ACADEMIA ECONOMIC PAPERS
45 : 2 (June 2017), 279–304

Up-or-Out Policy in Universities

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Keywords: Up-or-out, Academic tenure, University competition
JEL classification: I21, I23

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ABSTRACT

For high school seniors with strong academic records who are choosing a university, one important factor is whether the university courses are taught by faculty members with strong academic ability. To recruit these students, universities implement an up-or-out policy with three features: (1) faculty members being promoted from assistant to associate professor are awarded permanent tenure, (2) those denied promotion to associate professor are asked to leave, and (3) the promotion decision is based on the quantity and quality of academic publications during the probationary period.

1. INTRODUCTION

In many US universities, applicants for tenure-track faculty positions (largely freshly minted PhDs) are assessed by tenured faculty members within the same specialization area. Applicants are evaluated mainly on their doctoral dissertations. Those who pass the evaluation are appointed as tenure-track assistant professors. Tenure-track assistant professors in the last year of the probationary period (typically 6 years) are evaluated for promotion mainly on the quantity and quality of their academic publications. Those who pass the evaluation are promoted to tenured associate professor, and those who fail are asked to leave after 1 year. Such a promotion policy has been described in the literature as an "up-or-out" policy.[1]

This paper presents an explanation for why universities generally adopt such a policy, which complements those already existing in the literature. I argue that by adopting the up-or-out rule, a university offers a credible commitment to its prospective students that its educational services are of high quality. Such a commitment will encourage top high school seniors to apply to the university.[2, 3] For high school graduates entering university, educational services at universities are mainly teaching services delivered by faculty members. Teaching services are not only intangible and inseparable, but also very highly instructor-intensive.[4] Therefore, by announcing and implementing the up-or-out policy, the university accomplishes its goal of committing to high-quality faculty and hence high-quality teaching services.

[1] The policy of requiring staff to get promoted or face termination is often observed in universities, the military, and professional service firms (e.g., law, accounting, consulting).

[2] Applicants for admission to study at universities in the US not only include high school students in grade 12, but also applicants for admission as graduate students. The arguments made in this paper still apply if applicants for admission to universities include applicants for admission as graduate students.

[3] High-ability students are more likely to attend universities that have successful researchers (Siow, 1997). Indeed, a higher level of publications at a university creates a larger pool of more qualified student applicants (Becker et al., 2003). Furthermore, undergraduate applicants with strong high school records of academic performance select academic quality as one of the most important factors influencing their choice of university (e.g., Litten, 1982; Choroszy et al., 1983; Braxton, 1990; Paulsen, 1990).

[4] Intangibility and inseparability are two characteristics of services often mentioned in the literature on services marketing. The intangibility of teaching services means that they lack physical substance and therefore cannot be seen or touched before they are bought. Inseparability of teaching services means that they are produced and consumed simultaneously. In other words, students are receiving instruction in class at the same time a faculty member is delivering it. Due to the intangibility and inseparability of teaching services, applicants cannot evaluate the quality of teaching services that they will receive if they are later admitted to a university.

High-quality university faculty means university faculty with strong academic abilities. However, a scholar's academic abilities can only be validly evaluated by scholars within the same specialization. This is why the academic work (mainly an unpublished dissertation) of a freshly minted PhD applying for a faculty position with a university is evaluated by the university's senior faculty members within the same specialization. In order for (associate) professors to recruit freshly minted PhDs with a high quality dissertation, their jobs must be protected by tenure (Carmichael, 1988). With this job protection, professors will not worry about their job security being threatened if freshly minted PhDs with high academic potential become their colleagues. The present study proposes that a university's policy of granting tenure to associate professors makes its prospective students believe that the freshly minted PhDs it hires are those with high academic potential.[5]

To attract applications from potential students, universities adopt not only the policy of awarding tenure to associate professors, but also the following policy: once a tenure-track faculty member's academic abilities are demonstrated to be not high enough for promotion and tenure, he is asked to leave the university. Before elucidating this claim, I want to make a key point. If a university wants to attract applications from potential students by terminating tenure-track faculty members whose academic abilities are demonstrated to be not high enough for promotion and tenure, it must at the same time adopt a criterion for promotion and tenure such that its potential students believe that tenure-track faculty members with high enough academic abilities are promoted and awarded tenure and those without not. The quantity and quality of academic publications serve as such a criterion for three reasons. First, the quantity and quality of academic publications are a reliable measure of a scholar's academic abilities. Second, the decision on whether to recommend promotion to tenure for a faculty member is made by his tenured colleagues. However, the more objective the criterion used for such a decision, the less room for exercising subjective discretion (such as recommending promotion based solely on a colleague relationship), and hence the more likely that decision will be based on the criterion. The quantity and quality of academic publications are a fairly objective criterion. Obviously, quantity is objective. Although quality is subjective in nature, there are currently accepted objective mea-

[5] Freshly minted PhDs with high academic potential are more likely to be scholars with high academic ability. A freshly minted PhD with a dissertation of high scientific quality is considered to have high academic potential. He is not considered to have high academic ability, since a dissertation is not enough to judge a freshly minted PhD's academic ability, and since the extent of the advisor's contribution to the dissertation is unclear.

sures by which to evaluate the quality of an academic article, such as the number of citations it receives, the impact factor of the journal in which it was published, and the impact factors of journals where it was cited. Third, for universities that intend to attract potential students through outstanding faculty, brochures for student applicants would highlight the university faculty's major academic achievements. Disclosing the faculty's major academic achievements would enable anyone to monitor whether faculty members who evaluate candidates for promotion to tenure promote unqualified ones and hence reduce their incentive to promote such candidates.

