Financing Higher Education Students' cross border mobility

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Abstract

The current system for financing cross-border students, based on the host country, is neither sustainable nor efficient: it produces too little cross-border education. On that background we explore two alternative solutions. The first one substitutes to the financing by the host country, a financing by the country of origin, through vouchers that the student may use at home or abroad provided it is in a recognized institution. The second one, potentially an efficient design, combines that substitution with a reimbursement of education costs through interjurisdictional transfers or the change of vouchers into contingent loans. At the end we also explore the case of differentiated tuition fees, a solution however inconsistent with present rules of the European Union.

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1. INTRODUCTION

Let us call « Bologna » a student from a Member state of the European Union, EU, who spends partially or totally, a cycle of studies in an institution located in another Member state, and who is then regularly enrolled in that latter institution. Thus, she is not an exchange student like an Erasmus student. Practically, a student who, after completing her secondary education in Germany, enrolls for medical studies in Austria is a Bologna student; similarly a French student, who, after obtaining her *baccalauréat* in France, undertakes studying veterinary medicine or paramedical studies in Belgium, is a Bologna student as well. Those students have to be in mind when reading this paper since they prefigure the expected development of that category, though they bear extra specificities.

So defined Bologna student raises a question to the economists and public deciders: which Member state has to finance her studies? Asking the question in that way immediately positions in a double European perspective, that of a publicly financed higher education[2], including cross border higher education, on the one hand; that of a financing by Member states rather than by the EU itself, in line with the Subsidiarity principle, on the other hand.

Today, in most EU Member States, studies are financed by taxpayers of the jurisdiction which hosts the student; the student herself, regardless of her citizenship, provided she is a citizen of an EU Member state, pays the same tuition fee as local resident, most often a small or even negligible fee. We say that such a way of organizing the funding of studies follows the *host country principle*, that latter country being that where foreign human capital is enriched.

This paper investigates that system using a model developed and discussed by Gérard [2006, 2007 and 2008a,b]. The introduction of strategic behavior by governments was introduced in Gérard [2010]. In that latter paper, the demand side of the market for studies is ignored, assuming that demand is rationed by supply. In that context, we examine whether the application of the host country principle is efficient from the viewpoint of the European Union as a whole.

Since the answer is negative, alternative mechanisms are investigated. First we consider a financing scheme based on the *student's origin country principle*: the studies are financed by the country where the student comes from, understood as that of her previous studies. That funding might be operated through a twofold voucher – one voucher to finance the cost of studies, another voucher to finance the cost of living. The voucher designed to finance the studies might be used at home or abroad provided it is in an institution whose quality is recognized by the issuer of the voucher. The other voucher might be modulated in line with social targets of the issuing country.

Another scheme, more adapted to interjurisdictional mobility over the career, expands the previous one turning the vouchers into a *contingent loan* possibly combined with a *Bhagwati tax*.[3] It allows us to obtain through a decentralized design, the efficient amount of higher education abroad. At that occasion we also consider centralization.

An important *caveat* needs to be issued at this stage already, and it will be repeated at the end of the paper: the alternative solutions presented and discussed in this paper only apply to students coming from developed countries; there is no indication in this paper that governments of developing countries should be asked to support their students or that those students should be charged a higher tuition fee than their classmates.

Two variables play a key role in this paper. One is the possible extra social return brought to the country where she works, by a person who got credits or graduated abroad and thus has become bi- or multi- cultural (Mechtenberg and Strausz [2008]).[4] The other is the probability

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[2] We follow a.o. Aghion *et al.* [2008]; see also Justmann and Thisse [1997, 2000], Andersson and Konrad [2003], Barr [1998], Poutvara and Kanniainen [2000].

[3] That tax has been suggested by economist Bhagwati in order to offset developing countries whose students, after completing their education in developed countries, decided to stay and work there rather to return home; see Bhagwati [1976] and Wilson [2008].

