Teaching versus Research: the role of Internal Financing Rules in Multi-Department Universities

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Abstract

In this paper, we combine the multi-department structure which characterises universities with the multitasking nature of the academic's incentive problem. We show by mean of an example that a conglomerate structure in the university may actually be instrumental in inducing high efforts from the academic in its two basic activities. Accordingly, depending on the shape of its preference, the university may implement various combinations of teaching and research outputs by altering the incentive package it offers to academics.

Keywords: University governance, multitasking

JEL Classification: D21, D82, G31, I20

1 Introduction

Universities count teaching *and* research as part of their core social goals and, in an ideal world, one would like to see any university to excel in both dimensions. As a matter of fact, universities may also specialize on the mass teaching segment or the research oriented one and very little is known about how effective universities are in achieving either the ideal of combining teaching and research or the more limited objectives they retain. While some evidences from UK (see Shattock, 2002) point to universities which perform very well in research as well as in teaching, it is hard to obtain a more general picture, i.e. to see what happens exactly in those less prestigious universities. The situation is even more opaque in many continental systems where university assessment is in its very enfancy. As argued by Neary et al. (2003), it is widely accepted that "...poor governance structures and inappropriate incentives...still characterize so many European Universities" (p. 1240).

Combining high quality teaching and high quality research is actually desirable for the universities themselves, in particular in a system where universities are mostly financed on a per student basis and where students' choice depends on (1) teaching quality and (2) university's prestige (which is related to research quality). However, combining high quality teaching and high quality research is often viewed as a source of conflict within universities taken as an aggregate. And as a matter of fact, one may observe that some institutions tend to specialize into teaching activities while others are mostly known for their research achievements.

An obvious reason why research and teaching objectives look conflictual is that at the individual level, an academic cannot perform the two tasks simultaneously. The share of an academic's time which goes to teaching cannot go for research and vice versa. While part of the problem might be solved at the level of a university by specialising academics' tasks, it is often believed that full specialization is not desirable because the activities are complementary in nature. More fundamentally, the tensions between teaching and research activities come from the fact that teaching activities is a crucial source of revenues for universities, especially in continental Europe where the bulk of an institution's budget comes from subsidies and tuition fees that are directly related to the number of students. Under such a financing rule, teaching is costly because it leaves less time for research but it is nevertheless profitable, and necessary, because it raises money which may ultimately finance research.

Notice that a key feature of such a system is the existence of cross-subzidization from teaching sectors to research ones.

Very different factors contribute to explain the universities' actual choice regarding research and teaching quality levels. Among those, the preferences of the universities, their culture, play a crucial role: some universities count mass teaching as their primary mission and will particularly emphasize on that dimension while others will try to excel in their research activities, and might devote little attention to their teaching duties. But the choice of teaching and research level is for sure a constrained one. Even for a university which wants to focus a lot on research, completely neglecting teaching is not possible when the financing of higher education institutions is based mainly on the number of students. Although the resulting trade-off between teaching and research activities has not been widely investigated in the literature, recent contributions in the area definitely put the budget constraint at the heart of the analysis, i.e. the way they formalize the university governance problem is essentially a matter of raising funds on the teaching side to spend money on research activities (see Beath et al (2005)).

Del Rey (2001) models competition between universities who decide on the allocation of funds between teaching and research activities. In her model, teaching achievements and research records enter the university objective function and funding is positively related to the number of students. She studies the balance between research and teaching efforts as a function of the funding rules, which actually determine the scope for research through the financing raised on students. De Fraja and Iossa (2002) point out that the increased students' mobility favors the emergence of "elite" institutions, i.e. a limited number of high research records universities co-existing with other universities focusing on teaching activities. In these two papers, the presence of competition between universities is central to the argument. Beath et al. (2003) focus on the tensions between pure and applied research under binding budget constraints. However, the teaching side of the academics' job is not considered in their paper. Beath et al. (2005) analyze the impact of the higher education funding on the universities' choice regarding teaching and research intensities. In particular, they study the impact of a research quality based funding for the academics[1] on research and teaching level. They show that an increase in the research quality related funding (and a corresponding decrease in the per student subsidy)

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[1]Like the research assessment exercises periodically performed in the UK.

leads to the specialization of universities in either -world class- research and minimal quality teaching or minimal research and higher quality teaching. University specialization implies that there is no longer universities that perform (fairly) good in both dimensions.

A common feature of the above mentioned papers is their focus on external forces to explain the organization of teaching and research within universities. In the present paper, we focus instead on the internal organization of the university and specifically on its implication for the coexistence of teaching and research activities. The paper is organized around two simple ideas. First, universities are active in several disciplines and typically organize teaching and research by relying on departments. Most often though, the budget is centralized and the resource constraint applies at the university level. It means that the allocation of resources is done at the university level too. Thus, universities rely on an internal financing system which is very similar to the internal capital market of a conglomerate firm (see Coupé, 2001). Second, within each departments, academics have to perform both research and teaching activities. While they choose the efforts they put in these two tasks, their choices might be governed by the incentives schemes provided by the authority. In this sense, the possible conflict between teaching and research is akin to a multitasking problem.

In Gautier and Wauthy (2007) we study in details the extent to which incentive schemes can be designed to take advantage of the conglomerate structure of multi-department universities. We show in particular that internal financing rules can be used to create yardstick competition and thereby enhance both teaching and research efforts. In this paper, we develop an example in which we show that depending on the shape of its preference, the university may implement various combinations of teaching and research outputs by altering the incentive package it offers to academics.

2   Model

We consider a university composed of N departments. Each department is responsible for adding to the stock of knowledge in its field through research activities and for disseminating that stock through its teaching activities. The quality of research and the quality of teaching of a department depend on the human and the financial resources spent on each task. In each department, there is a unique academic who

is responsible of research and the teaching efforts.

The research output of department i, denoted hereafter by R_i, is defined as $R_i = r_i(b_i)^{1-h}$, where r_i is the research effort of the academic i and b_i is the research budget of the department. We further assume $h < 1$ so that the marginal productivity of money is decreasing. Notice that a larger value for h means that, other things being equal, money is less essential as an input for research.

Student's enrollment in department i increases with the teaching quality. The latter being a function of the teaching effort exerted by the academic i. If we denote the teaching effort in department i by t_i, we assume that the number of students enrolled in that department (n_i) is $n_i = t_i$.

Each student registered in the university contributes to the university budget by an amount $\bar{s}$. $\bar{s}$ is the sum of the student's tuition fee and the government per-student subsidy (if any). The overall budget of the university B is then $B = \bar{s} \sum_{k=1}^{N} n_k + F$ where F represents all the university resources which are not tied to the number of students. B is entirely redistributed to departments as research funds. The departments have no other resources than those coming from the university's central budget.

The allocation of resources to departments is decided at the university level by its central authority. The allocation of B to the departments will be based on two different criteria. A fraction γ of the university's budget B will be distributed to departments according to the relative qualities of their research projects, that is a research-based allocation of funds. The remaining fraction $1 - \gamma$ will be allocated according the relative qualities of the teaching programs, that is a student-based allocation of funds. In particular, we assume that each department i receives a research budget b_i given by:

$$b_i = \left(\gamma \frac{r_i}{\sum_{k=1}^{N} r_k} + (1 - \gamma) \frac{t_i}{\sum_{k=1}^{N} t_k} \right) B \tag{2.1}$$

Let us call $\alpha_i = \frac{r_i}{\sum_{k=1}^{N} r_k}$ and $\beta_i = \frac{t_i}{\sum_{k=1}^{N} t_k}$; hence $b_i = (\gamma \alpha_i + (1 - \gamma)\beta_i)B$.

The above expression stresses the fact that in our model, it is indeed the *relative* quality of teaching and research which matters. Notice also that we assume all departments to be identical. Therefore they will exert the same efforts. This allows us to focus precisely on the role that can assigned to competition accross departments per se.[2] Hence, at the equilibrium we will have $\alpha_i = \beta_i = \frac{1}{N}$ $\forall i$ and

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[2]We of course acknowledge that the existence of a significant heterogeneity among academic

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all the academics will have the same research budget $b_i = \frac{B}{N} = \bar{s}t_i + \frac{F}{N}$. However, the university's financing rule (γ) will have an impact on the incentives to perform tasks and therefore on the efforts level as we will explain in the next section. A key feature of the the paper is the assumption that departments react to incentives and that the allocation of financial resources influences their choices of effort in both the teaching and the research task.

An academic i derives a private benefit from his research output. These private benefits are for example, notoriety, promotion, job opportunities,... By contrast, we assume that the academic does not derive any private benefit from his teaching achievement i.e it does not pay to be a good teacher. Accordingly, the academic's utility function is defined as follows:

$$U_i = \omega R_i - \frac{t_i^2 + r_i^2}{2}, \tag{2.2}$$

where ωR_i is the private benefit the academic enjoys when he achieves a research output R_i and $\frac{t_i^2 + r_i^2}{2}$ is the cost of performing a teaching effort t_i and a research effort r_i.

The specification of the academic's problem is of course extreme. It clearly makes the worst case for teaching effort in the sense that the only channel through which teaching efforts can be incentivized rests on the funding it raises for research. Notice also that this specification of the academic's preferences fits reasonably well with the view of a market for academics where research outputs are more valuable than teaching abilities: while research outputs are easily evaluated, and attached to individuals through external peer reviewing processes, teaching efforts are less easily transferred out of the institution and are thereby less valuable in the market. Notice also that we assume that there are no synergies, either positive or negative, between research and teaching efforts.

2.1 Incentives

Each academic i will select the level of efforts (t_i, r_i) in order to maximize his/her utility. Integrating the university's financing rule in the utility function, each academic i solves:

$$\max_{t_i, r_i} \omega r_i \left((\gamma \frac{r_i}{\sum_{k=1}^{N} r_k} + (1 - \gamma) \frac{t_i}{\sum_{k=1}^{N} t_k}) B \right)^{1-h} - \frac{t_i^2}{2} - \frac{r_i^2}{2} \tag{2.3}$$

departments may actually play a very significant role.

For convenience, we consider that the university's budget has no other resources than those coming from the students, that is $F = 0$. The first order conditions of the above problem read as follows:

$$t_i = \omega r_i (1-h) (b_i)^{-h} \left((\gamma \alpha_i + (1-\gamma)\beta_i) \frac{\partial B}{\partial t_i} + B(1-\gamma) \frac{\partial \beta_i}{\partial t_i} \right) \qquad (2.4)$$

$$r_i = \omega (b_i)^{1-h} + \omega r_i (1-h) b_i^{-h} \left(\gamma B \frac{\partial \alpha_i}{\partial r_i} \right). \qquad (2.5)$$

Integrating the fact that all academics are identical, that is $t_i = t$, $r_i = r$, $\forall i = 1, ..., N$, the first order conditions can be expressed as:

$$t = \omega r \bar{s}^{1-h} (1-h) t^{-h} g_1(N, \gamma), \qquad (2.6)$$

$$r = \omega \bar{s}^{1-h} t^{1-h} g_2(N, \gamma), \qquad (2.7)$$

where $g_1(N, \gamma) = \left(\frac{\gamma}{N} + (1-\gamma) \right)$ and $g_2(N, \gamma) = \left(1 + \frac{N-1}{N} \gamma (1-h) \right)$. In these first order conditions, the left hand sides are the marginal costs of respectively teaching and research efforts, the right hand sides are the marginal benefits of these two tasks. We are now in a position to discuss the *incentive* effect of the financing rule i.e. how the marginal benefit of each task is affected by the structure of university. This is the object of our first proposition.

PROPOSITION 2.1

1. *The efforts on the two tasks are complements.*

2. *The marginal benefit of teaching effort is decreasing with the number of academics N and with γ.*

3. *The marginal benefit of research effort is increasing with the number of academics N and with γ.*

Part 1 of the proposition states that the effort on one task stimulates the effort on the other task. Recall that the production of research output requires the combination of two inputs: research effort and research funds. Notice then that research funds in department i increase with the teaching effort in that department, though in a proportion that depends on the university's financing rule. Since the marginal productivity of each of these two inputs increases with the quantity available of the other input, more effort on one task increases the incentives to supply effort on the other task i.e. teaching and research efforts are complements. Importantly, this

complementarity is created by the university's financing rule since it establishes a link between teaching effort and research funding. Hence, even if the two tasks are independent in the academic's cost function, the university's financing rules create a complementarity between the two tasks.