Now why is it that a university develops a policy to attract applications from potential students by dismissing tenure-track faculty whose academic abilities are shown to be insufficient to merit promotion and tenure? The answer is related to the fact that a prospective student applying to a university does not know who will teach the courses he will take if he is later (usually about 6 months to a year later) admitted to and enrolls at it. Suppose an applicant for admission to a university as a student H, has an interest in East Asian politics. He learns from the information brochure of the Department of Politics that only three faculty members specialize in East Asian Politics and hence may teach the course on East Asian Politics. Of these professors, one is tenured associate professor A, another is probationary assistant professor B, and the third is assistant professor C, who was denied promotion and tenure but allowed to continue working at the university. Applicant H knows that associate professor A's academic ability is high, that assistant professor B's academic ability is either high or not high, and that assistant professor C's academic ability is not high. However, he does not know which of the three professors will teach the course on East Asian Politics if he is later admitted to the university and enrolls in the course. The main reason for this uncertainty is that it is the department, rather than he, which determines who will teach the course, and that the instructor's name for the course will not be available to students until the course schedule is made available – that is, until the semester immediately preceding the semester in which the course is offered.[6, 7] Obviously, if assistant professor C had been dismissed from the university, applicant H would learn

[6] Actually, the names of courses offered by a university are also not available to students until the course schedule is made available. Nevertheless, since potential students applying to a university know its faculty's specialization, they should be able to make a reasonably good guess about what courses will be offered.

[7] If a course has more than one likely instructor, the department chair will need to determine, through negotiation, who will teach the course, unless only one faculty member wants to teach it. The course instructor can vary year by year, depending on the individual circumstances of the course/faculty assignment process. Hence, predicting who will teach the course is not simple and straightforward.

from the brochure that the faculty members who might teach the course on East Asian Politics would be associate professor A and assistant professor B. Hence, applicant H would expect that the academic ability of the course instructor and thus the quality of the course would be higher, compared to the situation where assistant professor C has been retained on the faculty.

It is worth making one point before I turn to a review of the relevant literature. The quality of teaching services provided by a course instructor is highly dependent on his expertise in the subject of the course and his teaching ability. Expertise is easier to measure and publicize than teaching ability. Expertise can be demonstrated through publications. Teaching ability cannot be reliably and objectively measured. Hence, a course instructor's publications are used as a proxy indicator of the quality of instruction provided in his course.

As was mentioned in the last paragraph, a course instructor's expertise is easier to measure and publicize than his teaching ability. Evidence for this can be found by examining the academic reputation indicators that are used in the well-established university rankings and that pertain to faculty work itself. Those indicators are essentially measures reflecting faculty accomplishments in the area of research rather than that of teaching (e.g., research reputation surveys, publications, citations). High achieving students, who choose universities based primarily on academic reputation, are much more likely to value university rankings and use them to inform their choice (Hazelkorn, 2014). For these students, the research productivity of faculty members could be seen as an important proxy for the quality of instruction provided by them.

Although the present study explains the existence of academic tenure by adopting the argument proposed by Carmichael (1988), the two papers have differences. In Carmichael's article, a university's objective is to maximize research output by recruiting the best freshly minted PhDs into entry level faculty positions. To attain such an objective, the university awards tenure to faculty at the rank of associate professor. In the present study, universities aim to attract applications from high school seniors with a record of high academic achievement.[8] To reach such an aim, universities award tenure to faculty members promoted to the rank of associate professor, dismiss faculty denied promotion and tenure, and base the promotion/tenure decision on the quantity and quality of academic publications.

Universities often pursue academic prestige or reputation. Evidence for this can

[8] My theory does not apply to community colleges, which have an open-door admission policy with few academic requirements (see Section 3 for more discussion).

be found in (1) the results of a 1982 survey of Presidents and Board Chairs of 50 Canadian Universities (University of Alberta, 1982), (2) the results of site visits to 26 U.S. campuses conducted by Brewer et al. (2004), and (3) the results of interviews conducted by Paul Blackmore with 20 Vice-Chancellors of U.K. universities (Blackmore, 2016). A university's academic prestige (reputation) is generated by excellent (quite good) faculty members and students.[9] The pursuit of academic prestige (reputation) can be regarded as a university's primary objective, while the recruitment and retention of excellent (quite good) faculty and students is its secondary objective, which must be met in order to complete the primary objective. Like Carmichael (1988), I focus this article on the secondary objective rather than the primary objective of a university.

My paper also relates to the literature on up-or-out rules. Within this literature, why a profit-maximizing firm practices an up-or-out policy is explained by four different theories: (1) to provide incentives for workers to invest in human capital (Kahn and Huberman, 1988; Waldman, 1990), (2) to provide incentives for workers to work hard (Ghosh and Waldman, 2010; Auriol et al., 2016), (3) to allow the firm to use scarce junior positions to screen an additional worker with greater potential and promise for a senior position (O'Flaherty and Siow, 1992; Demougin and Siow, 1994), and (4) to induce junior workers to imitate good rather than bad behavior (Glazer, 2012).[10, 11] In the present study, a not-for-profit university practices an up-or-out policy not to induce some action from its faculty nor to screen an additional junior faculty member with more promise and potential, but rather as part of its commitment to providing high-quality educational services to students.

In the literature on academic tenure and up-or-out rules, Siow (1998) is the only paper I am aware of that explains why universities typically offer tenure and adopt an up-or-out policy. He argues as follows. The frontier of knowledge in all academic disciplines is always expanding, making it difficult for individual scholars to keep up with the ever-expanding body of knowledge, even in their discipline. This characteristic forces scholars to specialize in particular subject areas within the discipline. Specialization produces two results: (1) a scholar's knowledge is subject to a greater

[9] For evidence, see, among others, Dill (1997), Conard and Conard (2000), Brewer et al. (2004) and Sweitzer and Volkwein (2009).

[10] Some studies that specifically concern the up-or-out system within law firms and within the military are excluded from my review of literature on up-or-out rules.

[11] These four theories examine from different angles the "out" part of up-or-out rules. Chen and Ishida (2015) examine another important feature of up-or-out rules, namely that an employee must achieve a certain rank within a certain period of time.

risk of obsolescence, and (2) the research work of an applicant for the position of assistant professor in a university will be evaluated by senior faculty members within the same specialization. Tenure provides job security and hence a positive incentive for faculty to specialize (McPherson and Winston, 1983) and to hire the top applicant into the position of assistant professor (Carmichael, 1988). The use of the up-or-out rule is related to specialization fostered by tenure. In universities, a department usually has faculty that specialize in various fields of a discipline. Hence, the number of faculty positions in each field is limited. Assistant professor positions are used to learn if junior faculty who specialize in various fields of a discipline are qualified for promotion to the rank of associate professor. However, in every field, the number of available assistant professor positions is scarce. So universities terminate assistant professors who do not receive a promotion, and fill the positions thus left vacant with newly hired junior faculty who are deemed the most promising. In the present study, academic tenure and up-or-out policy are part of the commitment to quality teaching. Even if the number of faculty positions in a university were "unlimited," the university would dismiss assistant professors who do not receive a promotion/tenure, because this practice would attract applications from high school seniors, especially high caliber ones. In this paper, I explain the use of an up-or-out tenure system from a university-potential student perspective, which is distinguished from the university-faculty member perspective taken by Siow. Since each of the two theories examines the use of up-or-out tenure systems from a different perspective, they are complementary, not competing. Both theories may be needed for a full understanding of such systems.

In the rest of this paper, I present my theoretical model and results in Section 2 and conclude the paper in Section 3.

2. THE MODEL

Two tenure-granting universities, universities 1 and 2, compete in two stages. At the beginning of the first stage, the universities simultaneously and independently decide whether to adopt an up-or-out or an up-or-stay policy.[12] Each university has a tenured

[12] One key point of this paper is that universities grant tenure in order to create an incentive for incumbent faculty to hire the very best candidates available. As already mentioned, this idea originates with Carmichael (1988). Since, in this study, the consideration governing the choice between granting tenure and not granting tenure is not new, such a choice is left out of my model. Instead, the focus of my model is on the choice between an up-or-out tenure system and an up-or-stay tenure system. By assuming that

faculty member, and both faculty members share the same specialization.[13] During the first stage, each tenured faculty member successively recruits two freshly minted PhDs (with the same specialization as the tenured faculty member) into the tenure-track assistant professor positions at his university. For the tenure-track faculty members whose probationary period ends earlier, the probationary period ends at the end of the first stage. For the tenure-track faculty members whose probationary period ends later, the probationary period ends sometime after the middle of the second stage. Suppose both universities have the same criteria for promotion to associate professor with tenure. In addition, suppose that for each tenure-track faculty member whose probationary period ends at the end of the first stage, his publications do not meet the criteria for promotion and tenure. If his university adopts an up-or-stay policy, he remains as an assistant professor until the end of stage 2. If his university adopts an up-or-out policy, he is permanently dismissed from the university at the end of stage 1. Suppose that after he is dismissed and before stage 2 begins, the tenured faculty member in his university recruits another freshly minted PhD (with the same specialization as the tenured faculty member) into the tenure-track assistant professor position, in order to keep the same student-to-faculty ratio.

The earliest part of the second stage is about recruiting students. At the beginning of the second stage, knowing the decisions taken at the first stage, the universities simultaneously and independently decide their tuition fees. Each university has a brochure that supplies potential students with crucial information, such as the university's tuition fees as well as the faculty and their specializations and accomplishments. The number of students each university plans to admit is n. The number of courses offered at both universities is 1. The course to be offered by either university is particularly relevant to its faculty's specialization. The objective of each university is to maxi-

both university 1 and university 2 are tenure-granting institutions, it is assumed that the tenured faculty member in each university has an incentive to recruit fresh PhDs with great potential.

[13] Later in this section, I make the assumption that the pay rates for faculty members at a university with an up-or-out policy are the same as their counterparts' at a university with an up-or-stay policy. An anonymous referee questioned the possibility that, under such an assumption, there are tenured faculty members in a university with an up-or-stay policy. The referee asked, "If poor publication records will not cost a job, why should an assistant professor strive to publish well?" I lay out two reasons why that possibility appears likely. First, a junior faculty member's research performance is a function not only of how hard he works at research but also of his innate talent. Thus, although a junior faculty member in a university with an up-or stay policy works less hard at research, as long as his innate talent is high enough, he would achieve promotion and tenure. A university with an up-or-stay policy is able to attract talented new faculty members who value job security highly. Second, job insecurity might decrease work productivity. Under a tenure system coupled with up-or-stay clause, the possibility to be promoted and tenured creates effort incentives, and up-or-stay creates feelings of job security and thereby would lead to an increased level of productivity.

mize the enrolled students' aggregate academic qualifications, subject to the constraint that it at least breaks even (revenues equal or are greater than costs). Each university's only revenues are the tuition paid by students, and its only costs are the wages of its faculty. This means that for each university, all wage costs are financed by tuition revenues, which does not seem to be too strong an assumption for most non-profit private universities.[14] Since each university, no matter whether it adopts an up-or-stay policy or an up-or-out policy, has one tenured faculty member and two assistant professors, it bears the same costs under both policies (denoted $C_{us} = C_{uo} = C$, where the subscript "us" refers to up-or-stay and the subscript "uo" refers to up-or-out). Note that one could instead assume that an assistant professor on probation is paid more than an assistant professor who was not promoted to tenure, so that $C_{uo} > C_{us}$. In this section, after stating the model, I first derive the equilibrium for the case where $C_{us} = C_{uo}$ and then briefly describe the equilibrium in the case where $C_{uo} > C_{us}$.

The two universities in my model are best thought of as two highly selective private non-profit research universities. They are highly selective since they seek to admit the best students. They are private non-profit universities since their objective is not to make money, and since faculty wages are financed by tuition rather than by tuition and government funding. They are research universities since research is given most importance in decisions regarding faculty hiring, promotion and tenure.

There are N potential students. Assume that N is much greater than $2n$. At the beginning of the second stage, the potential students simultaneously decide whether to apply for university and, if so, which universities to pick. All potential students know that the course to be offered by either university is particularly relevant to its faculty's specialization, but no student knows which faculty member will teach the course if he is later (sometime between the beginning and the middle of the second stage) admitted to the university and enrolls in the course.

Suppose the potential students expect that the faculty members at either university are equally likely to be the course instructor. If any university adopts an up-or-out policy, the likely course instructors are the tenured faculty member and two assistant

[14] A university's revenues can be either unrestricted or restricted. Unrestricted funds are free for use in any way the university desires, but are most often used for instruction expenses (i.e. faculty salaries, instructional supplies, and equipment) or facility-operations expenses. For most private non-profit universities, tuition is the major sources of unrestricted revenue. The most significant sources of unrestricted revenue for public universities are tuition and government funding. Restricted funds are restricted to certain defined expenditures. Examples of restricted funds are a donation to be used toward the construction of a new library, a grant to be used for cancer research, and a donation used to provide financial aid to students. Donations and grants are often designated for a particular purpose by donors, sponsors, and other funders – and hence are seldom shifted to cover instruction expenses.

professors on probation. The tenured faculty member's academic ability is Q_H and any probationary assistant professor's is either Q_H (with a probability of p) or Q_L (with a probability of $1-p$), where $Q_H > Q_L$ and p is the probability of promotion from assistant to associate professor. Therefore, the academic ability of the course instructor expected by potential students (denoted Q_{uo}, where the subscript refers to up-or-out) is $(1/3)Q_H + (2/3)[pQ_H + (1-p)Q_L]$. If any university adopts an up-or-stay policy, the likely course instructors are the tenured faculty member, the assistant professor on probation, and the assistant professor who was not promoted to tenure.[15] Therefore, the academic ability of the course instructor expected by potential students (denoted Q_{us}, where the subscript refers to up-or-stay) is $(1/3)Q_H + (1/3)[pQ_H + (1-p)Q_L] + (1/3)Q_L$.[16, 17] Evidently, $Q_{uo} > Q_{us}$.

Different potential students have different academic qualification levels. Their levels are arranged in order from highest to the lowest and the i^{th} highest level is denoted by a_i. Thus $a_1 > a_2 > \cdots > a_N$. If the potential student with the qualification level at a does not enter a university, he receives an expected net benefit of zero. If he enrolls in the course held at either university and the expected academic ability of the course instructor is Q, he gets an expected net benefit of $aQ - t$, where aQ is the expected gross benefit from enrolling in the course or the expected quality of the course, and t is the tuition fee. This specification of gross benefit captures the idea that the

[15] My description of the model clearly shows that both stages cover more than 1 year. In each year covered, there should be applicants for admission as students of either university. However, except for applicants in the earliest year in stage 2, all other applicants are excluded from my model. Before explaining this exclusion, I first classify all applicants into two groups: (1) those for whom the year in which they plan to enroll is in stage 1; and (2) those for whom the year in which they plan to enroll is in stage 2. To the applicants in the first group, it makes no difference whether the university they apply to adopts an up-or-out or up-or-stay policy; in either case, the likely course instructors are the same. For the applicants in the second group, however, it makes a difference whether the university they apply to adopts an up-or-out or up-or-stay policy. If the university adopts an up-or-out policy, the likely course instructors do not include the assistant professor who was dismissed at the end of stage 1. However, this assistant professor will be included among the likely course instructors if the university adopts an up-or-stay policy. This paper argues that dismissing or not dismissing faculty members who fail to receive tenure and promotion makes a difference in a university's ability to attract applications from high school seniors. For the purpose of formalizing this idea, it is enough to include in my model the presence of only applicants in the earliest year of stage 2.

[16] Promotion policies (up-or-stay versus up-or-out) affect effort incentives and thus the promotion probability. Therefore, the promotion probability should be modeled as endogenous rather than exogenous. As I will explain later in Section 3, it turns out to be difficult to investigate incentive issues in my model. Consequently, I do not consider incentive issues and still treat the promotion probability as exogenous.

[17] Suppose that the promotion probability is exogenously higher in a university with an up-or-out policy than in a university with an up-or-stay policy. In this case, the expected academic ability of the course instructor is still higher in the former university than in the latter, with the difference becoming greater. One can readily show that this leaves the results of my model qualitatively unchanged.

higher a potential student's level of academic qualification, the more he enjoys higher quality teaching.[18, 19]

Suppose that the application fee for each university is zero. For each potential student, if the expected net benefit from enrolling at a university is not less than zero, he applies for an admission to the university. Otherwise, he does not. If he does not apply to either university or is rejected by all the universities he applied to, he will not attend a university. If he is accepted to only one university, he will enroll at that university. If he is accepted to two universities, which one he chooses to attend depends on the expected net benefit he would receive. If attending university 1 and attending university 2 give him different expected net benefits, he will attend the one that maximizes his expected net benefit. Otherwise, he will attend either university with equal probability.

Finally, assume that $a_{2n}Q_{us} > C/n$. The left side of the inequality is the gross benefit that the potential student ranked the $2n^{th}$ highest academic qualification expects to get if he enrolls at a university adopting an up-or-stay policy; in other words, it is the maximum tuition he is willing to pay for enrolling at a university adopting an up-or-stay policy. The right side of the inequality is the average cost per student for a university. The timing of the game is summarized in Figure 1.

I now turn to the resolution of the model. The equilibrium concept I use is subgame perfection, which requires Nash equilibrium play on all subgames. (Attention throughout is limited to pure strategies.) Given subgame perfection, I proceed to solve by backward induction. Thus, I begin by analyzing the four subgames that can arise in stage 2.

First, consider the subgame in which university 1 adopts an up-or-out policy and university 2 adopts an up-or-stay policy. The potential student with the qualification level at a prefers attending the lower quality university 2 to the higher quality university 1 only if the former's tuition fee is less than the latter's by more than the difference in

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[18] In my model, students are both consumers as well as inputs. To receive educational services, students must pay tuition fees to universities. Hence, they are consumers of educational services. The quality of the educational experience depends on the quality of the faculty and the quality of the students. Hence, students are inputs into the production of education.Students are treated as consumers and production inputs in some models in the economics literature on higher education (e.g., Rothschild and White, 1995). However, none of these models address the up-or-out policy.

[19] For each potential student, the expected quality of the course depends not only on his academic ability and the expected academic quality of the course instructor, but should also depend on the expected academic ability of the other $(n-1)$ students in the class. To simplify the analysis, the expected academic ability of the other $(n-1)$ students is excluded from the expected gross benefit function.

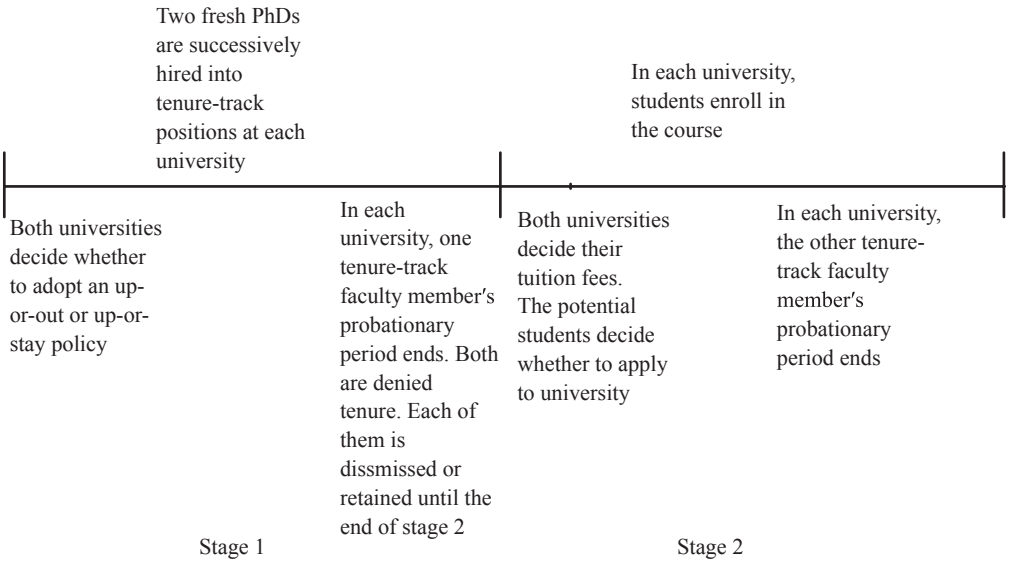

Figure 1 The Timing of the Game

their course quality that he expects, $a(Q_{uo} - Q_{us})$. Clearly, $a(Q_{uo} - Q_{us})$ is strictly increasing in a. Therefore, if university 2 wants to make potential students with higher academic qualification level prefer it over university 1, it must charge a tuition that is less by a larger margin than the tuition charged by university 1. This lower tuition puts university 2 at a disadvantage in the fight for recruiting high caliber students, given that the average cost per student is identical for the two universities.[20]

This subgame has an infinite number of equilibria. To economize on space, I only discuss the equilibria where university 2 sets its tuition fees at C/n. These equilibria are classified into three groups, depending on the interval within which the tuition difference between university 1 and university 2 (denoted by $t_1 - t_2$) falls. Before discussing the three groups of equilibria, I start with a point that will play a role in the

[20] Here, I relax the assumption that tuition is the only source of revenue for each university and instead assume that each university raises revenue through tuition as well as through donations. Suppose that donations are restricted by donors for financial aid to students. Suppose next that a university's reputation, which depends on the quality of its faculty and students, can help attract more donations. Compared to university 2, university 1 has higher quality faculty and students and thus possesses a better reputation, which in turn results in more donations for student financial aid. With more donations for student financial aid, it is clear that university 1 is less dependent on tuition payments to balance its budget. Therefore, the net tuition rate (the amount students actually pay after taking financial aid into consideration) at which it breaks even is lower compared to the net tuition rate at which university 2 breaks even. As a result, university 1 can afford to charge a lower net tuition rate than university 2, which is another advantage the former has over the latter.

discussion: Since I only discuss the equilibria where university 2 sets its tuition fees at C/n, and since I assume $a_{2n}Q_{us} > C/n$, each potential student who ranks in the top $2n$ of academic qualification level prefers university 2 over not attending university. I now describe each group of equilibria in turn.

(1) $t_2 = C/n$ and $0 \leq t_1 - t_2 < a_{2n}(Q_{uo} - Q_{us})$

The interval in which $t_1 - t_2$ lies is divided into two parts: 0 and (0, $a_{2n}(Q_{uo} - Q_{us})$). For the former, the tuition of university 1 is the same as the tuition set by university 2, and the expected quality of the course at university 1 is higher than that at university 2. Therefore, each potential student who ranks in the top $2n$ of academic qualification level prefers university 1 over university 2. For the latter part, although the tuition of university 1 is higher than that of university 2, each potential student who ranks in the top $2n$ of academic qualification level prefers university 1 over university 2 because the additional gross benefit he expects to gain from attending university 1 rather than university 2 is worth the additional tuition he has to pay.

Thus, each potential student who ranks in the top $2n$ of academic qualification level prefers university 1 over university 2, and each one prefers university 2 over not attending university. Consequently, each of them applies to both universities. Although both universities want to attract potential students who rank in the top n of academic qualification level, these students choose to enroll at university 1. Potential students who rank from $n + 1$ to $2n$ enroll at university 2.

Given the tuition of university 2, university 1 has no incentive to deviate from its current tuition since it operates without incurring losses while attracting potential students who rank in the top n of academic qualification level. University 2 also has no incentive to change its tuition. Setting a higher tuition would not attract any potential student who ranks in the top n of academic qualification level since a higher tuition would make students prefer university 1 more. Setting a lower tuition would turn the zero profit margin into losses. Since both universities have no incentive to deviate from their current tuition fees, these fees are the equilibrium tuition fees.

(2) $t_2 = C/n$ and $a_{j+1}(Q_{uo} - Q_{us}) < t_1 - t_2 < a_j(Q_{uo} - Q_{us})$, where $j = n, n + 1, \cdots, 2n - 1$

If $t_1 - t_2$ lies within this interval, then among potential students who rank in the top $2n$ of academic qualification level, those ranked in the first j prefer university 1 over

university 2 and those ranked in the last $2n - j$ prefer university 2 over university 1. Furthermore, each potential student who ranks in the top $2n$ of academic qualification level prefers university 2 over not attending university. Thus, among these potential students, those ranked in the first j apply to both universities and those ranked in the last $2n - j$ definitely apply to university 2. Although both universities want to attract potential students who rank in the top n of academic qualification level, these students choose to enroll at university 1. Potential students who rank from $n + 1$ to $2n$ enroll at university 2.

The explanation for why the tuition fees both universities are setting are the equilibrium tuition fees is the same as the explanation given in the last paragraph of (1).

(3) $t_2 = C/n$ and $t_1 - t_2 = a_j(Q_{uo} - Q_{us})$, where $j = n + 1, n + 2, \cdots, 2n$

If $t_1 - t_2$ lies within this interval, then among potential students who rank in the top $2n$ of academic qualification level, those ranked in the first $j - 1$ prefer university 1 over university 2, the potential student ranked in the j^{th} position is indifferent to which university he chooses, and those ranked in the last $2n - j$ prefer university 2 over university 1. Moreover, each potential student who ranks in the top $2n$ of academic qualification level prefers university 2 over not attending university. Thus, among these potential students, those ranked in the first j apply to both universities, and those ranked in the last $2n - j$ definitely apply to university 2. Although both universities want to attract potential students who rank in the top n of academic qualification level, these students choose to enroll at university 1. Potential students who rank from $n + 1$ to $2n$ enroll at university 2.

The explanation for why the tuition fees both universities are setting are the equilibrium tuition fees is the same as the explanation given in the last paragraph of (1).

Taken together, the above analyses indicate that in the subgame where university 1 adopts an up-or-out policy and university 2 adopts an up-or-stay policy, if the equilibrium tuition fee at university 2 is C/n, then the equilibrium tuition fee at university 1 is

any value in the interval $[C/n, C/n + a_n(Q_{uo} - Q_{us}))$.[21, 22, 23] Potential students who rank in the top n of academic qualification level enroll at university 1, and potential students who rank from $n + 1$ to $2n$ enroll at university 2.

The second possible subgame is where university 1 adopts an up-or-stay policy and university 2 adopts an up-or-out policy. Analysis of this subgame is omitted since it perfectly parallels the analysis of the previous one, with the roles of universities 1 and 2 interchanged.

Next, consider the subgame where both universities adopt the up-or-stay policy. Unlike the previous two subgames, this subgame has a unique Nash equilibrium; namely, both universities set their tuition fees at C/n. Since both universities set the same tuition fee C/n and have the same expected academic ability of the course instructor Q_{us}, each potential student who ranks in the top $2n$ of academic qualification level gets the same expected net benefit from enrolling at either university. Given the assumption that $a_{2n}Q_{us} > C/n$, each potential student ranking in the top $2n$ of academic qualification level expects a net benefit greater than 0 from enrolling at either

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[21] $t_2 = C/n$ and $t_1 - t_2 = a_n(Q_{uo} - Q_{us})$
In this case, potential students who rank in the top $n-1$ of academic qualification level enroll at university 1, and the potential student ranked n^{th} enrolls at either university with equal probability. Given the tuition of university 2, university 1 has an incentive to slightly lower its tuition. If it does so, it not only moves up from a tied-for-first-choice to a first-choice university for the potential student ranked n^{th}, but also continues to operate profitably. Since university 1 has an incentive to deviate, this case cannot be an equilibrium.

[22] $t_2 = C/n$ and $t_1 - t_2 > a_n(Q_{uo} - Q_{us})$
In this case, the potential student ranked n^{th} in academic qualification level enrolls at university 2. Given the tuition of university 2, university 1 has an incentive to lower its tuition to below $C/n+a_n(Q_{uo}-Q_{us})$ but at or above C/n. If it does so, it not only attracts potential students who rank in the top n of academic qualification level, but also operates without incurring losses. Since university 1 has an incentive to deviate, this case cannot be an equilibrium.

[23] There are equilibria in this subgame where $t_2 > C/n$, i.e., where university 2 earns positive profits. Suppose that t_1 is any value in the interval $[C/n, C/n + a_n(Q_{uo} - Q_{us}))$ and t_2 is any value in the interval $(C/n, a_{2n}Q_{us}]$. Since $t_2 \leq a_{2n}Q_{us}$, each potential student who ranks in the top $2n$ of academic qualification level applies to university 2. Each potential student who ranks in the top n of academic qualification level prefers university 1 over university 2. This is because either the tuition of university 1 is not higher than the tuition set by university 2 or if it is, the additional gross benefit he expects to gain from attending university 1 rather than university 2 is worth the additional tuition he has to pay. Although both universities want to attract potential students who rank in the top n of academic qualification level, these students choose to enroll at university 1. Potential students who rank from $n + 1$ to $2n$ enroll at university 2. Given the tuition of university 2, university 1 has no incentive to deviate from its current tuition since it operates without incurring losses while attracting potential students who rank in the top n of academic qualification level. University 2 also has no incentive to change its tuition. Setting a higher tuition would not attract any potential student who ranks in the top n of academic qualification level since a higher tuition would make students prefer university 1 more. Setting a low enough tuition to attract the potential student ranked n^{th} away from university 1 would turn profits into losses. Since both universities have no incentive to deviate from their current tuition fees, these fees are the equilibrium tuition fees.

university. Thus, he applies to both universities as his first choice. Since each university aims to maximize the expected aggregate academic qualification of its n enrolled students, half of potential students who rank in the top $2n$ of academic qualification level enroll at university 1, and half of them enroll at university 2. Furthermore, since each potential student who ranks in the top $2n$ of academic qualification level enrolls at either university with equal probability, the expected aggregate academic qualification of n students enrolled at each university is $0.5\sum_{i=1}^{2n} a_i$.

Neither university has an incentive to unilaterally change its tuition from C/n, so equilibrium is reached. If a university unilaterally raises its tuition, it is no longer a tied-for-first choice for potential students who rank in the top $2n$ of academic qualification level; they apply to the other university as their first choice. The expected aggregate academic qualification of n students enrolled at the former university thus decreases from $0.5\sum_{i=1}^{2n} a_i$ to $\sum_{i=n+1}^{2n} a_i$. If a university lowers its tuition, it incurs losses on each enrolled student.[24]

The fourth possible subgame is where both universities adopt an up-or-out policy. This subgame has a unique Nash equilibrium; namely, both universities set their tuition fees at the average cost per student, C/n. In this equilibrium, the expected aggregate academic qualification of n students enrolled at each university is $0.5\sum_{i=1}^{2n} a_i$. The explanation for these equilibrium results is the same as for the results obtained for the subgame where both universities adopt an up-or-stay policy.

Having characterized the equilibrium in all possible second-stage subgames, I

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[24] In each of the following five cases, the pair of tuition fees (t_1, t_2) is not in equilibrium. Hence, the only equilibrium is one in which both universities set their tuition fees at C/n.
(1) $t_1 = t_2 > C/n$
Given the tuition of university 2, university 1 has an incentive to slightly undercut university 2. If it does so, the expected aggregate academic qualification of its enrolled n students increases from $0.5\sum_{i=1}^{2n} a_i$ to $\sum_{i=1}^{n} a_i$, and it still operates profitably.
(2) $t_i > t_j > C/n$, where $i, j = 1, 2$ and $i \neq j$
Given the tuition of university j, university i has an incentive to slightly undercut university j. If it does so, the expected aggregate academic qualification of its enrolled n students increases from $\sum_{i=n+1}^{2n} a_i$ to $\sum_{i=1}^{n} a_i$, and it still operates profitably.
(3) $t_i > C/n = t_j$, where $i, j = 1, 2$ and $i \neq j$
Given the tuition of university j, university i has an incentive to lower its tuition to C/n. If it does so, the expected aggregate academic qualification of its enrolled n students increases from $\sum_{i=n+1}^{2n} a_i$ to $0.5\sum_{i=1}^{2n} a_i$, and it operates without incurring losses.
(4) $t_i < C/n \leq t_j$ or $t_i < t_j < C/n$, where $i, j = 1, 2$ and $i \neq j$
Given the tuition of the other university, a university incurring losses has an incentive to raise its tuition to a level that covers cost.
(5) $t_1 = t_2 < C/n$
The explanation for this case is the same as for case (4).

can now analyze the first stage of the game where each university chooses between the up-or-out and up-or-stay policies. The notion of subgame perfection allows the use of equilibrium expected aggregate qualification level of enrolled students in the second-stage subgame as the expected aggregate qualification level of enrolled students for that pair of policy decisions in the first stage. Thus, the game played between the two universities in the first stage is given in Figure 2. Since $\sum_{i=1}^{n} a_i > 0.5 \sum_{i=1}^{2n} a_i > \sum_{i=n+1}^{2n} a_i$ this game has a unique Nash equilibrium where both universities adopt an up-or-out policy.

Now I am ready to state my key result. The game has a unique equilibrium in which both universities adopt an up-or-out policy in the first stage, and subsequently set tuition fees at the average cost per student in the second stage.

I now illustrate my model with a numerical example. I fix the parameters of the model at $N = 20$, $n = 2$, $Q_H = 12$, $Q_L = 6$, $p = 0.5$, $C = 100$ and ($a_1 = 10$, $a_2 = 9.5$, $a_3 = 9$, $a_4 = 8.5$, $a_5 = 8$, $a_6 = 7.5$, $a_7 = 7$, $a_8 = 6.5$, $a_9 = 6$, $a_{10} = 5.5$, $a_{11} = 5$, $a_{12} = 4.5$, $a_{13} = 4$, $a_{14} = 3.5$, $a_{15} = 3$, $a_{16} = 2.5$, $a_{17} = 2$, $a_{18} = 1.5$, $a_{19} = 1$, $a_{20} = 0.5$). Then the expected academic ability of the course instructor in a university with an up-or-out policy is 10, compared to 9 in a university with an up-or-stay policy. In the equilibrium, both universities adopt an up-or-out policy in the first stage, and subsequently set tuition fees at the average cost per student, 50, in the second stage. Since both universities set the same tuition fees and have the same expected academic ability of the course instructor, each potential student gets the same expected net benefit from enrolling at either university. The expected net benefit to 20 potential students (ranked from top to bottom) from enrolling at either university is 50, 45, 40, 35, 30, 25, 20, 15, 10, 5, 0, -5, -10, -15, -20, -25, -30, -35, -40, -45, respectively. Evidently, those ranked 1 through 11 apply to admission to both universities, while the others choose not to apply at all. Since each university aims to maximize the expected aggregate academic qualification of its two enrolled students, two of potential students ranked in the top 4 enroll at university 1, and two of them enroll at university 2. Furthermore, since each potential student who ranks in the top 4 enrolls at either university with equal probability, the expected aggregate academic qualification of two students enrolled at each university is 18.5.

According to this paper's theory, a university with an up-or-out policy has two advantages over one with an up-or-stay policy, in attracting the best caliber of students. First, the quality of its faculty is higher. Second, with more donations, thus more student financial aid, it can afford to charge a lower net tuition rate. The second

		University 2	
		up-or-out	up-or-stay
University 1	up-or-out	$0.5\sum_{i=1}^{2n} a_i, 0.5\sum_{i=1}^{2n} a_i$	$\sum_{i=1}^{n} a_i, \sum_{i=n+1}^{2n} a_i$
	up-or-stay	$\sum_{i=n+1}^{2n} a_i, \sum_{i=1}^{n} a_i$	$0.5\sum_{i=1}^{2n} a_i, 0.5\sum_{i=1}^{2n} a_i$

Figure 2 Stage 1 Game

advantage arises partly from the assumption that a university with an up-or-out policy operates at the same cost level as one with an up-or-stay policy. As mentioned earlier in this section, one can instead assume that the former university has higher costs than the latter, because an assistant professor on probation is paid more than an assistant professor who was not promoted to tenure. In this case, a university with an up-or-out policy can still afford to charge a lower net tuition rate, as long as the advantage of more donations more than compensates for the disadvantage of higher costs. Otherwise, a university with an up-or-stay policy can afford to charge a lower net tuition rate, in which case it may or may not attract potential students ranked top n. If it does, both universities adopt an up-or-stay policy in equilibrium. In practice, up-or-stay policies are rarely observed in universities. This fact makes sense given my theory; it may reflect that even though an up-or-stay policy has the advantage of lower cost, that advantage is more than offset by relatively low faculty quality and less donations.

