during stay (Netherlands)	Denmark, Sweden, Netherlands, France
	Attempts to retain teachers educated in country by writing off student loans of graduates who enter the teaching profession	UK
Investment in research	The 2004 government budget includes new tax relief for companies that invest in R & D.	Ireland
	Science Foundation Ireland (SFI) will plow €400 milion into research over the next three years	Ireland
	The Volkswagen Foundation will fund the establishment of ten to twelve Lichtenberg professorships per year. The new initiative will enable higher education institutes in Germany to attract young scientists by establishing professorships in innovative research	Germany
	Some 7000 teaching researcher posts have been created since 1997 to retain talent and encourage the return of post-doctorates working abroad.	France
	In 2000 the British government and the Wolfson Foundation, a research charity, launched a five-year research award. The £20 million scheme aims to attract the return of Britain's leading expatriate scientist and the migration of top young researchers to the UK	UK

Figure 9:

MECHANISM	DESCRIPTION	COUNTRY
Marketing and recruiting policies	Nation-wide integrated Internet sites on opportunities and regulations	France, Netherlands, Finland, UK
	The Kastler Foundation provides personalised assistance to researchers from abroad.	France
	International data base for vacancies	Netherlands
	In the UK, open recruitment is common practice with some schemes supporting the costs of recruiting outstanding researchers from industry or overseas.	UK
	Germany Austria and France are actively recruiting undergraduate and post-graduate science students from Poland and other former eastern bloc countries. Germany and Austria offer incentives such as university courses in English and favourable funding schemes	France, Austria, Germany
	The Irish Ministers of Enterprise Trade and Development are recruiting expatriates to return to build the software industry; targeting those returning home for Christmas - Irish Christmas recruitment	Ireland
	The Department for Education and Employment launched the UK Education Brand which marked the beginning of a three-year programme to raise the profile overseas of UK education. The Brand, together with generic marketing materials, supports promotion activities overseas of UK higher education institutions. The budget put towards this initiative is 7.8 million EUR	UK
	Unified body for international marketing	France, Finland
	Pursuing agreements with international associations	Denmark
	Funding of International education-research networks	France
	In some research funding organisations in Member States, foreign participation in recruitment and/or evaluation committees is compulsory or facilitated by requiring applications to be written in a 'world' language	Portugal, Finland, Sweden
Studies and analysis of the immigration policies of the others countries	ESRC (Economic &Social Research Council): **"Science Brain Drain – How some European countries attract the top scientific talent"** suggests how to compete with Austria, Germany and France that are actively recruiting undergraduate and post-graduate science students from Poland and other former eastern bloc countries	UK
	ESRC : **"MOBEX project",** which examines the factors that influence scientists to make international career moves (with an analysis of the causes why Italy attracts few international scientists)	UK
	"Benchmarking Mechanisms and Strategies to attract Researchers to Ireland". A study for the Expert Group on Future Skills Needs. How the Ireland will face even more competition in attracting research talent	Ireland
	"High Level Expert Group on Improving Mobility of Researchers - Final Report" (4 April 2001) "Good practice examples" of the policies and strategies of the Member States to attract researchers	EU

Figure 10: