A Theory of Shared Governance in Higher Education

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Abstract This paper develops a stylized model that describes the relationship between the board composition and the performance of a university. It shows the conditions that need to be respected for a legislator to reinforce the participation of professors in the highest decision making organ of the university. Despite their internal bias and the opportunity cost of democratic institutions, their presence can be needed due to the specific information they have about their *alma mater* which is an input of the decision making process taking place at the board. This analysis sheds some theoretical lights on the introduction of board composition rule for higher education institutions as observed in several European countries.

JEL : I23, L31, G38.

KEYWORDS : Higher Education institution, academic governance, board composition.

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1 Introduction

Since the 90's, a major shift has been observed throughout Europe in the paradigm governing the relationship between higher education institutions and their main funding source, the authority responsible for higher education policy. More and more autonomy has been granted to universities and mechanisms of accountability have been introduced to encourage an adequate use of public funds (Aghion et al. (2010) and Van der Ploeg and Veugelers (2008)). Examples of such mechanisms are the creation of peer review committees accrediting educational and research programs or the obligation to externally report on their activities. The aim of this paper is to study a mechanism used by the funding authority to indirectly keep some form of control, despite granting autonomy, on the functioning of universities. Our concern mainly focuses on regulations of the composition of the supreme governing organ of the university and, more precisely, on how the board seats should be allocated between faculty members and outside stakeholders[1]. This tool is used by the public body in charge of higher education to ensure that the decisions made by the board of publicly funded universities are aligned with the ones that would be the best for the community.
Recently, major changes have been observed throughout Europe (Eurydice (2008), OECD (2008) and EUA (2010))[2]. Over the past years, the number of seats allocated to external stakeholders has increased at the expense of those previously taken by faculty members.
England and France are two representative examples of HE systems that are now slowly converging in the governance policies implemented where the relative importance given to professors in the board of their universities has decreased. In England, a country where the tradition has always granted a large amount of autonomy to universities, the HEFCE, a non-political public body that distributes public funding to HEI's, has issue a governance code of practice and some general principles that should be followed by each subsidized institution (CUC (2009)). It states that the highest decision making body of the university should have a majority of external members "for the incorporation of a wider range of appropriate expertise and the perceived objectivity which would derive from the presence of more lay members" (University of Oxford (2006), p. 3). While other English universities have vol-

[1] Outside stakeholders are usually members of the community coming from diverse groups such as national union organizations, the clergy, private firms, alumni, HE experts, donors, governmental institutions, etc. Note that including people representing the ministry in charge of HE would violate the concept of autonomy.

[2] In the US, regulations of the participation of professors in the university board are less an issue for several reasons. First of all, their participation is quite marginal. According to a survey of the AAUP (Kaplan (2004)), they are represented in only 30% of the private and 52% of the public higher education institutions. In many cases, they don't have voting rights. Secondly, institutions receiving public money are operated by state entities. On the other hand, private institutions only receive governmental funds indirectly through competitive grants offered to students and researchers. Therefore, the legislator doesn't face the same legitimacy to intervene as in Europe.

untarily adopted this model, the Regent House and the House of Congregation, the faculty senate of respectively the university of Cambridge and Oxford, have both voted against a move towards the governance structure proposed by the HEFCE. Right now, the situation is blocked and it is difficult to say if the HEFCE will introduce financial cuts to urge changes in their governance system.

Historically, the French system has granted little autonomy to higher education institutions which were under the direct supervision of the government. Since 2007 and the progressive implementation of the LRU (Loi du 10 août 2007 relative aux libertés et responsabilités des universités), universities, through the intermediary of the board, are now responsible for their budget, for estate management and for human resources. Although, relatively few changes have been observed in the composition of the board of universities some evolutions are soon to be expected. The Minister of higher education asked Philippe Aghion to set up a panel of experts who's main task is to propose further governance reforms that would boost the competitiveness of French universities. Taking top private American universities as best practice, a first intermediary report has formulated that the board should be "overwhelmingly composed of lay members" (Aghion (2010)). Even before considering a clear reform, these proposals received a lot of criticisms in the media mainly coming from faculty members and union representatives.

This work finds its motivation in this policy context. The objective of this paper is to highlight, using economic principles, the rationales that legitimate the participation of professors in the governance of their own institution and, more precisely, in the highest decision-making body of their university[3].

A stylized model that describes the agency relationship between the funding authority and faculty members is developed. We show how a regulation concerning the composition of the university board can affect the functioning of the internal democratic institution specific of the university and how it might further influence the decision making process of the board. The comparative static results of the model describe some of the forces that should be considered when the legislation decides the board design to implement.

The theoretical approach draws from the literature on corporate governance and the models

[3]The primitives of this model also give an explicit role to external stakeholders in the board. It is threefold: to represent citizen's preferences, to bring their expertise and to encourage an efficient use of the democratic institutional system. Hence, we are both following the line of argumentation behind theories seeing the firm as a system of incentives (as pioneered by Holmstrom and Milgrom (1991, 1994)) and resource dependence theories (Pfeffer and Salancik (1978)). For the former, the shape of governance institution is an instrument to (partially at least) resolve a multitasking problem (coupled with a moral hazard in team problem in our setting) while, for the latter, the relative importance of internal and external resources (the information at the disposal of professors and of outside stakeholders in our setting) define the optimal organizational structure of the firm. To motivate this, the formal, game theoretical, approach of the first cited is used.

closely related with the Sarbanes and Oxley act of 2002 on the duties and responsibilities of corporate boards of directors (Becht et al. (2003) and Adams et al. (2001)). Our starting point is the model of Harris and Raviv (2008) which links corporate board composition and firm performance. More precisely, the authors look at how, by choosing the number of external board members, it is possible to mitigate the costs related with a problem where external board members have an incentive to free ride from the acquisition of information needed for the decision making process taking place during the board meeting.

