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THE ORGANIZATION OF THE MARKET FOR PROFESSORS

by

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THE ORGANIZATION OF THE MARKET FOR PROFESSORS

Abstract

Peer review, up or out rules, tenure and the negative seniority wage premium are distinctive features of the North American market for professors. Besides evaluating some explanations, this paper also presents the historical record and contemporaneous features which all models have to confront.

Keywords: Higher education, research, teaching, peer review, tenure, up or out, seniority wage premium.

JEL subject classification: I2, J44

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THE ORGANIZATION OF THE MARKET FOR PROFESSORS

I. *Introduction*

In North America, about 3,800 universities and colleges employ 590,000 full-time faculty members (Statistics Canada 1992; U.S. Department of Education 1992)[1]. With so many employers and employees, and little institutional specific human capital, the market for professors is approximately competitive. However, the market has some puzzling features.

First, peer review in hiring and promotion is standard practice in academia, but not standard practice in other labor markets.

Second, academia practices up or out---a process where an employee is dismissed (out) if not promoted (up) after some finite probationary period. Under up or out, an employer dismisses an employee if he is not promoted after some finite probationary period. With heterogeneous workers and jobs, some workers will be best suited to junior positions. *Ceteris paribus*, it is inefficient to dismiss these workers from their junior positions when they are deemed unsuitable for promotion.

Third, the granting of tenure, commonly viewed by beneficiaries and critics alike as a lifetime employment guarantee, is also puzzling. How can tenure survive in a competitive industry where the production of new knowledge is of major importance, and the research output of professors is known to decline with age?

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[1] North America in this essay refers to Canada and the United States. Teaching refers to undergraduate instruction and students refer to undergraduates. Universities are institutions of higher education that put a major emphasis on research. Colleges refer to all others institutions of higher learning including junior colleges.

Fourth, professors face a negative seniority wage premium. Unlike the labor market at large, after controlling for years of labor market experience, professors' salaries decline with institutional seniority.

Different models have been proposed to explain the different features noted above. Besides evaluating these models, this paper presents the historical record and some contemporary features of the market for professors that all models have to confront.

A difficulty with evaluating these models is the lack of a consensus on the objectives and environment in which universities and colleges operate (Feldstein 1993; Hearn 1992; James 1990; James and Neuberger 1981; Rothschild and White 1993). While important, this issue is beyond the scope of this paper[2].

There is a large literature on other aspects of academic careers such as the demand and supply of academic personnel (Ehrenberg 1991; Freeman 1975); the age earnings and research productivity profiles of academics (Hansen et. al. 1978; Levin and Stephan 1991); the relative rewards for research, teaching and administration (Becker and Lewis 1979; Tuckman 1976; Youn 1992); and the economics and sociology of academic research (Cole and Cole 1973; Diamond 1994; Levin and Stephan 1992). This paper will focus on the organizational issues, drawing on the relevant literature.

Section II presents a selective history of higher education in North America, followed by peer review in section III, and models of up or out rules in section IV. Section V presents models of tenure, and the problem of shirking under tenure is discussed in section VI. Section VII presents models of the negative seniority wage premium. Concluding remarks are presented in

[2] Siow (1995) attempts to provide a unified model of these phenomena.

section VIII.

II. *A Selective History of Higher Education*[3]

Higher education in the colonies began with the granting of a charter to Harvard College in 1650[4]. The early colleges offered a liberal education. There were few electives and little specialization. In keeping with the common curriculum, the teachers in these colleges were generalists. Teaching was paramount and research was unimportant. While successful in attracting some students, a college education was not a prerequisite to economic success[5]. A college education was primarily a consumption good.

In the nineteenth century, disenchantment with the liberal curriculum grew both within and outside the colleges. The main charge was that the curriculum was increasingly irrelevant in an economy driven by frequent scientific advances, and therefore not advantageous to the college graduate. New private and public universities, based on research and the dissemination of scientific advances, opened. In response, the traditional colleges turned away from the classics to embrace science, offered electives, hired prominent researchers to their faculties, rewarded research, and transformed themselves into the modern universities as we know today. By the early twentieth century, the transformation of North American higher education was complete.

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[3]This section is freely derived from Geiger (1986), Hofstadter and Hardy (1952), and Veysey (1965). Any misinterpretation is my own.

[4] The earliest college in North America was the Collège de Quèbec which was founded in 1635 and closed in 1678. (Harris 1976).

[5] Veysey, p. 4-5.

The employment relationship between teachers and their employers also evolved[6]. Until the beginning of the twentieth century, there were two common employment models. In most universities, professors were employees at will, and had little redress against dismissal. In practice, most of them had *de facto* tenure and worked until retirement[7]. Some universities practiced a two-track system: at will emplomen, and tenured positions with explicit or implicit lifetime employment guarantees. The practice of granting lifetime employment guarantees to some professors began as early as 1720 when Harvard College received funds to appoint its first chaired professorship, the Hollis Professorship of Divinity. Since funding for the early colleges was erratic, these colleges used endowed chairs to attract reputable professors. Tenure, as it was first practiced, insured a chaired professor against the financial fluctuations of the college. By the twentieth century, the practice of granting tenure to some faculty members was well established.

The two-track system prevailed into the twentieth century. In 1920, Princeton University adopted the first up or out policy whereby instructors and assistant professors could expect a tenure decision by their fourth and third year of hire respectively[8]. Other research universities followed although up or out was not widely adopted in higher education until the 1960s.

With the formation of the American Association of University Professors (AAUP) in 1913, professors lobbied for a standard employment contract with specific employment guarantees. In 1940, the AAUP proposed the current standard model of academic tenure based on

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[6]This discussion of the employment relationship is freely adapted from Metzger (1973) which contains an excellent history of academic tenure in America.

