Abstract

Tenure is a relatively uncommon employment contract. We find that two factors can explain its existence in academia – (i) non-contractibility of output and (ii) non-contractible investment by an employee that enhances the chance of high output within the profession but which also significantly diminishes the employee's outside-occupation alternatives. Severance contracts are permitted in the model but will never be offered in equilibrium by universities. Tenure arises as the unique subgame perfect contract in the simple game in our model.

A Model of Academic Tenure[1]

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1 Introduction

"*A dismissed academic's chances of re-employment in his own profession may often be so small as to be negligible. If he has invested 30 years of his life in acquiring skill in, for example, Egyptology, he has a skill which is not marketable because no market in the subject exists. This means that the likelihood that those dismissed from jobs in such subjects will be deprived, not only of their jobs, but of their professions, must be regarded as very high indeed. .... It is unwise to enter into so risky an employment without being guaranteed some economic security in return. Otherwise the bargain is too disadvantageous to the academic.*" (Russell, p. 26)

Tenure is the dominant employment contract for university professors in the U.S. – as of 1972, 94% of all U.S. faculty served in institutions of higher learning that offered tenure.[1] What is tenure? Tenure is partly defined by the "1940 Statement on Academic Freedom and Tenure: with 1970 Interpretative Comments" as written and enforced by the American Association of University Professors (AAUP).[2] Tenure is also partly defined by the investigations of the AAUP when allegations of violations arise as well as the consequent possible censures of academic administrations by the AAUP.[3] In practice, tenure is characterized by a number of features. It is a commitment to employment for life. The only legitimate grounds for termination of a tenured professor are (i) gross neglect of duty, (ii) physical or mental incapacity, (iii) a serious moral lapse, or (iv) grave institutional financial exigency.[4] In practice, the award of tenure is typically considered after a probationary period of 6 to 12 years (the "1940 Statement" specifies a review period of not more than seven years). In practice, the faculty are directly involved in all tenure decisions as well as all termination procedures.

Contracts of this nature are rare outside academics and the institution of tenure often comes under criticism in bad economic times. Even in good times, the guarantees of lifetime employment and security against directed salary cuts are often perceived to be ways for some unscrupulous academics

[1] See Rosovsky, 1990, page 178, footnote 3.

[2] All official AAUP documents referred to within this paper can be found in *AAUP Policy Documents and Reports*.

[3] See Kurland 1980.

[4] See Rosovsky (1990) page 178.

to shirk their responsibilities.[5] It is also interesting to note that academic tenure exists in environments where there is no collective bargaining between a unionised faculty and the administration; it appears to be a contract that administrators too eventually find beneficial, even though, historically, there was opposition to its adoption.

Why then is there tenure in academics and why is this employment contract not widespread in other arenas?

"Academic freedom" is a common motivation offered for tenure and, in fact, is the title of the little book by the historian Conrad Russell from which the opening quote is taken. One interpretation of "academic freedom" is the unencumbered right to pursue truth, no matter how offensive the question or potential answer may be to university administrators, students, alumni, trustees, state legislators, or significant donors. Other interpretations have to do with the right of academics to manage their own affairs.[6] General freedom of speech is often considered part of academic freedom. But, how convincing is the argument that academic freedom makes tenure necessary?

Suppose (in the absence of tenure) that any terminated professor could quickly find comparable employment with comparable compensation, that is, the market for the academic's ccupation was "thick". Would the pursuit of truth be substantially advanced by the tenure contract?

Alternatively, suppose also that there was an infallible group of professional judges for each and every discipline who could provide an accurate public measure of the output of each professor within that discipline. Then contracts could be written that conditioned upon output realizations. University administrators would be unable to claim that high output was actually low since output would be verifiable.

Even if the outside opportunities of a professor deteriorated significantly over time, with verifiable output the employment contracts could be written to condition on the productivity of each and every faculty member. Similarly, in the absence of verifiable output, if outside opportunities for any professor did not deteriorate with time then a lifelong commitment of employment

[5] "... it is vastly more important that deserving men should be free from the menace of arbitrary dismissal than that every less deserving man, provided he is above the level of gross unfitness, should be dismissed." AAUP 1918, page 27.

[6] This interpretation goes back, according to Metzger (1955), to the University of Paris in the 13th century and its efforts to eliminate the right of its chancellor, a priest in Notre Dame, to issue or to revoke licences for giving "ordinary lectures".

would provide no advantage to either the employee or employer – the external market for the individual would overcome the issue of non-verifiability of output.

Is output that difficult to measure in academia?[7] Perhaps it is not so difficult to accurately measure research productivity within one's own subfield. But even within a discipline it is not uncommon for professors in different subfields from that of the professor under review to defer to colleagues in the subfield. In light of this common occurrence it is clear that professors in completely different disciplines have a great deal of difficulty in assessing the aggregate quality of another professor's work. This is true for university administrators as well, let alone third parties outside the university. Teaching is even more difficult to assess. Standard end-of-semester teaching evaluations will catch outliers on each side but provide little other information other than whether a professor is popular or not. Other aspects, such as the externalities provided by good colleagues, are even harder to measure. However, we need only a weaker assumption in this paper, namely not that output is not measurable but that it is not determinable by a court.

Under this assumption (i.e that occupation-specific investments by faculty, as well as output realizations, are observable but not verifiable), we construct a model where universities compete for faculty but the competition is imperfect, that is, markets are thin. Our primary result is the emergence of the tenure contract, over other alternatives, in equilibrium. Note that in our model, risk-neutrality is assumed throughout, so this is not an insurance explanation.

In what has been described thus far, university administrators have been implicitly assumed to be operating without their own incenive constraints. In fact, university administrators, like any agents, are not social planners. Academic administrators are concerned with the success of their university, and this can be inconsistent with what is best from the perspective of advancing knowledge in each of the academic disciplines. In this context, we show that tenure is not the preferred contract by university administrators, as a consequence of this kind of agency problem, while if this problem does not exist both employer and employee prefer tenure.