We depart from this approach in several ways specific to the context of the higher education sector. The internal decision making process of the university, where a prevalent role is given to professors, is very peculiar (see a.o. Brown (2001) and Masten (2006)). Compared with the corporate world where inside board members are predominantly executive managers, the universities' internal board members are elected representatives. This democratic configuration assumes that the various governance layers of the university (faculty, departments, research centers, etc.) need to rubber-stamp the input that their representatives can bring during the board meeting. Our model will implicitly consider this by considering the opportunity costs that this internal democratic organization creates at both the institutional and individual level. This will be at the roots of the trade-off faced by the board designer when choosing the number of faculty members who can participate to the board of the university. For this purpose, we re-interpret the original model in a multi-tasking framework where faculty members have to share their time between knowledge productive tasks (by teaching or doing research) and activities related with academic governance. According to several surveys (Tavernier and Wilkin (2001) and Link et al. (2007)), governance tasks crowd-out a substantial amount of the working time of professors away from other activities. Therefore, we focus solely on the divergence in objectives of the funding governmental authority and faculty members by assuming that the preferences of outside stakeholders are aligned with the government. This last assumption can be defended on two grounds. First, thanks to this extreme hypothesis, the conditions needed to have professors participating in the board obtained by the mean of this model, could be seen as a lower bound. Second, compared with the setting as pictured by Harris and Raviv, external board members of higher education institutions are not solely driven by extrinsic monetary motives[4]. In most legislation, law forbids monetary payments to board members in the not-for-profit sectors. Without denying the possible agency problems between the funding public institution and outside stakeholders, we prefer to leave this issue aside for future research by assuming that outsiders are benevolent. Instead, we prefer to shed some new lights on the debate about shared gov-

[4]See Bénabou and Tirole (2010) for a discussion on the non-monetary motives that could explain their participation.

ernance in higher education institutions by analyzing the role played by professors in their institution. Hence, in a similar fashion to Gautier and Wauthy (2006), the choice of the governance structure can indirectly influence the allocation of time of faculty members, which cannot be directly contracted upon, and on the performance of the university.

The two building blocks of our analysis are presented in section 2. The first describes the moral hazard in team problem faced by faculty members in the board and how the legislator can mitigate its cost by choosing the composition of the board. It is composed of two stages. In the initial stage, the public authority in charge of the higher education policy chooses, all else equal, the number of faculty members who can participate to the university board. Then, in the second stage, these faculty members have to decide how they want to allocate their working time between two tasks: the production of knowledge and academic governance. Depending on the time invested by each of the faculty representative in this second task, professors will reach or not an agreement about the information that can be used during the board decision making process. We can think of this as the opportunity cost of having a democratic internal organization. In this building block, we determine the probability with which the faculty members will successfully reach a consensus about the information that can be used as an input for the board meeting. Here, we assume that the expected utility derived from the board decision is exogenous.

The second building block of the model specifies the board decision making process where a policy has to be chosen. It is assumed that each of the two parties composing the board has a private, non-certifiable and complementary information about what is the most efficient policy. Professors are biased towards larger than efficient policy decision and they become informed with the probability defined by the outcome of the first building block of the game. The game then takes place as follows. First, the outside stakeholders, who are in control of the board, have to decide on who will make the final decision. They face two possibilities. They make it and then ask faculty members to communicate their private information or they delegate it to the faculty members and communicate to them their own private information. Finally, the decision is made. Hence, we have a moral hazard problem with hidden information. Due to the fact that information is private and non-certifiable and due to the conflict of interests between professors and outside stakeholders, each party will communicate strategically his information.

Section 3 shows the comparative static results derived from these two interconnected building blocks and link them with other empirical and theoretical works on the policy issue tackled by the model.

Section 4 concludes.

2 Model

2.1 Description

The timeline of the game is the following.

- Stage 0: Institutional design
  The regulator for higher education chooses n, the number of professors that will seat in the university board.

- Stage 1: Faculty time allocation
  Each i of the n faculty members seating in the highest decision making organ of the university decides how to allocate his time between academic governance x_i and the production of knowledge k_i.
  The outcome of stage 1 is observed. Both parties composing the board (professors and outside stakeholders) become informed of the state of the world. With probability $p(x, n)$, professors successfully reach an agreement about the information that can be brought on to the board. With probability $1 - p(x, n)$, professors go the board meeting without information.

- Stage 2: Delegation stage
  In both states of the world, the outside stakeholders of the university board have to decide to whether or not delegate the strategic decision choice to the faculty members. If delegation takes place, outsiders will communicate their private information about the strategic decisions that has to be taken to the professors. Otherwise, professors will communicate their private information to the outside stakeholders.

- Stage 3: Strategic decision stage
  The strategic decision s is chosen. The payoffs are observed.

The model is divided and solved in two parts: the academic governance part (composed of the first two stages) and the board decision-making process (composed of the two subsequent stages). It is solved using backward induction. However, we first analyze the academic governance part taking the expected payments derived from the board decision-making process as exogenously given. This is possible because the two parts can be solved independently. The strategic choices made in the academic governance part do not impact the choices made in the second part of the model. The number of professors participating in the board and their time allocation only determine the probability that we end up in one state of the world or the other.

2.2 Academic Governance

2.2.1 Faculty time allocation: stage 1 of the game

The university is composed of N faculty members. $N-n$ of them spend all of their working time doing research and teaching, namely producing knowledge. In this model, they are non-strategic agents. The n other faculty members are strategic multitasking agents. They are members of the board of the university and have to decide how to allocate their time, normalized to the unit, between the production of knowledge k_i and academic governance x_i. The first consists of the time spent on teaching and research activities while the second includes the time allocated on academic governance activities in order to reach an agreement among faculty members about the information that can be brought on to the board.
Each i of the n professors faces the following maximization problem under constraint:

$$Max_{x_i,k_i} \quad \delta_f k_i^{\gamma_f} + [\kappa_f + p(x_i, x_{-i}, n-1)V^F] \quad s.t. \quad x_i + k_i = 1 \tag{1}$$

The time spent on the production of knowledge is the unique input of a stylized production function of knowledge where we assume that there are decreasing return to scale, i.e. $\gamma_f < 1$. For simplicity, this parameter will be common to all professors. The second term shows how the time spent on academic governance enters the utility derived from the board decision. The underlying assumptions behind this specific functional form will be discussed in the next subsection. For now, what is important to understand is that κ_f is the expected intrinsic value for professors derived from the decision that needs to be made by the board of the university when there is no academic governance and that V^F is the expected added value for professors from making a decision based on the information on which academics have successfully agree upon during the internal democratic process. It enters the function in a multiplicative way with $p(x_i, x_{-i}, n-1)$, the probability to reach a successful agreement. This probability depends on the time x_i that professor i spends on academic governance and on the x_{-i} unit of time spend by the $n-1$ other multitasking professors. Note also that δ_f represents the weight given to the first of the two objectives. Therefore, the time allocation decision will depend on the trade-off between the utility derived from the individual production of knowledge and the one from the board decision, which bears some of the characteristics of a public good.
Implicitly, this means that the following assumptions are made. First, for simplicity, the two elements of the utility of faculty members enter the function in an additively separable way. This means that being active in academic governance cannot have an indirect impact on the individual production of knowledge. In other words, x_i and k_i are substitutes. Second,

we suppose that it is impossible to write a contract stipulating the allocation of time of professors, or at least, that this contract would not be enforceable due, for example, to a problem related with the measurability of the output produced. Third, we don't consider monetary issues due to a possible wage differential of being active with governance issues. Our concern is on faculty members active in the production of knowledge and academic governance, not on faculty administrators. Finally, to ease our computations, we will later on suppose that the n professors are homogeneous and we only focus on symmetric Nash equilibrium. Therefore, we are not concerned with who is active in academic governance but we are only looking at the incentives to participate to this type of tasks.
Solving (1), we find that the n following first order conditions must hold at the optimum:

$$\delta_f \gamma_f (1 - x_i)^{(\gamma_f - 1)} = \frac{\partial p(x_i, x_{-i}, n-1)}{\partial x_i} V^F \tag{2}$$

