The Liberalization of Tuition Fees: A Theoretical Assessment

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Abstract

We study the implications of a tuition fee deregulation in a context where two universities compete for students. To this end, we build a theoretical model with ex-ante homogeneous institutions. We show that the pecularities of the objective function and education technologies of universities protect them from a too fierce competition, as opposed to standard profit maximizing firms.

Keywords:
higher education institutions, bertrand competition, multi-tasking, non-rigid capacity

1. Introduction

The harmonization of the diverse European higher education systems brought by the so-called Bologna process has attracted a lot of attention. It aimed at improving the comparability of university programs to allow institutions to compete at an international level in order to attract students. Together with the increased mobility of students, this change is likely to engage universities into a fiercer competition process on the enrollment market. In most continental European markets, the level of fees has been heavily regulated so that universities are not free to use this weapon strategically as a response to their new environment. One fear is of course that universities engage into a race to the bottom in order to attract students, with the result that the revenues originating from the fees decrease drastically. Another scenario is that, being unable to compete in tuition fees, universities invest in

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April 23, 2014

cursus differentiation and/or other non-price dimensions and therefore divert their resources from other tasks, in particular research. According to this last scenario, one may further expect that universities actually raise their fees, should they be allowed to do so, and thereby limit students' participation.

Casual observation nevertheless suggests that during the last 15 years, most European countries have changed their legislation concerning their tuition fee policy (OECD (2013)) and the trend seems to go for an increase of the share of the cost of tertiary education that should be borne by students. This has been observed primarily via an increase in tuition fees. In many cases, the changes in tuition policy goes along with a greater financial autonomy granted to universities. This is especially true for master's programs and/or for fees asked to non-member states' students but is also generalized in countries where universities tend to have a large degree of freedom. With the crisis hitting the public finances of most European countries, this change is likely to pursue in this direction.

In this paper, we question the implications of a tuition fee deregulation from a theoretical point of view. It is tempting to rely on standard industrial organisation tools to approach this problem. In this respect, the increased mobility of students essentially means that enrollment demand at each university becomes more elastic. This is likely to reinforce tuition fee competition. Also, the increased comparability of the programs means that differentiation, if any, is better perceived. It is therefore tempting to immediately conclude that universities should differentiate their programs to relax tuition fee competition, exactly like firms tend to differentiate their products in oligopolistic markets. We shall argue however that, because of their specificities, universities are less likely than private firms to engage into a very fierce competition. In particular, the fact that universities pursue both teaching and research objectives drastically affect the scope for a tough competition for students.

The intuition is the following: From the point of universities, increasing tuition revenues is not likely to be an objective as such[3], though increasing the size of the population of students might be. In this case, decreasing tuition levels is clearly desirable. However, this may conflict with the pursue of high research achievements if research resources, specifically academics' time and money, are drawn from a common pool that also contributes to produce education. Should fees be deregulated, decreasing fees can be viewed as a way to

[3]As for-profit institutions are rather an exception in the higher education sector.

attract more students, which is likely to increase or decrease tuition revenues depending on the elasticity of individual demands. However, attracting more students may also imply that less resources are available for research. This is of course clear when tuition revenue decreases but it may also be the case if tuition revenues increase should academic time available for research decrease sharply.

The aim of this paper is to explore this intuition systematically. Very few contributions exist in the literature, though we are not the first ones to address the issue of the competitive specificities of the higher education sector. Epple et al. (2008) develop a general equilibrium model where universities choose their fees and their admission standards in order to attract students. Universities are assumed to be ex-ante differentiated with respect to the financial endowment they have. They show that a hierarchy of institutions will prevail with the most able students enrolling in the wealthiest institutions independently of their wealth as tuition discounts would be granted to the students in financial need. Eisenkopf and Wohlschlegel (2012) look at the competition between institutions who are able to choose the level of difficulty of their curriculum. Assuming that this standard both influence the student's participation and the education externality on the local economy, they find that institutions will tend to differentiate themselves further in order to relax the effects of competition. Del Rey (2001) and De Fraja and Iossa (2002) both study the choice of admission standards by multi-tasking universities using a spatial model. The first paper finds that we will have symmetric institutions at the equilibrium. On the other hand, the second paper finds that this result will hold only if mobility costs are large. It is remarkable to notice that these papers all differ in the specification of the objective function they assign to universities. All these paper have in common that they consider institutions which are ex-ante differentiated with respect to their location, their financial endowment or admission standard. We depart from this hypothesis and assume ex-ante identical multi-tasking institutions competing only in tuition fees.

From a theoretical point of view, the model we develop is not entirely standard, even from an industrial organisation point of view. University competition in tuition fees closely mimics firms price competition. In the case where curricula, like products, are assumed to be homogeneous, enrollment, like product demand, is a discontinuous function of a university's fee level. In standard industrial organisation models, this discontinuity explains why firms cannot refrain from undercutting each other, thereby ending up with zero profit. This mechanism is however not as generic as it may seem a priori. It is indeed entirely conditional on the presence of constant marginal costs. When marginal costs are increasing, meeting additional demand becomes more and more costly at the margin and firms may find it unprofitable to do so. The relevant question then is the following: do firms have to fully meet demand or not? If not, they may ration consumers; if yes they may lose profits when undercutting and therefore be more inclined to match the other's price. So, in both cases, price competition is relaxed. Dastidar (1995) is of particular interest for the analysis to follow. He studies the competition between firms in a homogeneous product market with convex costs in a setting where firms must satisfy their full demand. Dastidar shows that price undercutting will not always be a best response for prices higher than the marginal cost. Dastidar's paper also establishes the existence of a continuum of Nash equilibria ranging from a price strictly above marginal cost to the monopoly price. Despite being ex-ante identical, the need to serve the full demand can lead to a decrease in competition and to equilibrium prices set at a level higher than the marginal cost of production. Chowdhury (2009) develops a similar idea but in a framework where non-rigid capacity constraints create a convexity in the cost function.

We argue that competition between universities producing both research and education may generate a comparable mechanism, because of the impact tuition fee competition has not only on education achievements but also on research outputs. Under reasonable conditions, the structure of the payoff function of universities applying to the tuition fee game resembles that of a profit maximizing firm producing under decreasing returns to scale. As a consequence, such universities are likely to escape from the race to the bottom in fee and manage to coordinate on high tuition fees in a Nash equilibrium.

We proceed in three steps. First, we build, in Section 2, a benchmark framework that aims to describe the price competition between two multi-tasking institutions. Then, we develop two specific models and show that the direction in which fees are likely to evolve after a deregulation is largely indeterminate, though the scope for a tuition increase is serious. In Section 3, we consider a setting where the cost of providing education is convex while, in Section 4, an increase in enrollment has an impact on the production of research. Section 5 concludes.

2. Initial setting

In this section we focus on a simplified setup where two universities compete for students by setting fees. We assume that universities are homogeneous while the potential students differ in their willingness to enroll. In other words, enrollment demand is locally infinitely elastic as students who find it profitable to enroll always enroll to the lowest fee university. In other words, as far as demand is concerned, Bertrand competition should take place: in case of fee deregulation, a race to the bottom is expected. We show in this section that this result holds in a first setting where universities pursue multiple objectives. In the next sections, we formalize the fact that, when the fall in tuition fee increases enrollment, it might as well increase the unit cost of providing education services at the margin (as developed in Section 3) or it might increase the opportunity cost of providing education services by reducing the research time available (as developed in Section 4). When this is the case, a continuum of equilibria exist, the race to the bottom is avoided and depending on the level of the regulated fee, there is a scope for fee increases as a result of deregulation, despite of the presence of competition. By considering two peculiarities of the higher education system, we show that a race-to-the-bottom as the one observed in a classical Bertrand setting is far from obvious.
There are two homogeneous universities that compete in fee to attract students. They value teaching achievements T as well as research output R. The objective function of univerisities is specified as follows:

$$Max\ F(T, R)$$

Many particular specifications of this objective function with multiple objectives are possible (and several ones have been retained in earlier papers). As usual, a critical issue is whether T and R are separable in the objective function or not. Notice that separability allows for a complete specialization of a university's tasks. Another critical issue is the extent to which teaching achievements and research output depend on enrollment N_i. Regarding teaching activities, it seems fair to consider that the objective is weakly increasing in enrollment while research is likely to be only indirectly related to enrollment through academics' available time and university budget. More precisely, one needs to specify further the teaching and research technologies. In the case where the population of students is homogeneous in their ability, we are inclined to assume:

$$T(N_i) \text{ with } \frac{\partial T(\cdot)}{\partial N_i} > 0.$$

A convenient assumption that we will make throughout this paper states that: $T = N_i$.
Regarding research output, a reasonable assumption is that research requires money and academics' time. In this respect the relation with enrollment is ambiguous since more students may imply more (or less) research budget (represented by Y_i) and (weakly) less academics' time (represented by $r - a$). We assume that time devoted to teaching is a linear function of the number of students enrolled. More specifically, we assume the following specification:

$$r^a = t - \chi N_i$$

where t denotes the total academic time at the universities' disposal, and $\chi \in [0, 1]$ denotes a proportionality coefficient that summarizes the teaching/student ratio.
For simplicity, we retain a Cobb-Douglas function to model the production of research such that:

$$R(Y_i, r^a) = [Y_i]^\alpha [r_a]^\beta \tag{1}$$

where α and β are the output elasticities of money and time, respectively.
Universities set fee f_i non-cooperatively. The per-student cost of education is such that $c_i = \delta$. We assume that δ's are similar for both universities and is constant. They only receive funding from the fee paid by the N_i enrolled students.

In order to simplify the analysis and possibly obtain tractable closed form solutions, we shall assume the separability between research and teaching, and hence a perfect substitutaility between the two objectives. This also allow us to introduce the option of full specialization in either teaching or reserach as an a priori relevant option. The optimization problem of a university i is thus defined as:

$$\max_{f_i} \gamma N_i + [Y_i]^\alpha [r_a]^\beta \quad s.t. \quad Y_i + N_i \delta = N_i f_i$$

where the parameter γ is a weight showing the importance given to the teaching compared to the research objective.

The utility students derive from graduating at university i is defined by $u_i(\theta) = \theta - f_i$ where θ represents the student's willingness to pay to go to the university. θ is uniformly distributed in $[0, 1]$. The student population is therefore normalized to the unit.[4]
Because universities are strictly homogeneous, the demand for enrollment addressed to a particular university is a discontinuous function of tuition fees. Specifically, we have:

$$N_i(f_i, f_j) = \begin{cases} (1 - f_i) & if \quad f_i < f_j \\ \frac{1}{2}(1 - f_i) & if \quad f_i = f_j \\ 0 & if \quad f_i > f_j \end{cases} \tag{2}$$

If we assume that universities have to meet demand, i.e. they are not allowed to deny admission,[5] the best reply of university i against f_j, might a priori take two forms:

1. $f_i = f_j$ in which case the universities share students equally. We call this best response profile *Matching*.
2. $f_i < f_j$ in which case university i grabs all students. We call this profile *Undercutting*.

Two remarks are in order at this step. Notice first that below some specific threshold, enrollment is so large that no time nor money is left for research. Second, deciding not to enroll students (by setting $f_i > f_j$) cannot be a best reply in the present setup because research output is nil when tuition revenues is nil.
In the standard competition model a la Bertrand, the *matching* profile is always dominated by the *undercutting* profile since this last profile ensures a discrete upward jump in the objective function by increasing revenues. The aim of this basic setting is to offer a first simple model where universities competing a la Bertrand have multiple objectives. In order to better highlight

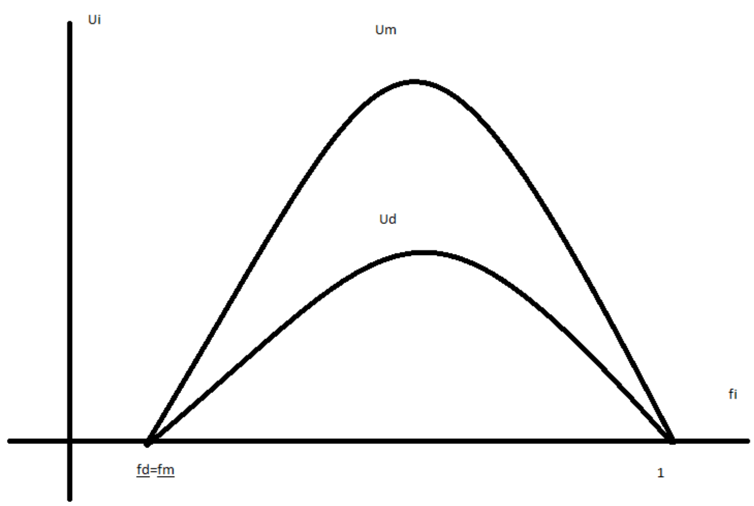
[4]Notice that we assume here that students are homogeneous in all respect but their willingness to enrol. In particular we do not allow for heterogeneous abilities, or locations. This assumption is retained in order to ensure that competition is a priori as fierce as possible. Introducing additional heterogeneity would smooth the process we describe hereafter but would preserve our qualitative results.