The logic behind the model is best captured by considering the marginal benefit of teaching. In this respect, the conglomerate structure of the university might be a problem. Indeed it is likely to weaken incentives towards teaching. Redistribution of funds between departments lowers the academics' incentives to contribute to the university's budget i.e. to attract students through a high quality teaching. The benefit of an additional student - the additional tuition fee- will be redistributed to the N departments of the university and the academic will receive only a fraction $\gamma \alpha_i + (1 - \gamma)\beta_i < 1$. Clearly, the fact that the academic does not fully capture the benefit of his/her teaching effort hurts the incentives. This effect is particularly important when N is large because each academic receives a fraction $\frac{1}{N}$ of the total budget. It is also more important when γ is larger. The parameter γ is an important incentive tool that has a dual impact on incentives: negative for teaching and positive for research. A large γ means that competition for research fund is intense and it therefore stimulates the incentives to perform research effort. More efforts on research might then induce more efforts on teaching because of complementarity. Conversely, a low γ means that a large fraction of the budget is secured in the department that managed to attract the students and as such, it is a strong incentive for teaching effort.

We are now equipped to characterize the optimal effort levels and study their dependence to the basic parameters of the model.

2.2 Efforts

Using equations (2.6) ,(2.7), it is immediate to obtain:

$$t^* = \bar{t}\left[g_1(\gamma, N)^{\frac{1}{2h}} g_2(\gamma, N)^{\frac{1}{2h}}\right] \tag{2.8}$$

$$r^* = \bar{r}\left[g_1(\gamma, N)^{\frac{1}{h}} g_2(\gamma, N)^{\frac{1-h}{h}}\right] \tag{2.9}$$

where $\bar{t}$ and $\bar{r}$ denote the optimal values for efforts in the limiting case where $N = 1$ and $\gamma = 0$, i.e. in the case where there is only one department (i.e. no redistribution takes place) and funding is exclusively depending on students' enrollment. Direct computations indicate:

PROPOSITION 2.2

1. *The optimal teaching effort (t^*) decreases with the number of academics N and decreases with γ.*

2. *(a) If $h \geq \frac{1}{2}$, the optimal research effort (r^*) increases with the number of academics N and increases with γ.*

   (b) If $h < \frac{1}{2}$, the optimal research effort either always increases with γ and N or is non-monotonic
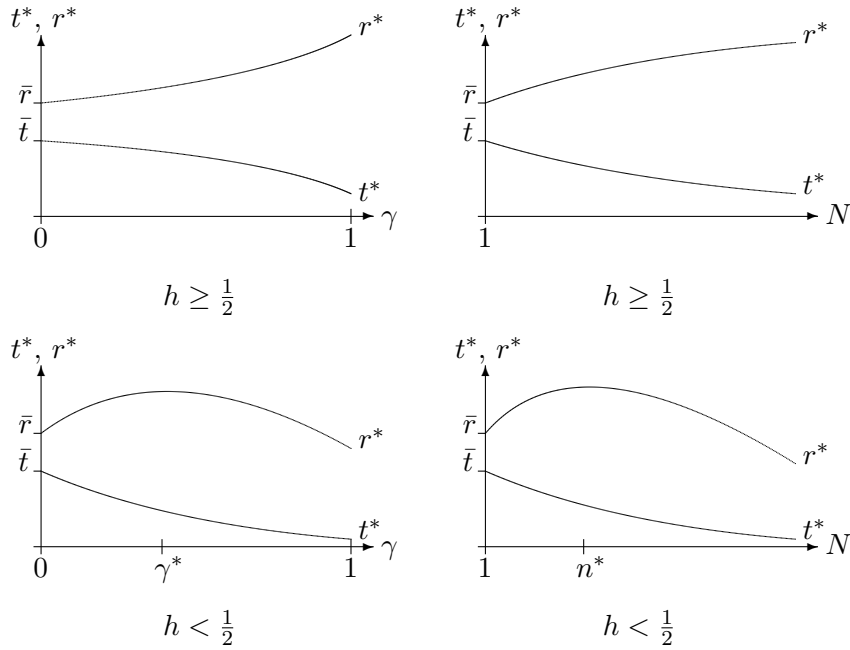
Notice that when h is small the shape of r^* is non-monotonic. Recall indeed that a smaller h actually means that the marginal contribution of money to research output is large, other things being equal. Since the positive effect of the conglomerate structure on research efforts hangs on the presence of yardstick competition between departments, the effect is very quickly eroded whenever a small part of the total budget is subject to research competition (γ is large) or when the benefits of competition are widely diluted (N is large).