[4] Chevalier and Gérard [2009] notices that few empirical works only investigate the wage effect of mobility ; that effect may differ quite importantly from +20 to -5 pro cent. Mechtenberg and Strausz [2009] qualifies the advantage of being bi-cultural through higher education.

to return home after completing studies abroad. In that context, countries may seek to attract graduates educated abroad and the inefficiency of a principle will arise from its under-provision of internationalization of studies.

Let us add that, from a policy point of view, the host country principle is not sustainable in the long run. The figures in Table 1 show that Austria and Belgium, small countries sharing the same language as a large neighbor, are the largest net importers of students in Europe. Higher Education institutions in those small countries do enrich foreign human capital with the money of domestic taxpayers who already have contributed to make up the reputation of those institutions. That enriched human capital then returns home where it increases the value added of a country which gets that improvement free of charge. Such costly externality pushed Belgium to introduce a mechanism of *quotas* for foreign students in concerned fields of studies, substituting quantity rationing for unauthorized – by European Union law – price rationing; very recently the European Court of Justice decided that such quotas were against European Union legislation except if Belgian authorities could proof that they are justified by reasons of public health – like a potential lack of graduates in paramedical studies compared with the local needs – and that they are proportional to those needs.[5]

From an economic viewpoint an externality is at stake, whose internalization may create additional efficiency. In this paper, that internalization obeys an institutional device that we think politically relevant in the European Union context. That internalization process could follow another avenue: that of a charging an efficient price. Such a solution, dealt with in the penultimate section of the paper, is however incompatible with today European law, except again if the same price is also requested from domestic residents as in the UK case.

Table 1 – Profile of students' mobility in various EU Member states

Country	Foreign students (%)	Balance of mobility (%)	Country	Foreign students (%)	Balance of mobility (%)
Belgium	6,46	-4,69	Spain	0,51	0,29
Austria	8,07	-4,42	Hungary	0,91	0,49
UK	4,04	-3,56	Italy	0,62	0,65
Sweden	3,57	-2,65	Poland	0,04	1,13
Germany	3,01	-1,82	Portugal	0,65	1,34
Ireland	2,34	-1,52	Finland	0,63	1,47
Check Rep.	2,66	-1,09	Greece	0,04	3,15
Netherlands	2,03	-0,75	Slovakia	0,36	8,35
Denmark	1,59	-0,47	Luxembourg	0,00	187,77
France	1,63	-0,39			

Source : Gérard et Vandenberghe [2007], based on Oecd and Unesco figures from 2006 or 2007.

The second and fifth columns of the Table show the percentage of foreign students from EU Member states in local institutions of Higher Education; the third and sixth columns give the ratio between the difference between the number of outgoing local students – to EU countries

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[5] See European Court of Justice [2010]. That decision of the Court of Justice increases the relevance of this research. The number of credits which are supplied to foreign students by local authorities according to the *host country principle* actually may be regarded as *quotas*. According to the *student's origin country* principle, the number of vouchers made available by a jurisdiction in a specific field of studies, which can be used in a recognized institution within or outside the territory of that jurisdiction are in another form of *quotas*, but that latter form do not discriminate among EU residents wishing to study in the jurisdiction.

– and that of incoming students – from EU countries – on the one hand, and the total number of Higher Education students in the country on the other hand. Countries around the Mediterranean See, except France, are net exporters, as well as new EU Member states like Hungary, Poland and Slovakia, but not the Check Republic whose attractiveness for students is well known.

Interested reader will usefully read Mechtenberg and Strausz [2008, 2010] and their references. For that contribution "the most stable result established by this kind of literature is that although increasing mobility […] will lead to higher private investment in education, public provision will decrease. The government will tend to free ride on the education system of other country". Buettner and Schwager [2004] obtains similar results while, next to the free rider effect, Kemnitz [2005] sets forth competition between governments to provide education to mobile students.

Thereafter, section 2 presents and discusses the current *host country principle*; section 3 shows the inefficiency of that principle; section 4 presents and discusses the alternative *origin country principle*; section 5 shows how efficiency might be achieved through either a centralized or a decentralized funding system, especially, in that latter case, by coupling the origin principle with a *contingent loan* or, and, a *Bhagwati tax*; three remarks are issued in section 6 which pave the avenue for as many extensions of the paper; price differentiation is examined in section 7; and finally conclusions are proposed in section 8.

2. THE HOST COUNTRY PRINCIPLE

Let us assume a very simple European Union consisting of two Member states denoted by i and j. Each of them wants to maximize the social welfare of its own jurisdiction. Therefore it decides on the degree of international openness of its future workers; that degree is measured by the number of credits, or ECTS[6], that it commits to provide to students from the other Member state.

The tuition fee requested from students is zero and then the cost of providing higher education is totally supported by the jurisdiction budget, what is close to the actual funding system. Also there is no difference between the costs of providing higher education to foreign and domestic students; indeed, such difference, if any, is small as reported by Chevalier and Gérard [2009].

Moreover the cost of studies may include a fellowship which, at least, covers the opportunity costs of studying, i.e. the cost of not participating to the labor market during the studies. The robustness and lessons of the model does not require such assumption, but it enables to usefully expand its application. That fellowship may include an amount aiming at attracting students in fields which are less rewarding in money terms or in social recognition though they are especially useful socially.[7]

The cost of studies, fully socialized and supported by the local budget, is eventually financed by taxes on the future contribution of graduates to the national production of wealth; that cost is identical across borders.

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[6] ECTS means European Credit Transfer System; a year of study corresponds to 60 ECTS.
[7] That point is also developed by Gérard and Vandenberghe [2007].

The objective function of the government of country i might be written,

$$W_i = f^i\left(e_{ii}, r\beta e_{ij}, (1-r)\beta e_{ji}\right) - c\left(e_{ii} + e_{ji}\right) - we_{ii} - we_{ij} \tag{1}$$

In that equation, $f(x)$ is the local wealth production function[8]; e represents the number of ECTS: among the two subscripts associated to that variable, the first one denoted the country of origin of the student, and the second one indicates the country where she studies; $c(x)$ is the cost of producing an ECTS.[9] Variable r is the probability of returning home after completing studies abroad. Parameter w stands for the opportunity cost of devoting time to getting an ECTS rather than contributing to current production of local wealth. The equation shows that a country benefits from ECTS obtained abroad by its own residents who return home after their studies. And that it also benefits of the credits obtained in its territory by foreign students who decide to remain in the country after their studies. Both groups are said to be bi-cultural and have an extra ability to contribute to domestic wealth production characterized by $\beta \geq 1$.[10]

The first order condition of the maximization of the function with respect to the sole decision variable of this model, e_{ji}, is

$$f_{ji}^i = \frac{c'}{\beta(1-r)} \tag{2}$$

The second order condition is in turn,

$$\frac{\partial^2 f_{ji}^i}{\partial e_{ji}^2} < 0 \; ; \frac{\partial c'}{\partial e_{ji}} \geq 0$$

Equation (2) allows us to also examine the reaction of one jurisdiction to the behavior of the other. That reaction is characterized by

$$\frac{de_{ji}}{de_{ij}} = -\frac{\partial^2 f_{ji}^i}{\partial e_{ji} \partial e_{ij}} / \frac{\partial^2 f_{ji}^i}{\partial e_{ji}^2} < 0 \tag{3}$$

For the ease of the discussion we may adopt a particular specification of the wealth production function, let

$$f^i(x) = \alpha \ln x \; ; x = e_{ii} + \beta r e_{ij} + \beta(1-r)e_{ji} \tag{4}$$

From equation (4) and the hypothesis that ECTS costs are linear $-$ $c(x) = c'x -$, it turns out from (2) that we have the reaction function,