The left hand side of (2) represents the marginal cost of not spending an additional unit of time producing knowledge. The right hand side shows the marginal benefit of spending time in order to reach an agreement among faculty assuming that the $n-1$ other faculty board members are spending x_{-i} unit of their time in academic governance. The interactions between n and the x_i's will determine the pattern of free riding off administrative tasks. This is at the root of the trade-off faced by multitasking faculty members. To explicitly solve this game, we need to specify a functional form. As in Harris and Raviv (2008) and often in corporate governance (Adams et al. (2010)), the cumulative distribution function of a geometric function $p(x_i, x_{-i}, n-1) = 1 - (1 - x_{-i})^{n-1}(1 - x_i)$ will be used. It has the nice property that it allows us to rewrite explicitly the time allocation decision of professors. It also assumes a one to one relationship between the share of time invested in academic governance and the probability to have a successful agreement. Using this example and further assuming a symmetric time allocation, we can rewrite the n first order conditions as follows:

$$x^* = 1 - \left(\frac{\gamma_f \delta_f}{V^F} \right)^{\frac{1}{(n - \gamma_f)}} \tag{3}$$

The condition that needs to be respected to have an interior solution is that $V^F > \gamma_f \delta_f$. It means that the value of reaching an agreement among faculty members about the information that can be brought by their representatives to the board of the university must be sufficiently high such that it is worth for faculty board members to invest some of their time in this task. If this is not respected, then $x^* = 0$.

At this stage of the game, a first set of comparative static results can be derived:

$$\frac{dx^*}{dn} < 0 \quad ; \quad \frac{dx^*}{d\delta_f} < 0 \quad ; \quad \frac{dx^*}{d\gamma_f} < 0 \quad ; \quad \frac{dx^*}{dV^F} > 0 \tag{4}$$

Intuitively, this means that adding more faculty members in the board increases the trends in free riding behavior. If the individual production of knowledge is relatively more valued then faculty board members will re-allocate their time to focus more on this task. An increase in the productivity parameter makes academic governance relatively less attractive to multitasking professors. Finally, an increase in the added value derived from academic governance makes it a more attractive task to implement. All these results are in line with our expectations.

2.2.2 Institutional design: stage 0 of the game

At this initial stage of the game, the government body responsible for higher education chooses the institutional design that should be implemented by universities. They do so by passing a legislation governing the composition of the board and, more precisely, the number n of board seats to be allocated to faculty members. Such an intervention can be legitimated by the large amount of public funding received by universities.

In this work, we will further depart from the literature on corporate governance by assuming that this choice is not only based on the maximization of the value created by the decision made by the board. The reason behind this assumption is that the presence of democratic institutions also creates an opportunity cost at the institutional level. This characteristic is peculiar to higher education institutions. The main task that must be fulfilled by the manager of a firm who's also member of the board of directors is to delegate. On the other hand, professor's main task is to produce a highly specialized output for which their individual time is the main input and for which no close substitute exists. Therefore, by choosing n, the funding authority can balance the impact of the scarce working time of professors between the production of knowledge and tasks related with academic governance.

Mathematically, the objective of the legislator is to maximize the total production of knowledge at the university level, K, plus the value derived from the board decision. δ_o stands for the relative weight of the first term in the payoff function of the government bodies in charge of higher education. The maximization problem can be written as:

$$Max_n \qquad \delta^O K + [\kappa + p(x_i, x_{-i}, n-1)V^O] \tag{5}$$

This maximization problem is subject to the n maximization problem of the multitasking professors as described in (1). Note also that V^O represents the added value derived by the funding authorities from making a board decision using the information on which academics have successfully agreed upon. κ is the intrinsic value derived by the legislator from the decision that is made by the board of the university when there is no academic governance. As in (1), they will be explicitly derived as the outcome of a decision making process in the next subsection.

Two cases will be considered. In the first extreme example where $\delta_o = 0$, internal democratic institutions won't be regarded as an opportunity cost at the institutional level. In the second one, we will consider that public authority faces a trade-off when choosing n. Note that, in the forthcoming analysis, integer problems will be ignored.

- $\delta_o = 0$

In this case, the governmental body in charge of higher education are only concerned by the utility derived from the board decision. Using the same specification for the probability function as in the previous subsection and only focusing on Nash equilibria, we find that the outcome of the maximization problem is such that:

$$\frac{\partial[\kappa + \big(1 - (1 - x^*)^n\big)V^O]}{\partial n} = V^O \frac{\gamma_f}{(n - \gamma_f)^2} \ln\left(\frac{\gamma_f \delta_f}{V^F}\right)\left(\frac{\gamma_f \delta_f}{V^F}\right)^{\left(\frac{n}{n-\gamma_f}\right)} < 0 \tag{6}$$

This means that in the case where $\gamma_f \delta_f < V^F$, the minimum amount of faculty members possible will be included in the board. This is equal to one under this specific setting. Adding more professors in the board will lead to a decrease in the probability to reach an agreement among professors because all the board members would then free ride off academic governance tasks. However, it is important to note that this result is the consequence of the implicit assumptions found behind the functional form of the example used and the assumption of non-cooperative behavior of professors. After re-interpreting x as the probability of a professor to reach an agreement, it assumes that the variable choice made by a multitasking professor at the initial stage of the game is independent from the one of all the other faculty members participating at the board. In other words, free riding will always be important because the time invested by each faculty members are perfect substitutes. Mathematically, this means that $\frac{dp(x^*(n),n)}{dn} = \frac{\partial p}{\partial x}\frac{dx}{dn} + \frac{\partial p}{\partial n}$ is negative for any n. Therefore, under these conditions, we will always have a corner solution with $n = 1$.

Following similar approaches in other contexts, different rationales have been offered in the economic literature in order to explain the unlikeliness of this corner solution (see a.o. Mukhopadhaya (2003), Harris and Raviv (2008) and Adams et al. (2010)). By assuming that

the existence of democratic institutions is seen as an opportunity cost at the institutional level, we will provide an alternative interpretation specific to the context of universities.

