On the Indeterminacy of the Optimal Tuition Fees for a Monopoly University

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Abstract

This paper explores the implications of tuition fee liberalization in a market for students controlled by a monopoly university. The objective function of the university is typically oriented towards teaching and research outcomes. We show that the joint concern for teaching and research implies that the tuition fee level after liberalization is basically indeterminate.

Keywords:
higher education institutions, tuition fee competition, multi-objective,

1. Introduction

Higher Education students are increasingly mobile in Europe after the so-called Bologna process. There are different reasons for that: public subsidies, better information, lower transportation costs...In this context, universities express the concern that a fiercer competition engages universities into a race to the bottom at the level of fee in order to attract students, with the result that the revenues originating from the fees decreases drastically. Another concern is that devoting more efforts to attract students, universities partly sacrifice research.

A key issue in this respect is the expected evolution of tuition fees. At least in Europe, where fee levels have been severely, if not entirely, regulated until now. Casual observation suggests indeed that during the last 15 years, most European countries have changed their legislation concerning their tuition fee policy (OECD (2012)) and the trend seems to go for an increase of

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the share of the cost of tertiary education that should be borne by students. With the crisis hitting the public finances of most European countries, this change is likely to pursue in this direction (EUA (2011)).

The reaction of higher education institutions to a liberalization of tuition fees remains understudied from a theoretical point of view. It is tempting to import theoretical models developed in the firld of industrial organization to address this issue. The key problem then amounts to specify the objective function of the university. There exist no such benchmark as the neo-classical theory of the firm to select one particulat objective. For instance, De Fraja and Valbonesi (2012) assume that universities maximize research output. Teaching matters in their model only indirectly because it generates revenues. By contrast, De Fraja and Iossa (2002) assumes that universities maximize prestige, which depends positively on the number os student, their average quality and the research budget. Del Rey (2001) defines the objective function as a linear combination of total productivity and research funding while Gautier and Wauthy (2007) focus on aggregate research output accross departments. Fairly enough, the particular modelling choice retained in the above mentioned papers is parlty governed by tractability concerns. Beath et al. (2003) are more general in this respect and their model accomodates for many situations. In particular they focus on the extent to which a given set of funding rules affect the research-teaching trade-off dependiong on the objective function assigned to the university governance body. Our paper is very close in spirit to theirs' .

In the present paper, we model a monopoly university whose objective function combines research and education achievements. We show that the multidimensional nature of the resulting objective function leads to an essential indeterminacy regarding the level of the optimal fee, and therefore with respect to the direction of tuition fee adaptation in case of a liberalization. The impact of the liberalization on the fee level enterily depends on the specification of this objective function. It seems therefore urgent to improve our knowledge of the relevant specifications.

2. The Optimization Program of a Monopoly University

In this section, we formalize the optimization program of a university that is allowed to choose fee strategically. This is not a trivial task since, contrary to the neo-classical firm model in IO, there exists no consensus at all in the scientific community on a detailed specification of the objective function assigned to a HEI.[3]

- **Building an objective function**

We focus on the two main task traditionally assigned to universities, namely teaching and research. These two activities should enter directly in the objective function. A generic specification of the objective function is as follows:

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

where T denotes teaching achievements and R research output. Many particular specifications of this objective function 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.

The next critical issue is the extent to which teaching achievements and research output depend on enrollment. In this respect it seems fair to assume 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, we are inclined to assume

$$T(n^s) \text{ with } \frac{\partial T(\cdot)}{\partial n^s} > 0.$$

As far as teaching is concerned, one also has to specify a teaching technology that relates the number of students enrolled and the teaching achievement through the resources devoted to teaching activities, namely academics' time. Defining by t^a the time devoted to teaching, the most convenient assumption states that the teaching/student ratio is exogenous and constant[4], i.e.

$$t^a = \alpha n^s$$

Regarding research output, a reasonable assumption is that research requires money and academics' time:

$$R(Y, r^a)$$

[3] In this respect, most useful references have already been discussed in the introduction.

[4] One can for instance think to it is regulated by the public authority.

Notice then that in this respect the relation with enrollment is ambiguous since more students may imply more (or less) research budget and (weakly) less academics' time. A convenient shortcut consists in assuming that the academics' time available for research is defined residually as

$$r^a = t - t^a$$

As a result, academics' time is always subject to a trade-off between teaching and research

Another direct link with enrolment results from the fact the university should pursue her objective subject to some budget constraint. The specification of this constraint is obviosly crucial. On the revenues side, we shall find teaching revenues (tuition fees and subsidies mainly) and research fundings (public and private). On the other side we shall find the wage bill, teaching infrastructures and research expenses.