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[8] This is a production for the local jurisdiction across time, and thus duly discounted.
[9] Relating that cost to the total number of ECTS makes it actually linked to the total number of students since a year of studies for a given student amounts to 60 ECTS; thus specific costs, like congestion costs, might be taken into account.
[10] Mechtenberg and Strausz [2010] also considers the possibility for β to be smaller than one; consider the case where a student gets abroad the knowledge of a foreign language which is of limited use, and even loses her mother one.

$$e_{ji} = \frac{\alpha}{c'} - \frac{e_{ii}}{\beta(1-r)} - \frac{r}{1-r}e_{ij} \qquad (5)$$

That latter produces Nash equilibrium

$$e_{ji}^{H} = (1-r)\frac{\alpha}{c'} + \frac{1-r}{2r-1}\frac{e_{ii}}{\beta} - \frac{r}{2r-1}\frac{e_{jj}}{\beta} \qquad (6)$$

or in case of symmetric countries,

$$e_{ji}^{H} = (1-r)\frac{\alpha}{c'} - \frac{e_{ii}}{\beta} \qquad (7)$$

From an inspection of the latter two equations, it turns out that the number of credits provided to foreign students goes down with the probability r that they return home after completing their studies: smaller is their probability to return home, larger is the expected return on the investment of the host country in their higher education. The latter equation also shows that the degree of openness increases with the extra contribution to wealth production implied by being bi-cultural β.

3. INEFFICIENCY OF THE HOST COUNTRY PRINCIPLE

The equilibrium provided by equation (2) and thus by equations (6) and (7) is inefficient.

To show that, let us introduce in the model a benevolent supra-national authority, like the European council, commission or parliament. That authority decides on the right number of ECTS by maximizing the joint welfare of the two Member states. Then, the first order condition is no longer provided by equation (2) but by

$$f_{ji}^{i}\beta(1-r) + f_{ji}^{j}\beta r = c' + w \qquad (8)$$

The degree of openness is then efficient and larger: in the efficient solution externality has been internalized. And the opportunity cost for the whole set of countries has been taken into account as well. To show that, let us adopt the same specification as in the previous section and assume symmetric Member states, then (7) becomes,

$$e_{ji}^{E} = \frac{\alpha}{c'+w} - \frac{e_{ii}}{\beta} > e_{ji}^{H} = (1-r)\frac{\alpha}{c'} - \frac{e_{ii}}{\beta} \qquad (9)$$

That inequality, where superscripts E and H refer to the efficient and Nash equilibrium solutions respectively, holds for[11]

$$r > r^{H} = \frac{w}{c'+w} \qquad (10)$$

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[11] For illustrative purpose, suppose an opportunity cost of 12,000 Euros a year and a cost of studies of 7,000 Euros as it is the case in paramedical studies (see below and Gérard and Vandenberghe [2007]), then the threshold value for r amounts to .63 which is certainly compatible with today European situation.

4. THE ORIGIN COUNTRY PRINCIPLE

According to that principle, it is up to the country of origin of the student, understood as that where she completed her previous studies – like that where she got her high school degree –, to fund her higher education regardless the country where those studies are performed, but provided it is a school whose good quality has been certified to the paying authority. That system is quite similar to that used for health care. For higher education, it is used by Swiss cantons – see Gérard [2008] – and most often in the case of students sent abroad with a fellowship from her origin country.

Let us first set forth the main lessons which arise from the use of that principle; then we will discuss its properties and its feasibility.