2.3   Production Frontiers

We explained in the previous section how different organizational structures for a university - both in term of number of academics/departments and in term of financing rule γ- result in different levels of teaching and research efforts. Our

model also allows to characterize the different output combinations the university can achieve a a function of the internal organization it endorses. Our university produces two different outputs: graduated students in quantity t^* and scientific research in quantity R in each of the N departments. Notice that when we measure the teaching output by the number of students only, we put aside an important dimension of teaching: the students' acquired ability when they exit university. The latter depends obviously on teaching quality but also on the student's ability at the entrance and on the (average) quality of the cohort (peer effect). Most often, universities are not indifferent to the types of student they enroll. However, we neglect these (important!) effects in our framework and the university does not actively control the admission policy. Instead, the university has to enroll all the students which apply, irrespective of their ability at the entrance. In this sense, our model more specifically applies to university systems where the university have the mission of mass teaching and cannot control the ability of the enrolled students through exams and/or tuition fees.

For a given number of departments N, depending on the internal financing rule γ, the university achieves an output combination (n, R) equals to $(t^*, r^*(\bar{s}t^*)^{1-h})$. Proposition (2.2) tells us that when γ increases, n decreases. There are less students and therefore less funds for research. But it does not necessarily mean that the research output decreases because a decrease in research fund is compensated by an increase in the research effort (at least in those parameter space where r^* increases with γ). Direct computations indicate the following:

PROPOSITION 2.3 *The research output increases in γ for $\gamma \in [0, Min[1, \tilde{\gamma}]]$ where $\tilde{\gamma} = \frac{n}{n-1} \frac{1-h+h^2}{5-9h+4h^2}$*

Accordingly, our model leads to the identification of a production possibility frontier for the university

We are now in position to represent the production frontier of a university with N departments. The following figure represents the combination of output that a university can achieve as a function of its internal financing rule γ. Notice that we restrict attention here to that part of the frontier which is decreasing in the $n - R$ space, i.e. that part along which there is a real trade-off between research and teaching.
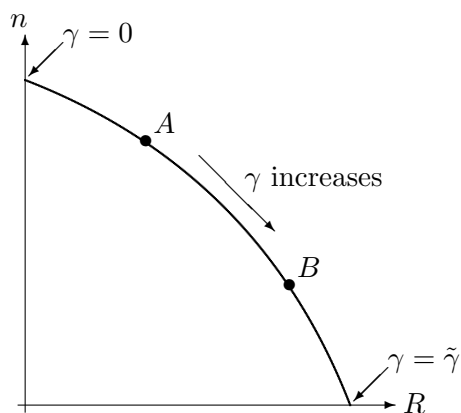
Thus, depending on their preferences for the two-dimensions of the output, the universities will choose different financing rules. For example, a university that value teaching a lot and emphasizes less research will select point A, while a university that is more interested in research and less in teaching will choose point B.

3   Final Remarks

This paper has shown that the allocation of the research budget to departments affects the academics' incentives to exert teaching and research efforts. Incentives, in turn, affect the effort levels and finally the output. Depending on their preferences for the research achievement and for the number of students the universities will choose different financing rules. A university which is more focused on attracting a lot of students will choose a low value of γ (i.e. a research budget based mainly on the number of students) while a university more focused on research will choose a higher value of γ to create more competition for research funds and to stimulate the research efforts. The choice of internal financing rules thus reflects the balance between teaching and research in the objective function, or more precisely in the preferences, of the university. In this respect, our results complements those of Beath et al. (2005) who study the teaching-research trade-off when universities possibly face different financing systems.

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