A natural specification is the following one:

$$n^s(t + \tau) + F = wn^a + b(n^s) + K$$

where n^s, n^a denote respectively the numbers of students enrolled and the numbers of academics. F is a fixed component, t and τ denote respectively the tuition fee and any possible public subsidy. w is the academic wage, $b(n^s)$ denotes administrative costs and Y represents the research budget. Most papers in this literature indeed rely on the budget constraint being binding to define the research budget residually as

$$Y = n^s(t + \tau) - wn^a - b(n^s - K)$$

As a result, the budget constraint can be directly plugged into the objective function. All in all, we end up with an objective function which can be entirely expressed as a set of functions whose main argument are students' enrollment and tuition fee levels.

$$F(T(n^s(f), t^a(n^s(f))), R(Y(n^s(f), f), r^a(n^s(f))))$$

Obviously, even with standard regularity assumptions on each separate component of this objective function, there are absolutely no reason to think that the objective function is itself regular, and in particular globally concave in fee level. Depending on the particular feature of the $F(\cdot)$ with respect to its main arguments $T(f)$ and $R(f)$, we can easily think of specifications such that there would be several local maxima; typically one with a low fee, large enrollment and limited research output and another one with large fee, limited enrollment and a large research output.

- **An example**

Let us assume that the population of students, when enrolling to university, is described by the utility function $U = x - f$ with x denotes the type of a particular student. Types are uniformly distributed in the $[0, 1]$ interval. The utility derived from not attending university is normalized to 0. The total number of potential students is N We may therefore define the demand for enrollment as:

$$n^s(f) = 1 - f$$

We shall further assume that the aggregate academics' time is fixed, i.e. we are in the short-run and we concentrate on the extent to which the liberalization of tuition fees will induce a redistribution between teaching and research activities.

$$T(n^s) = \alpha n^s$$

$$R(\cdot) = (fn^s)^k (T - \alpha n^s)^k$$

In other words, we basically assume that teaching output is simply a increasing function of the number of students and the amount of academic's time devoted to teaching activities (α). As far research is concerned, we assume a Cobb-Douglas function with money (proxied by collected fees) and time (defined as residual time available for research) as input. This is the most simple setup that allows to formalize the trade-off between teaching and research when fees can be chosen. Decreasing fee increases enrolment which contributes to imporove teaching achievements. But at the same time, it leaves academics with less time for doing research. The loss of time can nevertheless be compensated by an increased amount of collected fees. Note also that in the short-run, we may identify the lower bound for tuition fees such that there is no time left for research. When this non-negativity constraint is binding, the only remaining argument in the objective function is the teaching output

Finally, we define the objective function of the university as a CES function

$$F(T, R) = (T^\epsilon + (Max\{0, R\})^\epsilon)^{\frac{1}{\epsilon}}$$

Figure 1: A typical configuration of payoffs function

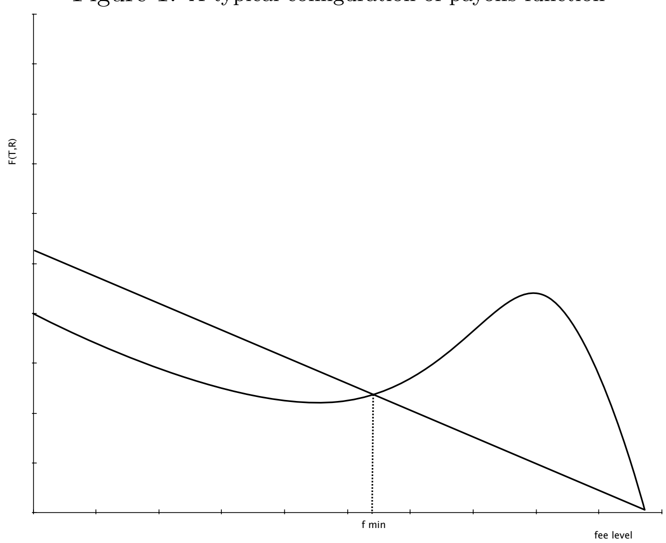

Figure 1 displays a typical configuration of the global payoff function. for $f \leq f^{min}$, the relevant function is the linear decreasing one, which exhibits a local maximum at the corner solution where enrollment is maximal. for $f \geq f^{min}$, the relevant function is the concave one exhibiting a local maximum. For most values of the parameters we end up with two local maxima and the position of the global depends on the value of the parameters.

It is not possible to solve the above expression for a local maximum. as a result we are not able to formally identify the relevant candidate. Some general qualitative results may nevertheless stated.

- First, the non-regularity of the global objective function implies that starting from some regulated fee level f^r, the direction of the change in fee is a priori indeterminate. In a monopoly context, liberalization may either increase or decrease enrollment depending on the preferences of the university (the value of parameter ϵ)

- Given university preferences, a similar conclusion holds regarding the properties of the research production function (parameter k). Other things equal, increasing returns to scale tend to favor an increase in optimal fees.

Summing up The multi-objective nature of HEIs therefore induces non-standard effects in the case where tuition fees is their single control variable.

Because enrollment levels affect both their total budget and the time available for professors to do research, the university is exposed to a trade-off between two regimes: a teaching intensive one (with low fees) and a research intensive ones (with higher fees). Which of the two is most likely to prevail depends on the university's preferences and technology.

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