4.1. The Principle

Though previously the government of country i decided on the number of ECTS that it provided to foreign students, it now determines the number of ECTS that it allocates to students from its own jurisdiction that it sends abroad and whose it will finance the cost of studies. Therefore it no longer maximizes (1) with respect to e_{ji} but

$$W_i = f^i\left(e_{ii}, \beta r e_{ij}, \beta(1-r)e_{ji}\right) - c\left(e_{ii} + e_{ij}\right) - w e_{ii} - w e_{ij} \tag{11}$$

with respect to e_{ij}. The first order condition of that maximization is

$$f_{ij}^i = \frac{c' + w}{\beta r} \tag{12}$$

Proceeding as previously, it turns out that

$$\frac{de_{ij}}{de_{ji}} = -\frac{\partial^2 f_{ij}^i}{\partial e_{ij} \partial e_{ji}} \Big/ \frac{\partial^2 f_{ij}^i}{\partial e_{ij}^2} < 0 \tag{13}$$

If the probability of returning home after completing studies abroad is larger than a threshold denoted by r^{OH}, the solution characterized by equation (12) is closer to the efficient solution than that provided by the application of the host country principle – see (2). Indeed, should we adopt the same specification as previously, the reaction function becomes

$$e_{ij} = \frac{\alpha}{c' + w} - \frac{e_{ii}}{\beta r} - \frac{1 - r}{r} e_{ji} \tag{14}$$

Then, at Nash equilibrium we have

$$e_{ij}^O = \frac{\alpha r}{c' + w} - \frac{r}{2r - 1} \frac{e_{ii}}{\beta} + \frac{1 - r}{2r - 1} \frac{e_{jj}}{\beta} \tag{15}$$

If the countries are symmetric that latter equation turns out to be

$$e_{ij}^O = \frac{\alpha r}{c' + w} - \frac{e_{ii}}{\beta} \tag{16}$$

We then observe, given a value of e_{ii}, that

$$e_{ji}^{E} > e_{ji}^{O} > e_{ji}^{N} \qquad (17)$$

The first part of that inequality always holds, while the second requires that[12]

$$r > r^{OH} = \frac{c'+w}{2c'+w} \qquad (18)$$

4.2. Properties and feasibility

Equation (17) shows that, under the realistic condition (18), moving from the *host country principle* to the *origin country principle* makes us closer to the efficient solution.

Beyond that economic property, funding of students by the origin country enables that origin country to expand the geographical area in which its policy is applied. Indeed, one can imagine the following operation for the proposed mechanism:

The origin country decides on the total number of students who are permitted to follow a given field of studies and who are financed therefore wherever they attend courses – at home or abroad – but provided it is in an agreed institution.

To those students, the origin country gives a voucher dedicated to cover the corresponding tuition fee, and possibly another voucher to finance the cost of living during the studies and to stimulate higher education attendance by socially targeted groups or to targeted some fields of studies.

In line with bi- or multi-lateral arrangements like bi-lateral treaties or EU directives, higher education institutions at home or abroad only enroll students able to show up a voucher.

It turns out that the higher education policy of the origin country – e.g. regarding enrolment in veterinary medicine – is not only applied by domestic schools but also by schools across the borders. That feature might be regarded as an improvement with respect to the current situation where a student who fails admission tests in a given field in her country of origin migrates to the country next door for the purpose of studying that field, and returns home after completing her education, with a degree fully recognized by her origin country.

Three remarks deserve consideration at this point of the exposition. First, the cost of studies is assumed identical across countries for any given field. That makes the valuation of the voucher easier; beyond that, it implies that the partner countries are able to jointly determine the cost of getting a set of ECTS or a degree in a given field of studies. Gérard and Vandenberghe [2007] provides figures based on public funds allocated to French speaking Belgian Higher Education institutions for the academic year 2005-2006: around 7,000 Euros per student per year in paramedical non-university higher education institutions like schools

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[12] Based on the same values as previously for *c'* and *w*, the threshold is valuated at .53 which is certainly compatible with EU today situation.

for nurses; 11,000 or 17,000 Euros per student per year in medicine and veterinary medicine (the former for the first two years and the latter for the subsequent years).