The paper proceeds as follows. We review the literature on tenure and up-

[7] "The performance of the activities of academic workers – teaching and scholarship – is certainly hard to measure. These activities do not produce concrete, measurable products of easily discernible quality; neither their output nor their inputs are easily observable or measurable." (McPherson and Winston, p. 111)

or-out contracts. The model is presented. We then provide a brief discussion of the incentives of university administrators. Our primary result has been noted earlier.

This paper does not consider the aspects of academic freedom that have to do with faculty governance and with freedom of speech. Once again, Russell's book is an excellent summary of the arguments for special provision for academics to guard against attacks on these freedoms.[8]

2 Background and Previous Literature[9]

In several articles, Metzger [1955, 1973, 1990] has provided a remarkably comprehensive history of the evolution and development of tenure in American universities and readers who are interested should consult these references. We refer below to a few significant instances.

The Ross case at Stanford in 1900 is an important historical case often offered to illustrate academic freedom. Ross, an economist, expressed some viewpoints that were contrary to the interests of the railroad industry. Stanford was founded by a railroad baron and his surviving daughter took offence at the statements of Ross. Exerting great pressure on the President of Stanford University, she eventually secured Ross's dismissal. The Ross dismissal was critical because it prompted a young philosophy professor at Stanford, Arthur Lovejoy, to resign. After establishing a distinguished scholarly reputation over the ensuing 12 years, Lovejoy was the prime instigator for the creation of the AAUP.

The AAUP founding members published the "General Declaration of Principles" in the inaugural edition of the *AAUP Bulletin* (1915, pages 20-

[8] As a counter-example to the contention that academics do not need special protection in a democratic society, Russell mentions his father, Bertrand Russell, who lost his college lecturership at Trinity College, Cambridge for opposing British policy in the 1914-18 war, and whose appointment to teach logic in City College, New York, was revoked in 1941 for his views on "Marriage and Morals". If this could happen twice to one of the foremost intellectual figures of the twentieth century, it becomes difficult to argue it can not happen here or to any of us.

[9] The AAUP maintains two large files of actual correspondences concerning the tenure debate for the period 1915 to 1940. In addition, the AAUP maintains a historical library regarding the evolution of tenure. We are grateful to Jordan Kurland of the AAUP for granting us access to these files and records.

43). This is a remarkable document in terms of its scope and clarity. The authors note that the impetus for the creation of the AAUP, and the push for a uniform tenure contract, originated with the unjust dismissal of several social scientists in the early part of the twentieth century (i.e. economists who were unjustly dismissed included Ross at Stanford, Fisher at Wesleyan, and Nearing at Penn, see Pollitt and Kurland (1998)).

If a tenured professor is dismissed for cause other than moral turpitude[10], then the 1940 Statement provides for a severance payment of one year's salary. This may give the appearance that severance payments are part of the tenure contract. However, this severance payment is not specified as one which a university administrator can activate, at their discretion, as part of the unilateral dismissal of an annoying member of the faculty. In practice, the severance payment is only paid if a faculty member cannot perform their duties, mentally and/or physically, or if the university closes the tenure-home department of the faculty member for reasons of financial exigency. Note that, per the "1940 Statement", the conditions under which this severance payment would be activated have nothing to do with deliberate actions of the tenured faculty member. If a university administrator dismissed a tenured faculty member without cause and offered an unacceptable severance payment[11] then both the university and the administrator would almost surely be censured by the AAUP. Given the importance of faculty committees in appointing university administrators, as well as the public nature of an AAUP censure, it would be very costly in terms of an administrator's future career to engage in such behavior.

Tenure has little meaning if the administration can dramatically lower annual salaries. Although some downward adjustments are legally possible with tenure it is typically the case that a faculty members current nominal salary is viewed as the minimum for all future years.[12]

Several papers have been written on tenure and/or up-or-out employment rules. Kahn and Huberman (1988) find that up-or-out employment rules are

[10]The "1970 Interpretative Comments" of the "1940 Statement" define moral turpitude as "behavior that would evoke condemnation by the academic community generally". An example would be the explicit quid pro quo by a tenured faculty member of money or sex for grades.

[11]Such cases typically result in civil litigation. Although there is substantial variance, the "typical" out-of-court settlement is two years salary.

[12]The "base" salary excludes summer months and administrative supplements. If these are included in compensation then salary will fluctuate much more.

a useful commitment device for employers. Employees can significantly enhance productivity if they make investments. A firm can provide an incentive for the worker to make the investment by rewarding high output. However, without an up-or-out employment contract a university would have an incentive to claim that a high output faculty member is actually a low output one and then reduce, or not increase, the compensation of the professor. Correctly predicting this node, faculty would have diminished incentives to invest, which is not in the long run interests of the university. An up-or-out contract prevents the misrepresentation of output by the university since it would have to terminate anyone who it claims to have realized low output. In other words, an up-or-out contract is an important commitment device used by the university. However, this motivation for tenure ignores the competition between universities for professors. Claiming that a high output professor has produced low output is a formula for losing the professor to another institution.

Waldman (1990) extends the work of Kahn and Huberman (1988) by allowing for general human capital accumulation. Waldman's analysis provides an explanation for some of the commonly observed features of the wage path for academics.

Carmichael (1988) notes that tenure is an important commitment device for the faculty of an academic department in terms of hiring decisions. Incumbent faculty, who are the only ones qualified within the university to assess the quality of junior or senior job applicants, will select the very best people from the pool provided that there is no threat that the newly hired faculty will displace them. Tenure provides the incumbent faculty with this insurance. It is not clear why this reasoning does not apply in fields outside academics as well. Also, we can find no discussions in the historical documents that either university administrators or professors were concerned about this particular kind of inappropriate decision making by incumbent faculty.

A common thread exists in the papers of Demougin and Siow (1994) and O'Flaherty and Siow (1992, 1995). Workers live for two periods. In every period there is a senior experienced manager in each division of a company who manages an unskilled worker. Because of the costs associated with hiring senior division managers from the outside it is desirable to promote junior unskilled labor from within, provided they demonstrate themselves to be productive workers in the first period. An unskilled worker who has not demonstrated sufficient productivity to become a division manager may

still be profitable to retain as an employee in the second period, but then the firm forfeits the opportunity to review another junior person who might demonstrate sufficient productivity to become a manager. In fact, the firm wants to keep looking for possible division managers, given the costs of hiring them from the outside. So, the best contract is one that terminates junior people who demonstrate low productivity. This is an up-or-out rule.

Finally, in the unpublished manuscript of Ito and Kahn (1986), risk-averse workers are offered a wage floor and job security in order to curb disincentives for risky specific human capital investments. (This is similar in spirit to the Russell quote at the beginning of our paper, but it does not address the basic question of why there should be risk with sufficient market alternatives.)

In contrast to these earlier papers, our model considers: (1) Investment by faculty that is not firm (university)-specific. (2) Explicit competition for "superstar" faculty. (3) Tenure, rather than promotion, in the sense that we do not concentrate on the "up-or-out" aspect, which tenure shares, for example, with partnership arrangements in law firms, but focus instead on the commitment by the university not to terminate a faculty member's employment. (We emphasize again that risk aversion does not play a role in our model.) We now describe the model in more detail.

3 The Model

We consider the following model:

1. **Strategic players.** There are two universities, labelled U_1 and U_2, and two members of faculty, M_1 and M_2. Each university has one slot (position), but can create an additional one at a small cost. Each university is interested in maximizing the *average* net expected surplus per slot, where the net surplus is defined as the expected output of the faculty member filling the slot less the salary paid to this person.[13]

[13] "By far the most dependable indicator of university status is the faculty's degree of excellence that determines everything else; a good faculty will attract good students, grants, alumni and public support, and national and international recognition. The most

Each faculty member is interested in maximizing his or her wage less the cost of any occupation-specific investment. All strategic players are interested only in the two periods of the model (plus period -1), and value any future beyond the end of period 2 at 0.

2. **Non-strategic entity.** There is one non-strategic entity, which we call "industry". This is supposed to encompass all occupations, including self-employment, other than the academic occupation on which we focus.[14] Industry acts as a source of potential employees if M_1 and M_2 are dismissed as well as an alternative to the academic occupation for M_1 and M_2 should they choose, or be required to, leave academics.

   A crucial aspect of the model will be the assumption that maintaining one's outside option in industry requires a certain kind of activity (consulting, for example) and investment in academics reduces the level of this activity and hence results in the deterioration of this outside-occupation outside option.[15]

3. **Time line of events, player characteristics and output and investment values.** We consider basically two periods. These are to be understood as following period -1, where ex ante identical faculty members and universities are randomly matched.

   Period -1

   (a) $M_i, i = 1, 2$ has a probability π_{-1} of being a "high (H)" type and thereby producing successful output (S) in period -1 with probability p_H and a failure (F) with complementary probability.

effective method to maintain or increase reputation is to improve faculty quality. ... The move of a professorial superstar from one institution to another can result in instant recognition." [Rosovsky pages 229-231]. This well known fact is the justification for our objective of maximizing average payoff. This objective, within our model, implies that bidding will occur for only the highest achievers and those with most potential for success.

[14] It is possible it could include alternative academic occupations as well, for instance medicine for a historian. We exclude related academic occupations, such as finance and economics.

[15] A similar assumption of decreasing outside option is made in a different context by Rajan and Zingales (1998). Chatterjee and Chiu (2000) also consider a case where the optimal type of investment would reduce outside options. Note that we do not have the outside option *within* the academic occupation declining as a result of investment – this would be hard to justify.

A "low (L)" type produces a success with probability p_L and a failure with complementary probability. We assume that $p_H > p_L$ and that $p_H = 1 - p_L$. Thus, the probability of a high type in period 2, after observing a sequence of outputs (S,F) in periods -1 and 1, denoted $\pi_2(S, F)$, is equal to π_{-1}.

We note that while output can be observed, it is not verifiable and thus contracts cannot be contingent on output realizations. This is a second crucial feature of the model and follows the Grossman and Hart (1986) and Hart and Moore (1990) framework for the firm[16]. Period -1 is to be interpreted as the preliminary (tenure) review period.

At the beginning of period -1, each faculty member is either terminated or continued. If terminated then the university hires a replacement worker from "industry" while the terminated professor obtains employment in industry receiving wage α per period. To avoid dealing with trivial cases where everyone gets promoted, those who get F realizations are assumed to be terminated. We assume there are unlimited opportunities in industry. The university can also draw on the industry pool in order to meet short term needs, such as to fill a slot made vacant by the dismissal of a regular faculty member.

Period 1.

(a) At the beginning of period 1, we assume that $M_1$and M_2 are both employed in universities and each has the same probability π_1 of being a high type. U_j now offers its faculty member one of three contracts. (Each university will offer just one of these contracts– the following describes the set of permissible contracts a university can offer.)

1. A spot market contract in which the employer will observe the realization of output (success or failure) at the end of period 1 and make an offer of a period 2 wage, or decide to dismiss the employee and hire from industry.

[16]In fact, Hart (1995, p.38) mentions the university tenure decision as an example where performance could be observable but not verifiable in court.

2. A wage-severance contract in which a minimum wage w_s is fixed for period 2 but the employer is given the option of activating a severance clause. Under this scenario an employee who is dismissed at the beginning of period 2 receives a severance payment of s. Alternatively, only the severance payment could be specified.

3. A tenured contract that promises a minimum wage w_T, and an assurance of continued employment.

Note that contracts contingent on output realizations and on actions taken by the employee are not allowed, even though the output and actions are all observable. There is no private information; M_i does not know his type and neither does the university.

After receiving the contract offers, each employee decides whether to accept or reject and take a job in industry. If an employee goes to industry, one of the employers will hire short-term from industry.

An employee who accepts a contract has to decide, in period 1, on a level of planned investment i at a cost $c(i)$,with $c(\cdot)$ assumed strictly convex, twice continuously differentiable in i, $i \in [0,1]$,and $c'(i) \to \infty$,as $i \to 1$. The investment, also observable but not contractible, affects output in period 2, but not in period 1, in the following way: the probability of success for a high type goes up to $p_H + i(1-p_H)$ everything else remaining unchanged. There is a similar specification for M_2.The output is v if there is a success and 0 if there is a failure. We note that investment does not play the role of an insurance for the low type, since the low type does not gain by investment.[17]

Period 2.

(a) At the beginning of period 2, after observing the investments and the output realization in period 1, the following game takes place: U_1 moves first and makes a bid on M_2 or passes. U_2 follows, makes

[17]We assume faculty have no differential information about their ability type. In other words, no continuing faculty member can draw meaningful inferences, other than the ones that can be drawn based on publicly observable events, about their chance of being of either high or low ability given that they were not terminated.

a bid on M_1 or passes. U_1 then responds with a counter-offer for its own employee or termination (if there is no tenure), followed by U_2 for M_2. Each university can be silent at any stage. If both universities are silent in a given stage, the last offered salaries are binding and the employees accept or reject the offer.[18] If an employee does not accept either of the offers or is terminated, he or she goes into industry. If an employer is without an employee, she will hire an individual from the outside market with $\pi \leq \pi_{-1}$ and pay this person at least α.

Payoffs are realized every period. There is assumed to be no discounting.

4. **Decreasing outside option.** If a faculty member M_k is terminated at the beginning of period 2, after investment, his or her pay in industry becomes $\alpha(1 - i_k)$.[19][20]

[18]If the wage offer to one's own employee comes before the auction, we could potentially get a continuum of subgame equilibria in certain cases (though they could be off the equilibrium path in the whole game). For example, if both employees have low realisations and have identical investments, suppose U_1 offers its employee M_1 a salary w strictly larger than $M_1's$ industry outside option. In simultaneous play U_2 must also offer w to M_2, otherwise U_1 will bid for M_2. We thank Debraj Ray for pointing out this possible difficulty in this alternative form of the game.

[19]Or, of course, any function decreasing in i_k. "The Report of Committee A on Academic Freedom and Academic Tenure", *AAUP Bulletin*, 1918, notes the following. "It should be remembered, too, that the College or University professor is a specialist. The market for his services is limited. In any one year, or series of years even, there may be no positions available in which his special training and interests could be utilized."

[20]This formulation is, of course, a simplification. An alternative formulation is as follows. Let η represent investment in "industry" and let $\alpha(\eta)$ be a strictly concave, increasing, twice differentiable function of η. Let the cost of investment be given by the strictly convex, twice differentiable function $c(.)$ of investment. In industry, an employee will choose η to maximize $\alpha(\eta) - c(\eta)$. Let the maximizing η be η^* and the value of $\alpha(\eta^*)$ be α (with some abuse of notation).

In academics, the payoff to investment in the spot market setting, which will be explicitly stated later in the paper, is of the form

$pY(i) + (1 - p)\alpha(\eta) - c(i + \eta)$ where i is the investment in academics and $Y(.)$, the expected second-period payoff given the choices of the other player, is linear in i. (The linearity follows from the assumptions made later in the paper.)

It is clear that if $(1-p)\alpha'(\eta)$ starts off higher than $pY'(i)$ but crosses it at some value η^A where $(1 - p)\alpha(\eta^A) > c'(\eta^A)$, then there will be some investment in industry and some in academics in the spot market by the university employee. It is also clear that $\eta^A < \eta^*$, so

4 Analysis of the Spot Market Contract

4.1 Two F realizations

4.1.1 Expected output

Suppose that each employee had an output realization in Period 1 of F. Denote the investments of M_1 and M_2 as i_1 and i_2, respectively.

The expected Period 2 output for M_j $(j = 1, 2)$ is:

$$Y_j(F_j) = \pi(F)\{p_H + i_j(1 - p_H)\}v + (1 - \pi(F))p_L v. \tag{1}$$

The first term takes into account the revision of the probability of success for the high type by the investment.

For the short-term employee, who by assumption makes no investments and has a probability π of being high ability, the expected output is

$$Y_0 = \pi \cdot p_H \cdot v + (1 - \pi) \cdot p_L \cdot v. \tag{2}$$

The employer's outside option surplus for continuing to employ either M_1 or M_2 is $Y_0 - \alpha$, where α is the reservation wage of the recruit from industry.

If U_j decides to retain its current employee, M_j, its payoff would be given by

$$Y_j - \alpha(1 - i_j) = \pi(F) \cdot [(p_H + i_j(1 - p_H)]v + (1 - \pi(F)) \cdot p_L \cdot v - \alpha \cdot (1 - i_j)$$

(Here $\alpha \cdot (1 - i_i)$ is the amount the employee would get in industry.)

We note that $\pi \leq \pi_{-1} = \pi_2(S, F)$. Therefore for these low realizations of output, $Y_0 \leq Y_j$, and for positive values of investment, $\alpha(1 - i_j) < \alpha$. Thus the employer is unequivocally better off (with positive investment and at worst indifferent with 0 investment) by retaining the current employee and paying him a low wage corresponding to his outside occupation outside option (if the employer can make the employee accept these terms) than by hiring from industry for one period.

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that the value of $\alpha(\eta^A)$ is less than α. Therefore the possible investment in the academic option has decreased the outside option in industry.

We work with the simpler formulation in the rest of the paper.

4.1.2 Wages paid in the spot market

Suppose $i_1 \geq i_2$; then $Y_1 \geq Y_2$. If the inequality is strict, U_2 will consider bidding for M_1 and will be willing to go up to $Y_1 - Y_2 + \alpha(1 - i_2)$, while M_2 will not have any bidders and will therefore obtain a wage of $\alpha(1 - i_2)$ inside U_2 if the university is unsuccessful in getting M_1, and outside the university otherwise. We note that even though M_2 could have a job in academics in the latter case, this job also will not pay him more than $\alpha(1-i_2)$. M_1 will get $Y_1 - Y_2 + \alpha(1 - i_2)$. If $i_2 \geq i_1$, the wages will be set similarly with $\alpha(1 - i_1)$ as the base.

4.2 Two S realizations

The analysis in this case is similar to the previous section, except that $\pi(F)$ is now replaced by $\pi(S)$. Note that even in this case, both employees could end up with $\alpha(1 - i)$, if, for example, the investments are the same, even though their expected output is higher in this case than in the last subsection. The additional surplus is captured by the employers in the absence of bidding.

4.3 One F, one S realization

Suppose that M_1 has had a F realization in period 1, and M_2 has had a S realization. It is now no longer possible to determine which player's wage will be bid up without considering the magnitude of the difference in investments. From expressions similar to (1) and (2), we get

$$\begin{aligned} & Y_1(F_1) - Y_2(S_2) \\ & = \pi(F)\{p_H - p_L + i_1(1 - p_H)\}v - \pi(S)\{p_H - p_L + i_2(1 - p_H)\}v. \end{aligned} \tag{3}$$

Suppose, for example, that i_1 is close to 1 and $i_2 = 0$, and that $p_H = \frac{1}{2} + \varepsilon$, where ε is small. Then the difference above becomes close to

$$\begin{aligned} \pi(F) - \pi(S)\}\{p_H - p_L\}v + \pi(F)(1 - p_H)v = \pi(F)vp_H - \pi(S)(2p_H - 1)v \\ = \pi(F)v - \pi(S)\varepsilon v. \end{aligned}$$

This could be positive for ε sufficiently small.

We therefore have to consider both cases, where $Y_1(F_1)$ is larger than $Y_2(S_2)$, and vice versa. If $Y_1(F_1)$ is larger then employee 1 obtains $Y_1 - Y_2 + \alpha(1 - i_2)$. In this case, Player M_2 loses to M_1 in every realization as long as $i_1 > i_2$. M_2's payoff will then be just $\alpha(1-i_2)$ and therefore i_2 will be chosen equal to 0. (Discouraged academics will look a great deal like new recruits from industry.)

In the more reasonable case, if i_1 is not too far away from i_2, M_1 will lose with a F realization if M_2 has a S realization.

We summarize these results in a proposition.

Proposition 1 *Consider the spot market in period 2 with $i_1 \geq i_2$. Then the wages offered to the employees are as follows:*

Realization SS :

M_1 *obtains* $Y_1(S_1)-Y_2(S_2)+\alpha(1-i_2) = \pi(S)v(i_1-i_2)(1-p_H)+\alpha(1-i_2)$;

M_2 *obtains* $\alpha(1 - i_2)$.

Realization FF :

M_1 *obtains* $\pi(F)v(i_1 - i_2)(1 - p_H) + \alpha(1 - i_2)$;

M_2 *obtains* $\alpha(1 - i_2)$.

Realization FS :

(a) *There exist* i_1, i_2, *and* p_H *such that for* i_1 *sufficiently greater than* i_2 *and for* p_H *sufficiently close to* $\frac{1}{2}$,

M_1 *will be the winner in the tournament* $(Y_2(S_2)-Y_1(F_1) < 0)$ *and obtain* $\pi(F)\{p_H - p_L + i_1(1 - p_H)\}v - \pi(S)\{p_H - p_L + i_2(1 - p_{H)}\}v + \alpha(1 - i_2)$;

M_2 *gets* $\alpha(1 - i_2)$.

(b) *For those values of* i_1, i_2, *and* p_H *such that* $Y_2(S_2) - Y_1(F_1) \geqslant 0$ *then* M_1 *gets* $\alpha(1 - i_1)$,

M_2 *gets* $Y_2(S_2) - Y_1(F_1) + \alpha(1 - i_1)$.

(Realization SF can be analyzed in a similar way.)

Proof. See discussion preceding statement. ■

4.4 Investment decisions by employees.

Proposition 2 *If there exists an equilibrium where case (a) in realization FS of Proposition 1 holds, then* $i_2 = 0$.

Proof. Employee M_2 obtains $\alpha(1-i_2)$ no matter what the end-of-period 1 output realization. This is maximized by setting $i_2 = 0$. ■

We now look for an equilibrium in investment choices under condition (b) of the Proposition above. The expected payoff to Player M_1, given the value of i_2, if i_1 is chosen to be $\geq i_2$ is:

$$\begin{aligned} R_1(\pi, i_1, i_2) \quad &= p(SS)[\pi(S)v(i_1 - i_2)(1 - p_H) + \ \alpha(1 - i_2)] \\ &+p(FF)[\pi(F)v(i_1 - i_2)(1 - p_H) + \ \alpha(1 - i_2)] \\ &+p(SF)[(\pi(S) - \pi(F))v(p_H - p_L) \\ &+(i_1\pi(S) - i_2\pi(F))(1 - p_H)v + \alpha(1 - i_2)] \\ &+p(FS)[\alpha(1 - i_1)] - c(i_1). \end{aligned} \tag{4}$$

The expected payoff to player M_2, given the value of i_1, if i_2 is chosen to be $\leq i_1$ is:

$$\begin{aligned} R_2(\pi, i_1, i_2) \quad &= [p(SS) + p(SF) + p(FF)]\alpha(1 - i_2) \\ &+p(FS)[(\pi(S) - \pi(F))v(p_H - p_L) \\ &+(i_2\pi(S) - i_1\pi(F))(1 - p_H)v + \alpha(1 - i_1) \\ &-c(i_2). \end{aligned} \tag{5}$$

(p(SS) is the probability of each player getting an S realization at the end of period 1. p(FF), p(SF), and p(FS) are correspondingly defined.) We differentiate with respect to i_1 and set the resulting expression equal to 0, assuming an interior solution. Note that all the terms above are linear in i_1, except for the cost $c(i_1)$. The first-order conditions are therefore of the form: $K = k\alpha + c'(i_1)$, where K and k are constant. Let the unique value of i_1 that solves this be i_1^S, given i_2.