- $\delta_o > 0$

To derive further results when $\delta_o > 0$, we need to specify K, the total production of knowledge. For this purpose, we will use a stylized production function that describes the importance of the production of knowledge of each faculty members and the complementarities between them. The role played by complementarities has been largely recognized (theoretically and empirically) in the economic literature (see a.o. Dasgupta and David (1994) and Stephan (1996)). In our model, $r = \frac{\eta-1}{\eta}$, where η is the elasticity of substitution, will represent the extent of complementarity between the production of knowledge of each individual professor. Hence, we can rewrite the total production of knowledge as:

$$K = \Big[\sum_{i=1}^{N-n} 1_i^r + \sum_{i=1}^{n} (k_i^{\gamma_f})^r \Big]^{\frac{1}{r}} = \Big[N - n + n((k^*)^{\gamma_f})^r \Big]^{\frac{1}{r}} \tag{7}$$

Solving (5) with this specification, we must have that, at the optimum, the following holds:

$$\frac{\delta^O}{r} \Big[-1 + ((k^*)^{\gamma_f})^r + n\gamma_f r (k^*)^{(\gamma_f r - 1)} \frac{dk}{dn} \Big] \Big[N - n + n((k^*)^{\gamma_f})^r \Big]^{\frac{1-r}{r}} = -V^O \frac{\gamma_f \ln\left(\frac{\gamma_f \delta_f}{V^F}\right)}{(n-\gamma_f)^2} \left(\frac{\gamma_f \delta_f}{V^F}\right)^{(\frac{n}{n-\gamma_f})} \tag{8}$$

On the left hand side of (8), we have the marginal benefit on the total production of knowledge of having one more professor on the board. It shows the fact that it might be preferable to spread rather than concentrate the academic governance tasks on several faculty members. It is composed of 3 parts. The first component is the direct effect due to having one less full time knowledge producing faculty member. The second shows the quantity of knowledge that this faculty member will still be producing but only on a part time base. He now spends $k^*\%$ of his time producing knowledge. The last component is the indirect effect due to the free riding away from governance activities at the benefit of knowledge producing tasks. On the right hand side of (8), we have the marginal cost of having an additional professor on the board. As explained in the case where $\delta_f = 0$, this is a cost due to our specification of the probability to reach an agreement which assumes a strong incentive to free ride. In conclusion, we can state the following:

Proposition 1 (Academic governance) *We have that:*

1. *If $V^F < \gamma_f \delta_f$ and/or $V^O < 0$, then the public funding authority will prefer that no faculty member participates to the board of the university. All the seats of the boardroom will be allocated to outside stakeholders.*

2. *If* $0 < \gamma_f \delta_f < V^F$, $V^O > 0$ *and* $\delta_o = 0$, *then public funding authority will choose the minimum amount of professor possible (one under this specification) to be active in the board.*

3. *If* $0 < \gamma_f \delta_f < V^F$, $V^O > 0$ *and* $\delta_o > 0$, *then if* $\eta < \tilde{\eta}$ *and* δ_o *is not too small, then more than the minimum amount of faculty member will participate to the board of the university.*

In the last two cases, faculty board member will spend $x^* = 1 - \left(\frac{\gamma_f \delta_f}{V^F}\right)^{\frac{1}{n-\gamma_f}}$ *of their time on academic governance tasks and the rest is spend in the production of knowledge. Professors will reach an agreement about the information that can be used during the board decision making process with a probability equal to* $1 - (1 - x^*)^n$.

The intuition behind these results is straightforward. If the internal democratic process does not bring a sufficient added value to the utility derived from the decision made at the board level, then it is better to have a board only composed of outside stakeholders. When academic governance is valued sufficiently but the legislator only cares about the value derived from the board decision, the smallest amount possible of professors will be seating in the board. While for sufficiently large δ_o more seats will be allocated to professors. This result can be understood from the fact that a positive δ_o aligns the objectives of the governmental authority with the one of professors by considering that the production of knowledge is also valued. This will only hold when η is sufficiently large, in other words, when it will be preferable to spread rather to concentrate the effort of all the professors on the production of knowledge.

2.3 Board decision-making process

The objective of this subsection is to offer a way to rationalize the decision making process of the board of the university about a policy choice. This will allow us to derive the precise specification of the second term of equations (1) and (5) by solving stage 2 and 3 of the model. We will therefore endogenize V^F and V^O, the difference between the expected costs of a board decision making process occurring with uniformed and informed professors respectively from the point of view of faculty members and outside stakeholders. They will both depend on the outcome of an agency problem that takes place between the outside stakeholders and the faculty members of the university board. The two parties have a private non-certifiable information which is the input of what would be the best policy to implement and they face a conflict of interest about what is defined as the best policy[5]. The

[5]We further use the term information however this can be interpreted more broadly as an input (skill, expertise, information, etc.) that can be useful to make the right policy decision. See Goodall (2009) for a

outside stakeholders are assumed to be in control of the board. This means that they have to decide if they want to delegate or not the policy decision to faculty members. After the delegation decision is done, communication of the private information takes place. It goes from the party who is not making the final policy decision to the party making this decision. Due to conflict of interests between the two parties, the information will not be truthfully transmitted to the other party. Communication will take place in the form of cheap talk (Crawford and Sobel (1982)). Third, the policy decision is made. As we will show in this subsection, the outcome of this strategic delegation game will be the result of the tradeoff between the loss of control of not making the final decision and the loss of information due to the fact that each party communicates strategically his private information.

To model these interactions, we will closely mimick Harris and Raviv (2005, 2008)[6]. This stylized approach seems the most adequate in order to highlight the interactions taking place between the two main parties of the board of a university. First of all, it brings forward the importance of the advising role played by the members of the board in setting the strategies of the institution. Compared with board of directors, the board of universities often doesn't play a monitoring role and, in many cases, in Europe, rectors are not appointed by the board members but they are elected by a specific electoral body composed of the representatives of the different groups of the university community or by the faculty senate (OECD (2003) and EUA (2009)). Second, the agency problem created by the internal bias of professors sheds some new theoretical lights on the question of the degree of faculty participation in the decision making process of the university (McCormick and Meiners (1989), Brown (2001) and Masten (2006)). Third, as opposed to a strategic voting game, this approach puts forward, by assuming the possibility to delegate to professors, the importance of having a trusting relationship between outsiders and insiders of the university board. This is often seen as a basic principle of good governance. Finally, assuming the complementarity of the information of professors and of lay members in the decision making process is in line with the idea that professors have a specific knowledge of their own institution (and how to implement the decision made) while external lay members have technical expertise (for example legal and financial literacy) and knowledge about the environment (political, economical and social) in which the university is active. However, note that we don't make further assumption on the relative importance of one information relative to the other.

The premises of the board decision-making process are the following. The board is composed of two parties: the outside stakeholders and the faculty members. Both parties have access

discussion on this topic.

[6]The sole difference, other than the higher education context of the game, is that the party, which is not always informed, is the one biased towards larger projects.

to some complementary private information concerning what would be the best policy that should be implemented for the university. The outside stakeholders observe costlessly their private information $\tilde{o}$ which is uniformly distributed between $[0, O]$. On the other hand, faculty members are, as described in the previous subsection, only reaching with a probability $p(x_i, x_{-i}, n-1)$ an agreement concerning the information that can be brought by their representatives to the board. In case of a successful agreement, $\tilde{f}$ which is uniformly distributed between 0 and F is privately observed. Otherwise, $\tilde{f} = 0$.

The board has to make a policy decision which is represented by s, a unidimensional and continuous scale choice. In the context of a higher education institution, we can think of this parameter as, for example, the extent of the increase in the future budget of the university, the amount of money to invest to the creation of a new research center or the number of new professors to hire. It has an impact on $\tilde{U}$ which is the utility derived from the decision made by the university. The utility that can be ripped from the policy choice depends on the private information of both parties and is written using the following form:

$$\tilde{U} = U - (s - (\tilde{f} + \tilde{o}))^2$$

where U is the first best utility level. We assume that faculty members have a preference towards larger scale choice as represented by the bias b which is always positive. Possible rationales for this empire-building bias of professors have been discussed in Kaplan (2004) or more recently in Del Favero and Bray (2010). Their utility level is represented by:

$$\tilde{U}_f = U_f - (s - (\tilde{f} + \tilde{o} + b))^2$$

Both parties are risk neutral with respect to the policy choice made. Therefore, from this specific quadratic cost function, we know that the difference between the utility derived by outside stakeholders and by professors is equal to b^2. We will further on refer to this as the agency cost. From these premises, we can also derive σ_f^2 and σ_o^2 which are respectively the cost of not knowing $\tilde{f}$ and $\tilde{o}$. They can also be interpreted as the value of each parties' private information.

The board decision making process takes place as follows. There are two stages. In the first, the delegation stage, the outside stakeholders who are in control of the board have to decide on who will make the final policy decision[7]. They have two options: whether they make this decision, and then ask professors to communicate their private information

[7]Using the terminology of Harris and Raviv (2005), we consider an ex-post/project specific environment where the delegation decision is made when both parties know if faculty members have succeeded in arriving at an agreement or not during the academic governance part of the game.

through a report, whether they delegate the decision making process to professors, and then outside stakeholder will communicate their private information to professors. In the second stage, the scale decision is made. Due to the privacy of information and the divergence in preferences, cheap talk will take place, namely the private information will not be truthfully revealed to the other party.
In order to solve this game, we first look at the last stage and then go backward in the game to see the conditions under which delegation will take place.

2.3.1 Strategic decision stage: Stage 3 of the game

Here, we have to look at the strategic decision chosen for each outcome of the game[8]. If *outside stakeholders decide not to delegate the decision to the informed professors*, they will choose policy $s(o, r)$ based on the information that they have observed $\tilde{o} = o$ and the report r sent by the faculty members about their private information such that:

$$s(o, r) = \bar{f}(r) + o$$

where $\bar{f}$ is the expectation, from the outsiders viewpoint, of their posterior belief about $\tilde{f}$, given that faculty members have sent them a report r and, similarly to the case showed in Harris and Raviv (2005) that $\tilde{o} \leq o^*$. The way that r is chosen is done in the same fashion as in the cheap talk model of Crawford and Sobel (1982). The faculty members partition the support $[0, F]$ into $[f_i, f_{i+1}]$ cells and send a report r that is uniformely distributed somewhere in the cell where the private information $\tilde{f}$ lies. Inferring the cell from the report received where the true information value of professors is, the outsider's posterior belief is such that $\bar{f} = \frac{f_i + f_{i+1}}{2}$ for a report r located between f_i and f_{i+1}. In the Pareto-best Bayes equilibrium of the game, the support is partitioned in $N(b, F)$ cells. The larger the number of partition, the smaller will be the noise introduced in the communication. Note that, as shown in Harris and Raviv (2005), the size of the cells is unequal and increasing in i.
If *outside stakeholders decide to delegate the decision to the professors*, faculty members will choose policy $s(f, t)$ based on their private information $f = \tilde{f}$ and the report t that has been sent by the outside stakeholders such that:

$$s(o, r) = \bar{o}(t) + f + b$$

where $\bar{o}(t)$ is the expectation of the faculty posterior beliefs about $\tilde{o}$ given that the report t has been sent and the fact that faculty members have received the signal $\tilde{o}$ where $\tilde{o} > o^*$.

[8]If professors are uniformed, outsiders will choose the project $s(o) = \bar{f} + o$ where $\bar{f}$ is the mean of a variable uniformly distributed between 0 and F.

At the equilibrium, outsiders will partition the support $[o^*, O]$ into $N(b, O - o^*)$ cells. They will send a report t who's value is uniformly located in the cell where $\tilde{o}$ is located. Following a report situated in $[o_i, o_{i+1}]$, the posterior belief of professors about the true $\tilde{o}$ is equal to the average of the partition $\bar{o} = \frac{o_i + o_{i+1}}{2}$.

2.3.2 Delegation stage: Stage 2 of the game

We assume that the outside stakeholders of the university are in control of the board. This means that they can decide, independently of the number of faculty members seating in the board, to delegate or not the policy decision to the faculty members. This will allow us to endogenize V^F and V^O which represents the added value from a decision made following a successful academic governance process from, respectively, the point of view of faculty members and outside stakeholders. They will both be defined from the relationship between the characteristics of the information accessible by both parties (σ_o and σ_f) and the extent of divergence in preferences (b).

We have to solve two different subgames depending on whether or not an agreement has been reached during the academic governance process. Here, we compute the conditions under which delegation will take place for these two states. The expected costs for each possible outcomes will then be computed.

We first need to introduce $L(b, X)$. For $X = O, F$, this is the expected information cost of having information transmitted through an unverifiable report that is uniformly distributed on an interval of width X by someone with a bias b such that:

$$L(b, X) = E[\bar{x}(r(\tilde{x})) - \tilde{x}]^2 \tag{9}$$

where $\bar{x}(r)$ is the decision-maker's equilibrium posterior mean of $\tilde{x}$. Hence, $L(b, X)$ only depends on the quality of information that has been transmitted through the report as measured by $N(b, X)$. For the extreme case where $N(b, X) = 1$, $L(b, X) = \sigma_x^2$, no information is transmitted via the report. When outside members decide to delegate the decision process, it is common knowledge that $\tilde{o} \in [o^*, O]$. We further define $f(b, x)$ as the expected information plus agency cost when the private information is distributed between 0 and x.

The *first subgame is the one where faculty members have reached an agreement during the academic governance part.* In this setting, the delegation decision is equivalent to the one in Lemma 2 of Harris and Raviv (2008). The expected cost from the point of view of outside stakeholders when the decision is not delegated to professors is equal to the square of the deviation between the policy s chosen ($\bar{f}(r) + o$) and the first best realization $\tilde{f} + \tilde{o}$, this is equal to $L(b, F)$. This will occur with a probability equal to ($\frac{o^*}{O}$). If, instead, they decide

to delegate, and this will be done with a probability equal to $(1 - \frac{o^*}{O})$, the expected agency and information cost will be equal to $f(b, O - o^*) = b^2 + L(b, O - o^*)$.

Lemma 1 (Delegation Decision when academic governance was successful) *If faculty members have succeeded in reaching an agreement about the information that can be brought to the board, outside stakeholders will decide to delegate if and only if their private information $o = \tilde{o}$ is such that $o > o^*$ where o^* is defined as follows. If $b \geq \sigma_f$, the bias is so important compared to the value of knowing the faculties' information that external board members never delegate, therefore $o^* = O$. If $f(b, O) \leq L(b, F)$, then $o^* = 0$ and delegation will always take place. Otherwise, we have that $o^* \in (o, O)$ as defined by the following condition: $L(b, F) = L(b, O - o^*) + b^2$.*

Conditional on the fact that faculty members agree on the information to bring to the board's meeting and before we observe the realization of $\tilde{o}$, the expected agency plus informational cost for external stakeholders can be written as:

$$l_I^O = (\frac{o^*}{O})L(b, F) + (1 - \frac{o^*}{O})[(L(b, O - o^*) + b^2] \tag{10}$$

and the expected cost for professors as:

$$l_I^F = (\frac{o^*}{O})[L(b, F) + b^2] + (1 - \frac{o^*}{O})[(L(b, O - o^*)] \tag{11}$$

The *second subgame is the one where faculty members have not reached an agreement during the academic governance part.* If external stakeholders decide to delegate the decision, then the project scale implemented by the faculty members will be equal to $s = \bar{f} + \bar{o}(t) + b$. If they decide not to delegate, then external stakeholders will decide to implement a project of size $\bar{f} + \tilde{o}$. Therefore, under this case, external stakeholders will always have a lower expected costs by not delegating because their first best realization is then equal to $\tilde{f} + \tilde{o}$.

Lemma 2 (Delegation Decision when academic governance was not successful) *If faculty members don't reach an agreement about the information that can be brought on to the board, then the external stakeholders who are in control of the board will always prefer to make the decision themselves rather than to delegate it to the faculty members.*

Conditional on the fact that faculty members don't reach an agreement, the expected agency plus informational cost from respectively the point of view of outside members and of faculty members of the board of the university are respectively as follows:

$$l_U^O = \sigma_f^2 \tag{12}$$

$$l_U^F = \sigma_f^2 + b^2 \tag{13}$$

Using these expected costs of having or not an agreement and the probability to have a successful agreement, it is possible to rewrite explicitly the expected utility derived from the board's policy decision from the point of view of the faculty members and of the public authority. The second term of (1) and (5) can be respectively rewritten as:

$$U - [p(x_i, x_{-i}, n-1)l_I^O + (1 - p(x_i, x_{-i}, n-1))l_U^O] = U - l_u^O + (p(x_i, x_{-i}, n-1))V^O \tag{14}$$

$$U_f - [p(x_i, x_{-i}, n-1)l_I^F + (1 - p(x_i, x_{-i}, n-1))l_U^F] = U_f - l_u^F + (p(x_i, x_{-i}, n-1))V^F \tag{15}$$

Therefore, we have that $\kappa = U - l_u^O$ and $\kappa_f = U_f - l_u^F$ while V^F (V^O) is the difference between the expected cost of making the strategic decision while professors were informed minus the expected cost of making a strategic decision while professors were not informed from the point of view of professors (external stakeholders). It can now be explicitly defined in function of the relationship between the characteristics of the information of the professors and the stakeholders and the size of the divergence in their preferences as follows:

Proposition 2 (Board decision-making process) *We have that:*

1. *If $b \geq \sigma_f$, then, due to the high agency costs, outsiders never delegate. Therefore we have that $o^* = O$ and $V^F = V^O = \sigma_f^2 - L(b, F)$.*

2. *If $b < \sigma_f$ and $f(b, O) \leq L(b, F)$, then $o^* = o$ and delegation to faculty members always takes place. Therefore we have that $V^F = \sigma_f^2 + b^2 - L(b, O)$ and $V^O = \sigma_f^2 - L(b, O) - b^2$.*

3. *Otherwise, outsiders delegate with a probability equal to $\frac{o^*}{O}$ where $o^* \in [0, O]$ and is defined by $L(b, F) = L(b, O - o^*) + b^2$. We then have that:*

$$V^F = l_U^F - l_I^F = \sigma_f^2 + b^2 - \big[(\frac{o^*}{O})[L(b, F) + b^2] + (1 - \frac{o^*}{O})[(L(b, O - o^*)]\big]$$

$$V^O = l_U^O - l_I^O = \sigma_f^2 - \big[(\frac{o^*}{O})L(b, F) + (1 - \frac{o^*}{O})[(L(b, O - o^*) + b^2]\big]$$

Using the equilibrium condition for o^* of lemma 2, it can be easily shown that both V^F and V^O are always positive. A sufficient condition to be fulfilled is, when $b \geq \sigma_f$, to have that $N(b, F) > 1$. This means that at least some information is transmitted through the report sent by faculty members to outsiders. We also have that V^F is weakly greater than V^O. This means that faculty members derive more utility from strategic board decision taken with their information than outside stakeholders.

Linking together proposition 1 and 2, we have that a condition to be respected to have

at least one faculty member in the board is that the participation in academic governance task is sufficiently valued by this boar member. This is more likely the more important is his input in the decision-making process taking place in the board. If, on the top of this condition, the objectives of public authorities and of professors are not diverging too much, then it might be better to have more than a single professor in the university board.

3 Comparative static results

The following results are derived based on the results of proposition 1 and assuming that $V^F = V^F(\sigma_f, \sigma_o, b)$ and $V^O = V^O(\sigma_f, \sigma_o, b)$ are defined as in proposition 2. We only focus on the third case of proposition 1. This is the most interesting one and it seems to fit the most with the actual context of the higher education system in Europe.