Second, equations (6) and (15) show the negative link between the number of ECTS abroad e_{ij} and the similar number supplied to local students on the domestic territory[13], e_{ii}. That negative relation sets forth the possible substitution between studies at home and abroad, and is in line with the observation by various authors that opening of borders and mobility of students might involve a downward movement in the domestic supply of education – see e.g. Justman and Thisse [1997, 2000] who point out the link between under-provision of publicly funded education and mobility.

Finally, the requirement that vouchers be solely used in institutions agreed by the issuing country relates the mechanism described above to the criterion of quality at work in the Bologna process. Actually that requirement might be satisfied either through a process of mutual recognition – each Member state recognizes as good quality institution a school regarded as such by the authorities of the jurisdiction where it is located – or through a label granted by certifying agencies – e.g. the Equis label for management schools.

5. EFFICIENCY IS BACK

As shown by inequality (17), both the funding by the host country and the funding by the origin country imply an under-provision of cross border higher education. The reason is to be found in the appearance of externalities. In the first case the host country provides the origin one with a fraction r of students from that latter country, educated at the expenses of the former and who will never offset the cost of their studies through a contribution to local wealth and local revenue. In the second case the origin country provides the host one with a fraction $1-r$ of students from its own territory, educated at the expenses of its own taxpayers but who will never offset the cost of their studies through a contribution to the wealth and revenue of their origin jurisdiction. In both case a free riding process is at work and a jurisdiction benefits from an enriched human capital free of charge.

Is it possible to internalize those externalities? The answer is positive and two strategies at least are possible. The first one might be labeled *centralized* and the second one, *decentralized*.

5.1. The centralized strategy: EU fellowships?

The *centralized* strategy consists in setting up a jurisdiction encompassing countries i and j and in making it responsible for higher education policy. That solution however contradicts the Subsidiarity Principle at the heart of the functioning of the European Union. Therefore we do not further consider it in this paper.

However let us draw the attention of the reader on a particular feature at stake in a federal country like Canada where fellowships, in a limited number however, are granted by the Federal government although higher education is a competence of the provincial authorities.

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[13] More precisely the first mentioned equation put forward that the number of host students goes up when the number of foreign students educated in their own territory goes down; the second equation points out that the number of students sent abroad increases when the number of students permitted to study at home decreases.

This is a partial illustration of a possible move of some aspects of higher education policy to an upper level of government.[14]

5.2. The decentralized solution: contingent loans and Bhagwati tax?

The *decentralized* strategy may have a better future: the jurisdiction of origin – the country where the students come from – is supposed to be in charge of funding the studies of its students but, for each year of their career spent abroad, it benefits from a transfer payment from the country where they work. For the sake of the presentation, consider that country i is the country of origin of the student while j is both the country of her higher education – thus the *host country* – but also the country where she spends a fraction $(1-r)$ of her career – the *destination country*.

That transfer payment might have at least two designs. The first one is that of a *Bhagwati tax*: the country where the graduate is working provides the country of origin of that worker, as defined above, with a yearly payment aiming at compensating that latter country for the investment done in the higher education of that worker.[15] That amount of money might be obtained through a tax on the income of the graduate; that tax might be levied by the tax authorities of the country where she works and have its revenue transferred to the country of origin.

The other design is that of a *contingent loan* provided or guaranteed by the authorities of the country of origin and covering the tuition fees and possibly the cost of living.[16] That loan is contingent in the sense that the high of the interests – and possibly the refund of the principal – depends on the income of the graduate. It might be contingent in another sense as well: under some circumstances the payments of interests and the refund of the principal are not due; that may be the case for the years of the career spent at home since then the country of origin benefits from the contribution of the graduate to domestic wealth production. Notice that payments associated to a contingent loan might also be levied through the tax system.[17] Other strategies for recovering those amounts of money are also available however. In this paper however we ignore the proper contingent aspect of the loan.

Both designs might be regarded as equivalent since they both imply a payment by the country where the graduate works to the one which has made the investment in her higher education. Both designs also require cross border cooperation: at least a clearing mechanism for the former, a process of assistance to the recovery of liabilities in the latter.