Note that if $i_1 = i_2$, there is a kink at the common value of investment. If $i_1 = i_1^S = i_2$ then, in fact, Player M_1 would benefit by reducing investment below i_2^S. Thus there is no symmetric pure-strategy equilibrium. This is unfortunate, because there are the obvious coordination problems associated with which employee invests more and which one less, which we do not want to consider in this paper. We assume as a convention therefore that $i_1 > i_2$.[21]

[21] An alternative way out is for M_1 to choose (observable) investment first, followed by M_2. This will resolve the co-ordination issue, but is artificial. Incomplete information about the cost function of individuals would give a symmetric equilibrium but at the cost of somewhat more complicated expressions in the first-order conditions.

The next proposition characterizes this equilibrium.

Proposition 3 *Assuming both investment values are strictly positive, the following expressions characterize the spot market equilibrium:*

$$(p(SS)+p(SF))\pi(S)(1-p_h)v+p(FF)\pi(F)(1-p_H)v+p(FS)(-\alpha)-c'(i_1^S)=0. \tag{6}$$

$$(p(SS)+p(SF)+p(FF))(-\alpha)+p(FS)(\pi(S)(1-p_H)v)-c'(i_2^S)=0. \tag{7}$$

Proof. We obtain the value of $c'(i_1^S)$ from equation (6) and substitute into $\partial R_2/\partial i_2$ to obtain

$-(p(SS)+p(SF))\pi(S)(1-p_H)v+p(FS)\pi(S)(1-p_H)v$

$-p(FF)\pi(F)(1-p_H)v+p(FS)\alpha-\alpha(p(SS)+p(SF)+p(FF))$

Since $p(SF)=p(FS)$ this expression can be rewritten as follows.

$\pi(S)(1-p_H)v(-p(SS))+\pi(F)(1-p_H)v(-p(FF))$

$-\alpha(p(SS)+p(SF)+p(FF)-p(FS))<0.$

Since $c'(\cdot)$ is strictly increasing in its argument and since $Lim_{x\to 1}c'(x)\to\infty$, it follows that $i_2^S<i_1^S$. Therefore i_1^S is in the interior of $[i_2,1]$ and i_2^S is in $[0,i_1]$. The quantities i_1^S and i_2^S satisfy the FOC and the second-order conditions (because of the strict convexity of $c(\cdot)$) and are therefore optimal against each other. ■

4.5 Analysis of wage-severance contracts

We now consider briefly[22] the case where the universities both offer wage-severance contracts in period 1. There are two kinds of severance contract possible. The first pre-specifies a second-period wage of w_s and a severance payment of s with the employer retaining the right to activate severance.[23]

A severance payment s must satisfy the following feasibility condition for the employer.

[22]Severance does not play an important role at this stage; the difference between severance contracts and other contracts is addressed in the last section.

[23]If the second period wage is not prespecifiied then the employer could always offer a wage of zero in period 2 and induce an employee to quit, thus avoiding the payment s.

$$(Y_0 - \alpha) - (Y_j - w_s) \geq s \text{ for some } i \geq 0$$

If there is no value of i for which the above condition holds then the severance payment will never be activated.

For the period 1 employee to find severance acceptable it must be the case that

$$w_s - \alpha(1 - i) \leq s$$

Thus, we have

$$(Y_0 - Y_j) + (w_s - \alpha) \geq s \geq (w_s - \alpha) + \alpha i$$

Since $(Y_0 - Y_j) \leq 0$ and $\alpha i > 0$ the inequalities cannot both be satisfied.

Note that if the outside opportunity wage did not deteriorate with investment and/or the gross benefit of hiring an outsider was larger than retaining the current employee then severance would be feasible for some i and output realizations.

We conclude this section by examining the two-period individual rationality constraint for a faculty member. The general analysis is applicable both to the spot market and to the tenure contract, since it basically says that the expected sum of wages over two periods minus the investment cost must be at least as high as the employee's two-period payoff in industry.

The spot market analysis gives the wages for each realization of first-period output and employee investment. Thus, an expected wage, $E(\tilde{w}_2)$ can be calculated. Denoting the first period wage by w_1[24] and equilibrium investment by i^*, we must have

$$w_1 + E(\tilde{w}_2) - c(i^*) = 2\alpha. \tag{8}$$

This ensures that the faculty member wishes to work in academics rather than industry. There is also an ex post (one-period) individual rationality constraint in that second-period wages cannot be less than the employee's second-period outside option. This is taken into account in the previous analysis.

[24]These numbers will depend of course on the nature of the contract offered by the employer.

5 Tenure contracts.

We now consider tenured contracts, consisting of a minimum second-period wage, w_T, and a guaranteed job.[25] We first consider the case when only one of the universities offers a tenured contract — suppose this is U_1 while U_2 offers a spot market contract as before. Suppose the amounts invested are i_1 and i_2, and the expected second-period outputs given first-period output realizations are Y_1 and Y_2 respectively.

Since U_1 has tenured M_1, it can only bid for M_2 if hiring M_2 increases its average payoff. U_2 can bid for M_1 and terminate its own employee if it finds this optimal.

Bidding will therefore take place only for the employee with the highest surplus. If $Y_1 - w_T \geqslant Y_2 - \alpha(1 - i_2)$, (i.e. $w_T \leq Y_1 - Y_2 + \alpha(1 - i_2)$, then M_1 will obtain a payoff of $Y_1 - Y_2 + \alpha(1 - i_2)$ and M_2 of $\alpha(1 - i_2)$. If $Y_1 - w_T < Y_2 - \alpha(1 - i_2)$ M_1 gets w_T and M_2 gets the difference between the two net surpluses.