Proposition 3 (Value of the professor's information σ_f) *An increase in the information that can be obtained by faculty members leads to a decrease in the number of seats allocated to professors in the supreme decision making body of the university.*

Proof. See appendix.
As proved in Harris and Raviv (2005), an increase in σ_f, all else equal, is equivalent to an increase in the relative informational advantage faculty members have compared with the outsiders active in the board. This result is derived in two steps. First of all, we show that an increase in σ_f will positively impact the added value derived by both parties represented in the board from a successful academic governance process. It also increase the probability that outsiders delegate the decision making process to the faculty members. Finally, we show that this has a negative impact on the number of professors represented in the board. The first part of this result is in line with Brown (2001) who shows that faculty have a greater influence in deciding the orientation of the university on questions where they have more information. However, the second part of the results shows that this is not translated by a greater participation in the board of the university. On the contrary, this will lead to a decrease in the share of seats allocated to professors.

Proposition 4 (Value of the outsider's information σ_o) *An increase in the value of outside stakeholders leads to an increase in the number of seats allocated to professors in the highest decision making body of the university.*

Proof. See appendix.
This result is derived in a similar fashion as the previous one. Here, we have that an increase in σ_o will decrease the probability of delegation to professors as well as the added value

created by reaching an agreement during the academic governance process which fits with the results of Brown (2001). This leads to an increase in the number of professors active in the highest decision making organ of the university.
These two results are rather surprising explanations of the changes observed the last past years in Europe and the decreasing participation of professors in the university's highest decision making body. However, proposition 3 and 4 can be better understood when looking at the case where $\delta_o = 0$. There, following a positive change in V^F and V^O, the public regulator will not be able to increase the probability of a successful academic governance process by adding more professors in the board. An increase in n would have the opposite effect. Due to the free riding, it would decrease the probability of success. When $\delta_o > 0$, this effect is counterbalanced by the positive effect created by the general equilibrium effect observed on the allocation of time of the multi-tasking professors. This is due to the fact that, with the complementarities in the knowledge production process, it will be preferable to spread the knowledge productive tasks on more professors. Hence, these two results are primarily driven by the assumption that the time invested in academic governance by each professors are perfect substitutes.

Proposition 5 (Importance of the individual production of knowledge δ_f) *An incremental increase in the weight that professors put on the importance of their own production of knowledge leads to an increase in the number of seats allocated to professors in the board of the university.*

Proof. See appendix.
Even though an exogenous increase in δ_f leads to a decrease in the amount of time allocated to academic governance, we have that the legislator would prefer to adapt the composition of the board by adding more faculty members. This can be explain by the fact that, as for the two previous results, it would positively impact the total production of knowledge, not because it would increase the probability to arrive at an agreement among professors.
Therefore, this shift in the allocation of time of faculty members created by a change in the weight given on the first of its two objective, as defined in the literature as the academic ratchet effect (Ortmann and Squire (2000)), cannot be, according to our stylized approach, seen as one of the source of the change observed in the composition of the board of universities throughout Europe .

Proposition 6 (Faculty size N) *An increase in the amount of faculty working at the university leads to an increase in the number of faculty representatives who are sitting in the boardroom.*

After re-interpreting n as the extent of democratic governance in the university, we can relate this result with the one of Masten (2006) who empirically observes that, in the US, the governance system is relatively more democratic in higher education institutions employing a larger number of faculty members.

Proposition 7 (Importance of the total production of knowledge δ_o) *An incremental increase in the weight put on the total production of knowledge created at the level of the university leads to an increase in the number of professors who are taking part to the board of the university.*

This result is straightforward. An increase in δ_o means that the governmental authorities in charge of higher education puts more importance on the total production of knowledge. It improves the alignments of their preferences with the one of the faculty members. Consequently, this exogenous increase will lead to an increase in the number of professors in the board of the university.

4 Conclusion

This paper developed a model that explains the extent of faculty participation in the highest decision making body of the university. Despite conflict of interests and the costs of democratic internal institutions, their presence can be rationalized by the critical information and the expertise that they have concerning the functioning of their institution. According to our knowledge, this is a first formal piece in the theoretical puzzle that is concerned with the internal working of the university and the role played by its highest decision making organ, its board (Hermalin (2004)). A new insight is offered in this highly discussed policy issue. Some of the factors that should be considered when choosing the composition of the board are proposed. However, ultimately, their practical relevance is an empirical question. We hope that this paper will encourage empirical works testing some of these results, especially with European data.

Some policy recommendations emerge from this analysis. First, it urges caution in one size fits all governance reforms. The specificities of each institution must be taken into consideration as much as possible. This seems particularly true in the European higher education sector where, due to historical and institutional reasons, universities have inherited of highly diverse institutions with heterogeneous objectives. Second, it offers a way to motivate the introduction of a board composition policy by explaining why professors might deserve a seat in the board and by giving, in the primitives of the model, a specific role to lay members. Such motivations have often lacked in the fierce debate between proponents and opponents

of institutional reforms.

In order to keep the calculation tractable, some simplifying assumptions were made. The list of which is not exhaustive. Further investigations could lead to novel research directions. First of all, we have made the extreme assumption that outside stakeholders were benevolent agents. However, their involvement is often questioned (Pusser et al. (2006) and EUA (2009)). Possible extensions of the actual framework could look at interactions between the agency problem that takes place between them and the public institution in charge of higher education. For example, the extent with which different lay member selection mechanisms (chosen by the board, appointed by government officials, elected by citizens, etc.) could mitigate the cost related with this issue. Second, it would be interesting to look at cases where professors are asymmetric with respect to their knowledge productivity or their preferences and how it might affect the self-selection of some of them towards academic governance activities. Finally, future works should reconsider some of assumptions underlying the information technology (non-cooperative behavior of professors, perfect substitution of the time invested by professors in the academic governance process, the non-additivity of the knowledge acquired by professors who might have different knowledge and/or expertise, etc). The tendency toward free riding has been overestimated in this model.

This approach only defends a very narrow point of view that highlights a partial solution of the agency problem faced by the legislator. The participation in the board can also be rationalized by another complementary, rather than competing, point of view which sees this presence as a way to protect their ex-ante knowledge specific investment from ex-post expropriation by the university (Osterloh and Frey (2006) and Becht et al. (2003)). This property rights perspective could theorize the links between the issue of tenure in higher education and the governance structure of the university (McPherson and Shapiro (1999)).

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APPENDIX

Proposition 3

Proof. We first show how a change in the information that can be gathered by professors can impact the valuation of informed professors from the point of view of the professors themselves and of the outside stakeholders.