Formally the objective function (1) becomes, denoting by t the tax or transfer parameter,

$$W_i = f^i\left(e_{ii}, \beta r e_{ij}, \beta(1-r)e_{ji}\right) - c\left(e_{ii} + e_{ij}\right) - w e_{ii} - w e_{ij} + t(1-r)\left(e_{ij} - e_{ji}\right) \qquad (19)$$

Maximization of that function w.r.t. e_{ij} according to the origin country principle implies

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[14] Another aspect is to move to such upper level fields of studies where economies of scale are at work, like polytechnics; this is the case in Switzerland where higher education in general is a competence of cantons but polytechnics is a competence of the confederation (Gérard [2008b])

[15] That system is already at work among soccer clubs where often unknown clubs benefit from levies on players pays in order to offset their respective investment in the training of those players.

[16] On contingent loans see a.o. Barr [1989, 1998] and Chapman [1997, 2005].

[17] That is the case in e.g. Australia, as mentioned by Gérard [2008b].

$$f_{ij}^{i} = \frac{c' + w - t(1-r)}{\beta r} \qquad (20)$$

That condition is equivalent to the one in the efficient case given by equation (8) if

$$t = \frac{1 - \beta r}{1 - r}(c' + w) \qquad (21)$$

It turns out that

$$t(1-r) = (1 - \beta r)(c' + w) \qquad (22)$$

The discounted flow of transfer payments by the country where the graduate works offsets the investment in higher education funded by the country of origin of the worker as well as the loss for that country involved by the opportunity cost of studies, taking into account the bi- or multi-culturality effect. The same holds for the discounted flow of payments associated to a contingent loan.

Especially, if $\beta = 1$, a situation one can expect arising from an integration of the university system in Europe, that solution exhibits the property to be valid for any value of *r*. It thus allows for a generalization of the origin country principle and might be considered as a politically attractive design for the funding of higher education in the European Union.

6. THREE REMARKS AND EXTENSIONS

Three remarks may be roots for extensions of the research reported in this paper.

First, in this paper we have focused our analysis on the cross border mobility of so called Bologna students, *disregarding the determination of ECTS for purely domestic students*; actually we took that number as exogenously determined. This is of course a simplification since students actually make choice between studying at home or abroad, even if their choice is eventually constrained by quotas. We consider a simultaneous determination of ECTS supplied to both purely domestic and cross border students in Gérard [2007], in a different context however. In that context, there is no interjurisdictional dependence but both supply and demand of ECTS are at work with demand constrained by supply. That simultaneous determination could be done in the current context as well but it needs to expand the model.

Further, *we have deliberately confused and thus identified institutions of higher education and corresponding jurisdiction authorities*. This is an exaggeration, at least in reference to the practice of some EU countries. In French-speaking Belgium, for example, institutions are independent of the political authorities in the following sense: political authorities determine general rules and fix the aggregate budget for all the universities (viz. non university higher education); that budget is spread between the institutions *pro rata* the number of students enrolled (with some corrections in line with the fields of studies) and thus institutions have a strong incentive to compete for students. Therefore the objective function of institutions may diverge from that of the public authorities and a *principal-agent issue* arises.

And finally we have completely neglected the *possible difference in quality between institutions of higher education or between countries*. In that line we could reintroduce demand for ECTS and suppose that it obeys a function like

$$e_{ii} = a_i + bq_i \ , \ e_{ij} = a_i + bq_j \tag{23}$$

In that function the demand for ECTS depends on the ability a of the student, which in turn depends on her previous education, and of the quality of the higher education institution q. A cost of acquiring that quality needs then to be introduced and that level of quality might become a decision variable of the authorities.