[5]This assumption is not entirely innocuous. Indeed, forbidding students rationing allows us to preserve the existence of Nash equilibria in pure strategies. Should rationing be allowed, we would have to rely on mixed strategy equilibria. Notice however that in this last case the scope for high tuition fees in equilibrium is preserved on average.

the results of this section and the next one, we first assume that $\alpha = 1$ and $\beta = 0$, i.e. the research output is solely a function of the money invested in it.
Following these assumptions, the utility function of university i is such that:

$$U_i(f_i, f_j) = \begin{cases} (1 - f_i)(f_i + \gamma - \delta) & if \quad f_i < f_j \\ \frac{1}{2}(1 - f_i)(f_i + \gamma - \delta) & if \quad f_i = f_j \\ 0 & if \quad f_i > f_j \end{cases} \tag{3}$$

Figure 1: Initial case



This utility function is represented in Fig. 1 where U_d represents the case where fees are equal (i.e. the *matching* profile), so that students split between both institutions ($f_i = f_j$) and U_m the case where they enroll at a single university ($f_i < f_j$, i.e. the *undercutting* profile). Straightforward computations indicate that the lower bound, for a weakly positive utility level for f_i, is given by $\underline{f_d} = \underline{f_m} = \delta - \gamma$.

Proposition 1: Race-to-the-bottom Equilibrium. *$f_i = f_j = \underline{f_d} = \underline{f_m}$ is the unique Nash equilibrium of the tuition fee game defined by the objective function in Eq. 3*

Proof. For all the fees strictly above $\underline{f_d} = \underline{f_m} = \delta - \gamma$, there is an incentive to deviate by choosing a slightly lower fee in order to be the only institution attracting students on the market, i.e. price undercutting is a best response. Hence, there exists neither symmetric nor asymmetric equilibria in this range. At $\underline{f_d} = \underline{f_m}$, price matching is a best response compared to price undercutting as the incremental cost of attracting an additional student at the margin cannot be compensated by the fee he is paying. Last, against $f_j < \underline{f_d} = \underline{f_m}$, firm i is better off setting any fee $f_i > f_j$ in order to secure no enrollment and thus zero utility. Hence, there exists no equilibrium in this domain either. □

We find that, under this configuration, we will have a race to the bottom occurring with the specificity of having tuition fees lower at the equilibrium than the marginal cost of providing education. This is so because the benefits derived from attracting additional consumers are not limited to the revenues they bring, i.e. education is valued for its own sake. It is also important to notice that the utility derived at this unique Nash equilibrium is nil. Notice that in equilibrium $R_i < 0$, i.e. the amount of fee revenues allocated to research is negative. This means that research is cross-subsidizing education as funding only comes from the educational activities. This also means that the university's net operating revenues are negative. Thus, our approach takes a short run perspective by assuming that this deficit is covered by the endowment funds accumulated throughout the previous years by the university or by a lump sum subsidy.

3. In the presence of (non-rigid) capacity constraints

In the basic setting, each universities had no physical constraints and had a constant unit cost of production. In this section, we assume the existence of non-rigid capacity constraints in the production of education. There are several reasons to think that there are decreasing returns to scale in the production of education, at least after an enrollment treshhold. There is of course the interpersonal relation cost in the teaching practice. In addition, the fixed assets used in educational activities (as librairies, computer rooms or aulas) are, at least partially, rival in their consumption and have a fixed capacity. The same holds for administrative tasks linked to the provision of education which can also face congestion costs related to large bureaucratic institutions. The empirical literature on this issue (see Bonaccorsi et al. (2006) and references discussed therein) has shown that this is particularly

true in undergraduate education and in scientific degrees. The aim of this section is therefore to show how a formalization of the production of higher education more in line with these characteristics can influence the pricing decision of universities.
We denote this capacity threshold by $\overline{k}$. The university can however enroll (and thus graduate) beyond capacity but at an additional marginal cost equal to μ. This way of obtaining a convexity in the cost function is similar to the one of Chowdhury (2009).
More precisely, if $(1-f_i) > \overline{k}$, i.e. $f_i < 1-\overline{k}$, the payoff function of university i is given by