The expected payoff for M_1 assuming that $i_1 \geq i_2$ is

$$\begin{gathered} p(SS)[\max(w_T, \pi(S)(i_1 - i_2)(1 - p_H)v + \alpha(1 - i_2))] \\ +p(SF)[\max(w_T, (p_H - p_L)v(\pi(S) - \pi(F)) + (\pi(S)i_1 - \pi(F)i_2)(1 - p_H)v + \\ \alpha(1 - i_2))] \\ +p(FF)[\max(w_T, \pi(F)(i_1 - i_2)(1 - p_H)v + \alpha(1 - i_2))] \\ +p(FS)[\max(w_T, \alpha(1 - i_1)] \\ -c(i_1). \end{gathered}$$

The wage w_T can have different incentive properties depending on its magnitude. If it is large enough, for example, to always be the maximum of the pairs of quantities in brackets for every realization, then the employee will get w_T no matter what he invests. Given the cost of investment, he or she will then invest 0. We assume w_T to be relatively small, but fixed. (We

[25] In the analysis, it will appear that the guaranteed wage is the important feature and not the guarantee of employment. However, this is not true, since in the spot market case, the wage is set by the employee's outside option, which is what he would get if he turned down the contract and went into the market. Here the outside option is replaced by an "inside option" of w_T.

shall later make this more precise.) In particular, suppose that the expected payoff of the tenured faculty member can be written as:

$$p(SS)\pi(S)\{(i_1-i_2)(1-p_H)v\}+p(SF)\{(\pi(S)-\pi(F))(p_H-p_L)v+ (\pi(S)i_1-\pi(F)i_2)(1-p_H)v\}+p(FF)\pi(F)\{\pi(F)(i_1-i_2)(1-pH)v\} +p(FS)w_T-c(i)+(p(SS)+p(SF)+p(FF))\alpha(1-i_2).$$

Differentiating this with respect to i_1 and setting the derivative equal to 0, we obtain

$$(p(SS)+p(SF))\pi(S)(1-p_H)v+p(FF)\pi(F)(1-p_H)v-c'(i)=0 \quad (9)$$

Comparing equations (6) and (9), we see that a negative term has been replaced by 0, so that the value of i that makes this expression 0 has increased. Therefore, the investment value has increased. Now we can set $w_T=\alpha(1-i_1^*)$, for example.

Proposition 4 *(i) If U_j offers M_j a tenured contract rather than paying according to the spot market, U_j will be better off given that U_{-j} is using the spot market; i.e. spot market employment is not part of a subgame perfect equilibrium.*

(ii) It is a subgame perfect equilibrium strategy for both universities to offer tenured contracts.

Remark 5 *If there were no second slot, that is no competition for the high output person, tenure would still have been worth introducing if the other university had no tenure, but two universities with tenure and with no possible additional slots would elicit zero investment in this model. The second slot avoids this prisoners' dilemma.*

Proof. We need to show that U_j is better off by offering a suitable tenure contract. Let the expected payoff with a tenure contract be given by

$Y^1+p(SS)Y^2(SS,T)+p(SF)Y^2(SF,T)+p(FS)Y^2(FS,T)$

$+p(FF)Y^2(FF,T)-w_1-E(\tilde{w_2})$

where $Y^t(\cdot\cdot,T)$ refers to the output in period t, given the firm has offered a tenured contract. We know from equation (8) that $w_1+E(\tilde{w_2})=2\alpha+c(i_1^*,tenured)$. Therefore, the expected payoff is

$Y^1 + p(SS)Y^2(SS,T) + p(SF)Y^2(SF,T) + p(FS)Y^2(FS,T)$
$+p(FF)Y^2(FF,T) - 2\alpha - c(i_1^*)$.

To demonstrate that the university is better off with offering a tenured contract, we must therefore show that the difference in expected output is larger than the difference in the cost of the additional investment. This difference is equal to

$$\begin{aligned}&(i_1^* - i_1^S)[(p(SS) + p(SF))\pi(S)(1-p_H)v + \\ &(p(FF) + p(FS))\pi(F)(1-p_H)v] - c(i_1^*) + c(i_1^S)\end{aligned} \tag{10}$$

$$\begin{aligned}&= (i_1^* - i_1^S)[c'(i_1^*) + p(FS)\pi(F)(1-p_H)v] \\ &- (c(i_1^*) - c(i_1^S))\end{aligned}$$

$$> (i_1^* - i_1^S)(p(FS)\pi(F)(1-p_H)v > 0.$$

This last expression follows from the strict convexity of the cost function– $c'(i_1^*) > c'(i_1^S)$ and therefore $(i_1^* - i_1^S)c'(i_1^*) > c(i_1^*) - c(i_1^S)$.

(ii) The proof of this is very similar to the above and is omitted. ■

6 Incentives in Academic Administration

A major premise of this paper is that the output of a faculty member is not verifiable. Consequently, it seems reasonable to conclude that if we aggregate over any group of faculty we would encounter the same difficulty in publicly verifying output for the group. In light of this, how does one evaluate the performance of a Dean, Provost, or University President as academic administrators?[26]

What is the social planner's problem? How does this differ from the objectives of academic administrators? From its outset the AAUP tried to

[26]We conjecture that this partially explains the seemingly excessive emphasis by university administrators on department rankings, especially those prepared by impartial groups such as the National Research Council.

address these questions. The advancement of methods and knowledge within each discipline, and the conveyance of disciplinary methods and knowledge to students (as well as assisting policy makers), was clearly understood as the social planner's objective. The AAUP articulated the position that administrators were concerned with the advance of their own universities and that this objective may differ from disciplinary advance. For example, if a faculty member worked in an area of regulatory economics that greatly advanced this subfield but the results were at odds with the objectives of donors then the actions of university administrators may not be consistent with those of the social planner. The Ross case at Stanford is a good example.

A further difficulty arises because the time frames in higher education for realizations of output from investments can be much longer than the usual appointment periods of university administrators. From inception it may take five years before the first publication comes from a research project. Changes in the structure of a graduate program may not produce a noticeable change in placements of graduate students for 10 years. Similarly, changes in the undergraduate program will not be recognized as successful until they have reached steady state which might take two generations of students (8 years). And it is often the case that the term of university administrators is five years.