Lemma 3 (Effect of a change in σ_f on V^F) *An increase in the information that can be obtained by faculty members leads to an increase in the valuation of being informed from the point of view of faculty members. Outside stakeholders will then also be more likely to delegate the scale decision to the faculty members.*

Proof. More precisely, we look at changes in σ_f which represents the importance of the information of professors. First, we look at the case where information of faculty members is less important than the bias, $b \geq \sigma_f$. In this case, the outside stakeholders of the board will never delegate the scale decision, then $o^* = O$ and $V^F = \sigma_f^2 - L(b, F)$. As shown in the proof of proposition 3 of Harris and Raviv (2008), $2\sigma_f > \frac{\partial L(b,F)}{\partial \sigma_f}$. Hence, when $b \geq \sigma_f$, we have that $\frac{\partial V^F}{\partial \sigma_f} > 0$.
Second, when the information of professors matters more than the divergence of preferences between both parties who are forming the board, namely when $b < \sigma_f$, we need to look at when delegation always takes place ($o^* = 0$) and this decision depends on the private information $\tilde{o}$ observed by outsiders of the board ($o^* \in (0, O)$). If delegation always takes place, then $V^F = \sigma_f^2 + b^2 - L(b, O)$ and is increasing in σ_f. If we have that $o^* \in (0, O)$ as defined by the equilibrium condition $L(b, F) = L(b, O - o^*) + b^2$, we know that an incremental increase in σ_f will (weakly) increase the left hand side of the equilibrium condition. Therefore, to keep the equality, o^* will have to decrease such that $L(b, O - o^*)$ (weakly) increases by the same amount than $L(b, F)$. As shown in the proof of proposition 3 of Harris and Raviv (2008), the marginal impact on l_u^F will be larger than the one on l_i^F such that $\frac{\partial V^F}{\partial \sigma_f} > 0$.
The second part of the proposition is proven as follows. If faculty members are uninformed, then, an increase in σ_f will have no impact on the probability to delegate. When they become informed, the same reasoning as used to proof the first part of the proposition can be applied. An incremental increase in σ_f leads to a weakly decrease in o^*. Therefore, $(1 - \frac{o^*}{O})$, the probability to delegate, will increase. ■

Lemma 4 (Effect of a change in σ_f on V^O) *An increase in the information that can be obtained by faculty members leads to an increase in the valuation of having informed professors from the point of view of outside stakeholders.*

Proof. First, when outsiders never delegate (when $b \geq \sigma_f$ and $o^* = O$), we have that $V^O = \sigma_f^2 - L(b, F)$ and $\frac{\partial V^O}{\partial \sigma_f} > 0$. When the information of faculty members is so important that delegation always takes place, $o^* = 0$, $V^O = \sigma_f^2 - [L(b, O) + b^2]$. Therefore, an increase in the information accessible by faculty members will increase the value of having informed professors when entering the board decision making process according to outside stakeholders. Finally, if $b < \sigma_f$ and $\exists o^*$ such that $f(b, O - o^*) = L(b, F)$, then an increase in σ_f will lead to a decrease in o^* as explained in the proof of proposition 3. As shown in the proof of

proposition 3 of Harris and Raviv (2008), the marginal impact on l_U^O will be larger than the one on l_I^O such that $\frac{\partial V^O}{\partial \sigma_f} > 0$. ■

After applying the implicit function theorem to (8) and using these two lemma when applying the chain rule, we find that a sufficient condition to be respected in order to have that $\frac{dn}{d\sigma_f} < 0$ is the following:

$$\frac{n - \gamma_f}{rn} > \ln\left(\frac{\delta_f \gamma_f}{V^F}\right) > \frac{\gamma_f - n}{n}$$

This first inequality will always hold when we consider interior solutions. The second one will be respected whenever the difference between $\delta_f \gamma_f$ and V^F is not too large ($\frac{\delta_f \gamma_f}{V^F} > 0.5$).

■

Proposition 4

Proof. We first prove the following two lemma which shows how a change in the importance of the outsider's information can impact V^F and V^O.

Lemma 5 (Effect of a change in σ_o on V^F) *An increase in the information of outside stakeholders leads to a decrease in the valuation of having informed faculty members from their own point of view. Outside stakeholders will then also be less likely to delegate the scale decision to the faculty members.*

Proof. We look at the impact of changes in σ_o which represents the importance of the information of outside stakeholders. When $b \geq \sigma_f$, outsider never delegate and $V^F = \sigma_f^2 - L(b, F)$. Therefore, $\frac{\partial V^F}{\partial \sigma_o} = 0$.

When we have that $b < \sigma_f$ and $f(b, O) \leq L(b, F)$, then $V^F = \sigma_f^2 + b^2 - L(b, O)$. Therefore, $\frac{\partial V^F}{\partial \sigma_o} = -\frac{\partial L(b,O)}{\partial \sigma_f} < 0$. When we have that $b < \sigma_f$ and, on the other hand, $\exists o^*$ as defined by the condition $f(b, O - o^*) = L(b, F)$, we can show that $\frac{o^*}{O}$ will increase and conversely that $1 - \frac{o^*}{O}$ will decrease. For the equilibrium condition for o^* to hold after an increase in σ_o, the increase in O needs to be compensated by an increase in o^* such that $L(b, O - o^*)$ stays constant. However, the marginal change in o^* needed will be smaller than the one in O. This follows from lemma 1 of Harris and Raviv (2008) and proves the fact than outside stakeholders will be (weakly) less likely to delegate the scale decision to professors. By consequence, in this subcase, the impact of an increase in σ_a will be nil on l_U^F and positive on l_I^F. Therefore, we have that $\frac{\partial V^F}{\partial \sigma_o} < 0$. ■

Lemma 6 (Effect of a change in σ_o on V^O) *An increase in the information of outsiders leads to a decrease in the valuation of having informed professors from the point of view of outside stakeholders.*

Proof. First, when $b \geq \sigma_f$, V^O is unaffected by a change in σ_o. Second, when $b < \sigma_f$, a marginal increase in σ_o will decrease V^O. When, $o^* = 0$, it has no impact on l_U^O but a positive

one on l_I^O. When $o^* \in (0, O)$, as shown in proposition 5, it will lead to less delegation from the outsiders to the professors and the impact on l_I^O will also be positive. Therefore, we have that $\frac{\partial V^O}{\partial \sigma_o} < 0$. ■

As for the proof of proposition 3, a sufficient condition to ensure that $\frac{dn}{d\sigma_o}$ is positive is to have that:

$$\frac{n - \gamma_f}{rn} > \ln\left(\frac{\delta_f \gamma_f}{V^F}\right) > \frac{\gamma_f - n}{n}$$

■

Proposition 5

Proof. V^F and V^O not being impact by an exogenous change in δ_f, we can by applying the implicit function theorem on the equilibrium condition 8. The two following inequalities are sufficient conditions that need to be satisfy to state that $\frac{dn}{d\delta_f}$ is positive.

$$\frac{\gamma_f - n}{rn} > \ln\left(\frac{\delta_f \gamma_f}{V^F}\right) > \frac{\gamma_f - n}{n}$$

These conditions are stronger than the one for the two previous proposition because the first on will not always be respected. However, the closer $\gamma_f \delta_f$ is from V^F and the smaller is r, the more likely it will be fulfilled. ■