$$N_i(f_i, f_j)(f_i + \delta - \gamma) + (\overline{k} - N_i(f_i, f_j))\mu$$

Or, equivalently,

$$N_i(f_i, f_j)(f_i + \delta - \gamma - \mu) + \overline{k}\mu.$$

In words, we assume that if the university enrolls beyond installed capacity, it has to incur an extra marginal cost of teaching, which therefore impacts negatively the research output.
The utility function of a university i can then be rewritten as:

$$U_i(f_i, f_j) = \begin{cases} (1-f_i)(f_i+\gamma-\delta) - \max(0, (1-f_i) - \overline{k})\mu & if \quad f_i < f_j \\ \frac{1}{2}(1-f_i)(f_i+\gamma-\delta) - \max(0, \frac{1}{2}(1-f_i) - \overline{k})\mu & if \quad f_i = f_j \\ 0 & if \quad f_i > f_j \end{cases} \tag{4}$$

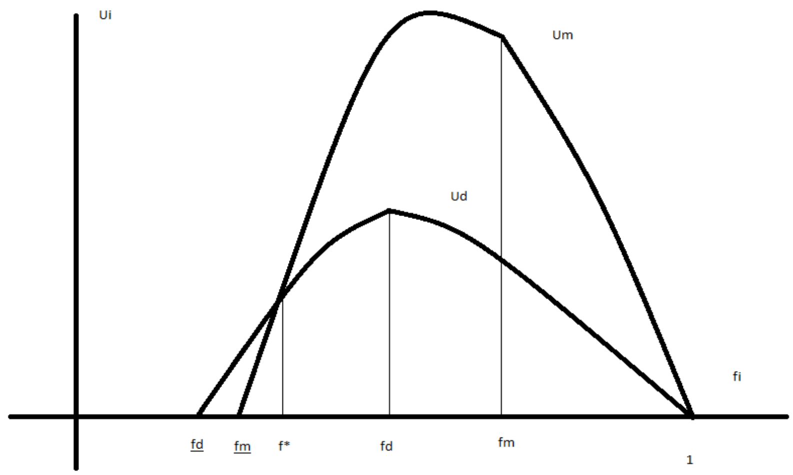
The presence of the upward jump in Eq. (4) introduces a kink in the objective function, irrespective of whether university i matches the other's fee or undercuts it. However, the critical fee for which the kink occurs differ from one case to the other. Moreover, it is not clear anymore that the undercutting strategy always dominates the matching one. A typical picture of Eq. (4) is represented in Fig. 2.

Straightforward computations using the first and second branch of Eq. (4) allows to define:

- $f_m = 1 - \overline{k}$: the fee level for which the constraint starts being binding along the first branch of Eq. (4). It is defined by $(1 - f_m) - \overline{k} = 0$.
- $f_d = 1 - 2\overline{k}$ identifies the corresponding binding fee threshold along the second branch. It is defined by $\frac{1}{2}(1 - f_d) - \overline{k} = 0$.

Below these fee levels, the unit cost of production is equal to $\mu + \delta$.
Then, denoting $U_m(f_i)$ and $U_d(f_i)$ as respectively the first and second part

Figure 2: Case with non-rigid capacity constraints



of Eq. (4), we define:

- $f^* = \mu + \delta - \gamma$ is the fee such that $U_m(f^*) = U_d(f^*)$.
- Finally, we have $\underline{f_m} = \frac{1+\delta+\mu-\gamma}{2} - \frac{\sqrt{K}}{2}$ and $\underline{f_d} = \frac{1+\delta+\mu-\gamma}{2} - \frac{\sqrt{K+4\bar{k}\mu}}{2}$ (with $K = ((\delta+\mu-1-\gamma))^2 + 4\bar{k}\mu$) which are respectively defined by $U_m(\underline{f_m}) = 0$ and $U_d(\underline{f_d}) = 0$.

Proposition 2 (University fee competition with non-rigid capacity constraints). *Suppose universities face a capacity level $\bar{k} < k^* = (1+\gamma-\mu-\delta)$, there exists a continuum of symmetric Nash equilibria in the domain $[\underline{f_d}, f^*]$. Universities enjoy a weakly positive utility in these equilibria and the equilibrium $f_i = f_j = f^*$ Pareto dominates the other ones.*