Suppose a university faculty member wants to pursue a career path within academia as an administrator. In light of the limitations identified above, what should he or she do? One answer is to invest time in any activity that is visible and easily measured such as starting a new department or a new institute. A change like this will require a substantial investment of resources. Prior to the existence of tenure, one way to garner such resources was to reduce the size of existing departments by dismissing faculty. In addition, the opinions of wealthy donors, as in the Ross case at Stanford, receive inordinate weight.[27]

To model the incentives and objectives of academic administrators explicitly would be quite a difficult undertaking, since one would have to analyze the tradeoffs between immediately visible and verifiable results and longer-term, possibly more permanent benefits. We adopt a simple, ad hoc approach

[27]In the current environment it can be argued that incentive distortions of administrators often manifest themselves via excessive emphases on interdisciplinary initiatives, where short term investments receive much public attention, much to the frustration of faculty who are concerned with the implied diversion of resources from disciplinary programs.

to this by assuming that all academic administrators value true output Y at λY, where $0 < \lambda < 1$. We now turn to the model with this additional feature.

The introduction of λ implies that the administrator puts the full and appropriate weight on cost but less than the full and appropriate weight on gross output. Any contract that encourages investment and thus enhances expected output is less likely to be selected as the appropriate contract by administrators who have $\lambda < 1$. Intuitively, the spot market contract will get more weight relative to the tenure contract.

Formally, we return to expression 10 and realize that the introduction of λ prohibits the definitive conclusion reached based upon the convexity of the cost function. Specifically, for low enough values of λ it may well be the case that $\lambda(i_1^* - i_1^S)c'(i_1^*) < c(i_1^*) - c(i_1^S)$. This would imply that the spot market contract is preferred to the the tenure contract, at least by university administrators.[28]

It is reasonable to conjecture that the early debate about tenure was really about the incentive distortions of University administrators. Once the faculty in the AAUP were able to convince the university community that low λ values resulted in the wrong contract being selected then the appropriate contract from the viewpoint of the social planner emerged.

7 Severance contracts, risk aversion and renegotiation

Though severance contracts have been considered briefly in the analysis, they have not played any central role. This section is an attempt to investigate the potential role of severance contracts.

7.1 A Variant of the Model

In the context of the current model, we can make the following observations. Suppose that for some reason, it becomes optimal at the beginning of period 2 for an employer to replace the current employee with someone from "industry". Although there are other potential motivations, we assume this

[28]The infeasibility of the severance contract is not impacted by the introduction of λ since if $Y_0 - Y_j < 0$ then $\lambda(Y_0 - Y_j) < 0$.

happens because a period 1 F realization is an almost certain indication of a low type: $p_L = 0$. (This is not true in period -1.) Then $\pi_2(F) = 0$ and an industry person has $\pi > 0$. It is now ex post optimal for the employer to dismiss the employee if $\alpha(1-i)$ is not too much less than α.

7.1.1 Renegotiation with Risk Neutrality

We consider the case where the university renegotiates with its tenured employee who has a F realization. Here the university might agree to pay s if the employee "retires". Suppose the renegotiation takes place with the following extensive form. Each is randomly chosen to make a proposal, which the other then accepts or rejects. If the proposal is accepted, the agent leaves with severance s and the university hires an outside person from industry with surplus $Y_0 - \alpha$. If either rejects, the university gets $Y_1 - w_T$ and the employee w_T. The employee will accept as long as $s + \alpha(1-i) \geq w_T$, and the university as long as $Y_1 - w_T \leq Y_0 - \alpha - s$. The employee's expected payoff is the average of the smallest acceptable severance for the employee and the largest acceptable severance for the employer, plus the outside opportunity wage.

$$\tfrac{1}{2}(Y_0 - \alpha - (Y_1 - w_T) + w_T - \alpha(1-i)) + \alpha(1-i)$$

The coefficient of the $(1-i)$ term in this expectation is $\alpha/2$. Consider the alternative where a pre-specified wage w_s and severance s are set down, to be activated by the employer. Now so long as $Y_1 - w_s \leq Y_0 - \alpha - s$, the university will activate severance. (If this inequality does not hold, severance is irrelevant.) The employee will then get $s + \alpha(1-i)$ no matter who makes the proposal, and the coefficient of $(1-i)$ is α. Tenured contracts, even with renegotiation, therefore do better than severance.[29]

7.1.2 No Renegotiation with Risk Aversion

If an employee, say M_1, is risk averse with concave utility function $u(.)$ and the university promises severance of s, his investment choice problem will be

[29] If the university has all the bargaining power then tenure and severance will produce identical investments. This is natural since the severance contract is set by the university at the beginning of period 1 when it has all the bargaining power.

$$\max_i \{p(SS)u[Y_1(S,i_1) - Y_2(S,i_2) + \alpha(1-i_2) - c(i_1)]$$
$$+p(SF)u[Y_1(S,i_1) - Y_0 + \alpha - c(i_1)] + (p(FS) + p(FF))u[s + \alpha(1-i_1) - c(i_1)]\}$$

It is clear that to avoid trivialities, the first derivatives of the first two terms with respect to i_1 must be positive, and the derivative of the third term is clearly negative. If $s = 0$, the spot market case, $u'[0 + \alpha(1 - i_1) - c(i_1)]$ will be higher for a given i_1 than if $s > 0$, because of the concavity of $u(.)$. The negative term in the first-order conditions will therefore be smaller with a positive s, and therefore severance will generate more investment than the spot market. With tenure the employee's investment choice problem is the same as the one confronted with severance except the last term becomes

$$(p(FS) + p(FF))u[w_T - c(i_1)]$$

The FOC's for the severance and tenure problems yield an ambiguous ranking. Thus severance might be the better contract.

8 Conclusions

Our conclusions can be summarised as follows:

Contingent contracts for university faculty, based on output or investment, are not possible since neither output nor investment are verifiable. Further, the accumulation of discipline-specific human capital by academics is often detrimental to their outside opportunities outside their occupations. We have shown in this paper that the confluence of these effects results in a tenure contract. Employers prefer it because it encourages increased levels of investment. Employees prefer it since it prevents employers from taking advantage of the erosion of the outside opportunities of employees as they strive for results in their discipline.

Of course, there might be other valid economic explanations for tenure, as well as some of the academic freedom arguments mentioned in the introduction. We have focussed on one set of arguments; our reading of the history of the emergence of tenure suggested to us that informal analogues of our arguments appear in the historical literature as well.

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