Before I conclude this section, I wish to make a remark regarding promotion practices at firms and universities. Most firms are hierarchies with different levels of work. The number of positions in each level is relatively fixed. In most cases, workers at a given level in a firm compete with each other for promotion to a vacant position at the next level. Promotion is generally based on relative performance: the worker who performs the best wins the promotion. This does not imply, however, that his competitors perform badly. Indeed it could be that some or many of them perform really well, because competing for promotion (and associated wage increase) may entail exerting greater effort, which in turn leads to better performance. In this case, it is rational for the firm to retain these well performing workers. This may

help to explain why up-or-out policies are rarely observed in firms that are organized hierarchically.[25]

In a typical research university, decisions on faculty promotion and tenure mainly depend on their publications. Tenure-track faculty members compete against a standard for promotion and tenure, not against each other. In general, the number of tenured faculty positions is not fixed but flexible.[26] This flexibility, coupled with the fact that tenure-track faculty members compete against a standard for promotion and tenure, means that everyone can be promoted to tenure if he meets the standard. And anyone who fails to meet the standard is denied promotion and tenure. Such faculty members are normally terminated as a faculty member, rather than retained in their current position.[27] Would the university incur a loss if it retains a faculty member who is turned down for promotion and tenure? If the answer is no, why does it not do so?

At this point let us go back to my model. In the second-stage subgame where one university adopts an up-or-out policy and the other adopts an up-or-stay policy, the equilibrium profit achieved by the university adopting the up-or-stay policy can be zero or positive. In the second-stage subgame where both universities adopt the up-or-stay policy, the equilibrium profit of each university is zero. Knowing what the equilibrium outcomes of the second-stage subgames will be, both universities choose to adopt the up-or-out policy in the first stage. Such equilibrium results correspond exactly to the situation depicted in the second question in the above paragraph. The main message of my model, that up-or-out tenure systems signal a commitment to quality faculty and teaching and thus attract top students, provides an answer to that question.

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[25] Of the few studies that attempt to explain why up-or-out policies are rarely observed in firms (Ghosh and Waldman, 2010; Chen and Ishida, 2015; Auriol et al., 2016), none points to the limited number of promotion slots to workers.

[26] In most U.S. universities, there are no limits placed on the number of senior positions (Moore et al., 2002).

[27] Two major types of models in the promotions literature have been proposed: tournament models and performance standards models (Lazear and Oyer, 2012). In tournament models, workers compete with each other for promotion. Promotion is based on relative performance of workers. In performance standards models, workers compete against a certain performance standard rather than against each other. Anyone who meets the performance standard can be promoted. As should be clear from my discussion, I believe that the question of whether an organization uses tournaments or performance standards to make promotion decisions is closely related to the question of whether it retains or dismisses those who do not get promoted. To my knowledge, this point has not been made previously.

3. CONCLUSION

For high school seniors with strong academic records who are choosing a university, one important factor is whether the university courses are taught by faculty members with strong academic ability. This paper proposes that to recruit these students, universities implement an up-or-out policy with three features: (1) faculty members being promoted from assistant to associate professor are awarded permanent tenure, (2) those denied promotion to associate professor are asked to leave, and (3) the promotion decision is based on the quantity and quality of academic publications during the probationary period. It should be noted that the analysis of this paper is purely positive. Because the model presented in this paper is simple, no policy implications can logically be drawn from it.

As with any model, my model is a simplification of reality and thus has limitations. A major limitation of my model is its neglect of incentive issues. For example, the issue that academic tenure creates an incentive for incumbent professors to hire new quality faculty is ignored. So is the issue that up-or-out rules provide a greater incentive to junior faculty members to work hard than up-or-stay rules. The reasons for such ignorance are that the incentive consideration of up-or-out tenure rules has been discussed and analyzed in the existing literature, and that my model wants to focus exclusively on a different aspect of such rules that hasn't been considered by other researchers. Of course, a more complete model incorporating incentive issues would provide additional understanding of such rules. In order to examine how each university in my model influences the incentives of its faculty members by establishing incentive pay structure and promotion policy, it is necessary to frame the relationship between each university and its faculty members as a principal-multi-agent relationship. It is, however, no simple task to develop a model that incorporates both incentive problems internal to each of the two multi-faculty universities and competition between them for the best students. In building such a model, account has to be taken of, among other things, utility functions of faculty members, the endogeneity of pay

rates for faculty members, and competition between universities for faculty. Consideration of these as well as other aspects of incentive provision is beyond the scope of this paper, and is left for future effort.

Lastly I devote some space to a discussion of community colleges in the United States. Most community colleges offer tenure. The probationary period is generally 3 to 5 years. Any faculty member denied tenure loses his job at the end of the probationary period; tenure is an up-or-out process. Most community colleges don't require faculty members to publish in order to get tenure. Instead, they require acceptable performance in teaching, service and professional development. It is often relatively easy for junior faculty members to get the "up" part of up-or-out.

My theory applies only to universities that seek to attract top students. It does not apply to community colleges, whose mission is to provide open access and affordable education to those seeking a post-secondary credential. Almost all community colleges are open-door, open access colleges, which accept virtually all students who apply, regardless of past academic performance and background. Due to this open-door policy, community colleges serve students of all backgrounds, including more academically unprepared and underprepared students. The reason why community colleges emphasize teaching over research has probably to do with the open-door policy. Students with weak educational backgrounds need more intensive and sustained guidance from instructors to assist them to continue their learning. What is much less clear and needs more research is the question as to why community colleges offer tenure.

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大學的非升即走制度

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摘　要

對學業成績好的高中畢業生而言,申請大學時最重要的考量之一是:所修的課是否是由學術能力好的老師所教。為了爭取這些學生來申請,大學有意願實行具有下列三個特性的非升即走制度:(一)晉升為副教授者被授予終身教授職;(二)不被晉升者被要求離職;(三)晉升與否主要取決於發表的學術文章的質與量。