Proof. For all the fees above f^*, price undercutting is preferred to price matching as $U_m(f_i) > U_d(f_i)$. For fees below f^*, undercutting is no more a best response as the benefits that it brings (in terms of fee revenues and of valuation of education for its own sake) are higher than its cost (the unit

and the non-rigid capacity constraint cost). In other words, For fees below $\underline{f_d}$, the universities will prefer not to attract any student (and have a utility equal to zero) compared to price matching or price undercutting. All fees between $\underline{f_d}$ and f^* are symmetric Nash Equilibria. It can be easily shown that all these fee levels bring a weakly positive utility level to the university. Furthermore, utilities are increasing in fee in this domain. Hence f^* Pareto dominates the other equilibria.
The condition for non-uniqueness of equilibrium is such that $f_m > f^*$, i.e. $\overline{k} < k^* = (1 + \gamma - \mu - \delta)$. This means that capacities must be small enough compared with the number of students who can potentially enroll. Therefore, the convexity created by capacity constraints must be playing a role at the equilibrium in order to have a multiplicity of NE. □

A specific case, respecting the non-uniqueness condition, is drawn in Fig. 2. Graphically, the main difference compared to the base case depicted in Fig. 1 is that the two functions have a kink and that they cross at a level above the f_i axis. We see that choosing at the equilibrium a fee between $\underline{f_d}$ and f^* gives a positive utility to both institutions. Notice also that the equilibria are easily pareto ranked from the point of view of the institutions: the equilibria exhibiting the highest fee dominates all the others.[6] This example suggests that the presumption according to which the liberalization of tuition fees would undermine universities' finance, because of a race to the bottom competition must be challenged.
An interesting comparative static analysis is the one with respect to the multi-objective nature of higher education, as formalized through γ. The size and the location of the range are both impacted by this variable. We have that an increase in γ leads to a decrease in the size of the range. $\underline{f_d}$ tends to zero and beyond as γ gets larger.

4. In the presence of time scarcity

In this section, we highlight a second mechanism through which market forces in the higher education system could be impaired. We will show that a

[6] This result is reminiscent of Dastidar's who illustrates firms' ability to sustain collusive outcome under Bertrand competition in case of increasing marginal costs (Dastidar (1995)). See also Cabon-Dhersin and Drouhin (2014) for a plausible selection procedure leading to the Pareto dominant outcome as unique equilibrium.

result qualitatively similar to the one just exposed can be obtained with the same cost structure as in our basic setting. When enrollment of additional students creates an externality on the research objective, we will show that there is a scope for fees higher than the one prevailling under our basic setting at the equilibrium. This negative externality can arise because of the additional time demanded to teach larger classes. Hence, an increase in enrollment will also create an opportunity cost by decreasing the time to invest in research activities.
For this reason, we follow the more general setting where α and β are both strictly positive in Eq. 1. In this setup, the maximization problem will be such that:

$$\max_{f_i} \gamma N_i + [Y_i]^\alpha [t - \chi N_i]^\beta \quad s.t. \quad Y_i + N_i\delta = N_i f_i$$

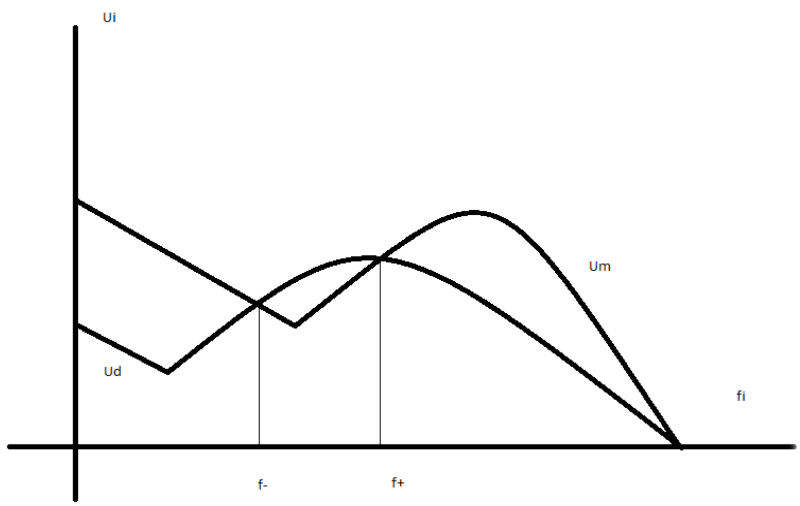
In this case, this is less clear whether, as in the model a la Bertrand presented in the basic setting, the *matching* profile is always dominated by the *undercutting* profile. Although *undercutting* ensures that enrollment sharply increases, along with tuition revenues, it also implies that time available for research sharply decreases. In other words, there is a possible loss in terms of research output. As a result, *undercutting* might be dominated by the *matching* strategy. Notice then that when this is the case, there is, like in the previous section where there are non-rigid capacity constraints, room for a multiplicity of equilibria.
In order to characterize the nature of Nash equilibria, one needs to identify the domain of f_i where *matching* dominates *undercutting*. To this end we solve the following equation for f_i:

$$\gamma(1-f_i)+[(f_i-\delta)(1-f_i)]^\alpha[t-\chi(1-f_i)]^\beta = \gamma\frac{(1-f_i)}{2}+[(f_i-\delta)\frac{(1-f_i)}{2}]^\alpha[t-\chi\frac{(1-f_i)}{2}]^\beta,$$

taking into account that $t - \chi N \geq 0$.
Needless to say, we are not able to obtain closed form solutions. Numerical computations indicate however that there exist meaningful parameters constellations where the desired result holds. Figure 3 illustrates the shapes of payoff function for specific values of the models' parameters.

The *undercutting* profile, represented by U_m shows the case where the university enrolls all the active students. It is a concave function for high fees down to the point where the non-negativity constraint $T-\alpha N \geq 0$ binds. For

Figure 3: A typical configuration of payoffs function



lower fee, the university concentrates on teaching so that its payoff is strictly increasing in enrollment, i.e. decreasing in fee level. U_d describes a universities' payoff under the *matching* profile. It is immediate to see that payoffs under the *matching* profile dominate the *undercutting* one for $f_i \in [f^-, f^+]$. In other words, in this range, the best reply of university i against f_j consists in matching this fee. By symmetry, this is also true for university j so that each fee level in this domain defines a symmetric equilibrium. On the figure, it is also clear that in this domain, the payoffs is maximized at the upper end of the interval, so that the equilibrium f^+ Pareto dominates all the other ones.

This example suggests that the presumption according to which the liberalization of tuition fees would undermine universities' finance, because of a race to the bottom competition must be challenged. Once again, where we are along the objective function is an empirical question. Compared with the previous setting, this result does not arise due to the actual cost of enrolling additional students but due to its opportunity cost, as this negatively influences the other obtective pursued by the higher education institutions

5. Conclusion

The multi-objective nature of universities and the peculiarities of the production of education induces non-standard effects in the case where tuition fees is their single control variable. Because enrollment levels affect their total budget, the marginal cost of providing education and the time available for professors to do research, the scope for a very severe competition in fees between universities is probably limited. According to our knowledge, this is the first time that the competitve forces at stake in the higher education sector are studied in a setting where universities are ex-ante homogenous.
This stylized model is the first to highlight the important role of scale in higher education markets. Recently, this issue has received a lot of attention in the media through the emergence of MOOC platforms (see a.o. The New-York Times (2013); The Economist (2013)). MOOC is an acronym for Massive Open Online Courses. These platforms provide courses to a very large number of students at a zero price. Thanks to these online platforms, it is possible to take advatantage of the scalability of internet by providing an education which is non-rival in its consumption as its marginal cost is zero, or at least very close to zero. Willing to increase the accessibility of higher education by reducing the financial burden of studying, several governmental initiatives (see European Commission (2013); The White House, Office of the Press Secretary (2013)) have arisen to encourage further innovation in this direction. This can take place in different forms by the rise of new contenders in the higher education system or, more likely, by the use of these technologies by the incumbent institutions in order to provide some of their classes through this medium or by providing online programs in parallel to the ones taught live. Based on our results, we can have an interesting insight on this topic. Yes, as formalized in Section 3, higher returns to scale n the production of education by universities can lead to a decrease in tuition fees. However, this is possible at the cost of three important assumptions. First, as shown in Section 4, these new enrollments must have no influence on the time availability of professors to do research. Second, these innovations must not necessitate an additional fixed cost. Finally, the quality of these programs must be seen as similar by students.
Ultimately, to be able to state robust policy recommendations surrounding this problematic, we need to know more about the precise presence of economies of scale in higher education and of scope between higher education and research. This empirical question has attracted a lot of attention

(see for example Cohn et al. (1989); Koshal and Koshal (1999)). However, evidences tend to give diverging conclusions about the presence of economies of scale/scope. Hence, further investigations should be done in this direction in order to better understand the characteristics of the production function of higher education institutions and how it can impact their pricing decision.

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