7. A PRICE DIFFERENTIATED OUTCOME

Moreover the solutions obtained and discussed so far have been stressed against the European Union situation. They might be compared with the outcome arising from a market mechanism with differentiated pricing, based on the state of origin, as it is the case in the *United States*. The tuition fee charged to foreign students by the institution of higher education or by the state where that institution is located, depends on the maximization of

$$W_i = f^i\left(e_{ii}, \beta r e_{ij}, \beta(1-r)e_{ji}\right) - c\left(e_{ii} + e_{ji}\right) + p_f e_{ji} - we_{ii} - we_{ij} \tag{24}$$

In that equation, p_f is the tuition fee to be paid by foreign students – those who are not permanent residents of the state where the higher education institution is located. First order condition of the maximization of (24) is

$$(1-r)\beta f^i_{ji} = c' - p_f \tag{25}$$

That equation shows that, at the equilibrium, in the country providing higher education, the marginal return on ECTS delivered is equal to the marginal cost of studies less the tuition fee received.

Taking into account the point of view of the two jurisdictions together, and thus using (8) which characterizes an efficient mechanism, we obtain that

$$p_f = rc' - (1-r)w \tag{26}$$

That price is an efficient price; it consists of two parts. The first one compensates the jurisdiction providing the higher education for its investment in the favor of the student and amounts to the marginal cost of studies multiplied by the proportion of the career spent in other jurisdictions, including that of origin. The second offsets the opportunity cost avoided by that jurisdiction if the student remains in its territory. Especially, should all foreign students return home after completing their studies, that optimal tuition fee is equal to the marginal cost of studies for the host country. On the contrary, if all the foreign students remain in the country of their higher education and contribute to the wealth and revenue of that country, the optimal tuition fee for foreign students should be negative; in that extreme case the authorities of the education providing jurisdiction will transfer to the student the opportunity cost avoided: indeed they get a graduate without occurring that cost.

Notice that equation (26) is consistent with actual pricing behavior of US universities where first year graduate students are charged a high tuition. In subsequent year that fee decreases and eventually becomes negative: at the end, the foreign students receive fellowships from US universities. In some sense the tuition fee goes down when the probability to remain in the country and to create value for the hosting US university and the country goes up.

8. CONCLUSION

Today funding of cross border higher education students based on the host country principle is neither sustainable nor efficient. Against that background the paper has investigated two alternative solutions both compatible with the principles of functioning of the European Union.

The first solution substitutes to the financing by the host country a funding by the country of origin of the student. Based on vouchers permitted to be used either domestically or abroad provided it is in higher education institutions whose quality has been recognized by the issuing country, that system is more efficient than the current one if the probability to return home after the completion of the studies is higher than a given threshold.

The second solution combines the principle of the first one with a refund by the graduate of the investment in higher education made by the origin country *pro rata* the years of her career that she spends outside her country of origin. That refund might take the form of a transfer payment between countries – a kind of Bhagwati tax – or that of turning vouchers into contingent loans the charge of them being possibly due for the sole years of the career spent outside the country of origin. That second solution might be designed in such a way that it makes it an efficient solution: the amount of cross border education generated by that process is then identical to that produced by a centralized mechanism aiming at maximizing common social welfare.

At the end of the paper remarks are formulated and extensions are suggested. Then a market solution is also examined which produces an optimally differentiated tuition fee for foreign students; such a solution, though practiced in the US, is however not compatible with today European law.

Two final remarks usefully take place at the end of this paper. First, the important *caveat* mentioned at the beginning of the paper, has to be repeated at the end: the alternative solutions presented and discussed in this paper only apply to students coming from developed countries; there is no indication in this paper that governments of developing countries should be asked to support their students or that those students should be charged a higher tuition fee than their classmates.

And second, that paper calls for further research. Candidates have been mentioned in section 6. They include considering (private) demand for education in addition to (public) supply, taking quality into account and making a distinction between the higher education institutions and the public authorities: those levels of power indeed might pursue different objectives and their relations could be nested in the framework of a principal-agent model.

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