[7] This was the case with Canadian universities until the late sixties. Cameron (1991).

[8] Geiger (1986), p. 226.

two distinct mechanisms: an up or out rule, and tenure. Under this model, a teacher is hired for a finite probationary period. A decision to promote the teacher to tenure, or to dismiss must be made before the probationary period expires. After a teacher is awarded tenure, dismissal before retirement age is allowed only for cause or under extraordinary circumstances because of financial exigencies. The dismissal under financial difficulty escape clause negates the original reason for tenure---to insure against the financial vagaries of the employer. There is no definition of the wage floor in the standard model. Through practice, the wage floor is the maximum nominal wage that is achieved except for across-the-board cuts in wages.

In their survey of 80 U.S. universities and colleges in 1955, Byse and Joughin (1959) found a variety of employment practices ranging from employment at will, and two-track systems to variants of the standard model. Universities were more likely than colleges to use the standard model. In the 1960s, the standard model became widespread in the U.S. Bowing to market pressure from American and British institutions, Canadian institutions also switched to the standard contract in the same period (Cameron 1991). By the early 1970s, an estimated 94% of all faculties served in U.S. universities and colleges that conferred tenure.[9]

This transformation should not be exaggerated. According to the 1989 Carnegie Founation survey of U.S. College and University Faculty (hereafter C89), over 7% of the full-time academic employees in doctorate granting universities did not have a standard contract[10]. In most universities and colleges today, a significant minority of courses are taught by non-tenure tracked employees. Many of these teachers, both full-time and part-time, have a *de facto* long term

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[9] Commission on Academic Tenure in Higher Education (1973); hereafter Commission.

[10] A description of C89 and definitions for all variables that were used are in Appendix A.

teaching relationship with the university, and do little research. Another segment of the academic community also has no tenure protection---the full-time researchers who are supported by external grants and/or consulting income. Often, they work in research institutes and departments within a university. However, when their external funding ends, the university is not obliged to continue financial support.

The most significant exception to the tenure system occurs in medical schools. In terms of budget and employment shares, medical schools and associated teaching hospitals are among the largest faculties in a university. Most of the teachers in medical schools are non-tenured faculty. The majority of the full-time faculty, including those who conduct research, do not have tenure and are supported by research grants and fees from paying patients. The employment contracts between the medical school and faculty cover a wide range: straight salary, salary plus a share of fees, partnership like agreements, barter agreements (exchange of teaching and other services for admitting privileges to teaching hospitals), and some tenure awards. There is no visible agitation among medical faculties to obtain the widespread award of tenure.

The emergence of research universities increased the mobility of professors, which had previously been low. With the rise of research universities, professors and their employers immediately recognized that external offers were opportunities to increase pecuniary and non-pecuniary rewards[11]. Using external offers as leverage to obtain large salary increases from incumbent university employers remains a common occurrence.

The employment contract for professors is still evolving. The standard model was adopted before mandatory retirement for professors in the U.S. was abolished by Congress in December

[11] Geiger (1986), p. 11.

1993. Interestingly, although Canadian universities operate similarly to their American counterparts, and the academic labor markets of the two countries are integrated, mandatory retirement is legal and currently enforced in Canada.

III. *Peer Review*[12]

When a university makes a hiring or promotion decision, it canvasses other professors in the relevant field for their opinions on the potential appointment[13]. These reviewers are usually senior professors selected from departments that are ranked equal or higher to the university's current ranking. The reviewers are asked to discuss whether the candidate under consideration is a suitable match for the university. In general, the university is soliciting opinions only on the quality of the candidate's research relative to others in the field. If the letters and the internal review are favorable, the candidate is offered a promotion or appointment.

The peer review process is designed to ensure that the research of the candidate in question is of the right quality for the school and is of interest to other researchers in the field. The process specifically guards against nepotism by senior faculty in universities. Since senior faculty are not penalized (due to tenure) for bad hires, the university needs a mechanism to guard against nepotism. A skeptic may argue that the peer review process can be "rigged" to generate outcomes that the senior faculty favor, to the detriment of the university. While rigging the process is possible, misleading the university becomes increasingly difficult as the candidate in

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[12] There is no formal model of peer review in the economics literature. This section is included because peer review is an important part of the organization of this market and also because it is relevant to Carmichael's discussion of tenure and the negative seniority wage premium.

[13] For entry level hires, the advisers of the candidates write the letters of recommendations.

question demonstrates weaker qualifications. *Ceteris paribus*, there will be fewer promotions of unqualified candidates relative to qualified candidates.

The peer review process for both hiring and promotion is an explicit mechanism. More subtly, universities also use an implicit peer review strategy in awarding pay increases to faculty. Consider the problem a university faces when a chairperson proposes a big salary increase for a particular member of the department[14]. The chairperson justifies the proposed increase by arguing that the professor's research has had a profound impact. If the university is willing to reward professors based on such claims, the moral hazard problem that ensues will adversely affect the financial state of the university. Universities solve the moral hazard problem by only awarding substantial salary raises when the professor in question produces a credible external offer. By responding only to external offers from other universities of equal or greater rank, the university is using an implicit peer review strategy to distribute nonstandard pay increases.[15]

This strategy for awarding pay increases is costly for universities and their faculties. There is inefficient mobility by professors, and a waste of resources by professors and outside universities in generating offers that are not accepted. Thus, the inability of universities to evaluate their own faculty imposes costs on the system.

Colleges place more emphasis on teaching and less emphasis on research. Since teaching is more difficult than research for outsiders to evaluate, college professors will find it hard to generate generous external offers. Without generous external offers, there will be less mobility

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[14] Becker (1979) considers other difficulties of paying for performance when performance is imperfectly observed.

[15] The external bidder does a formal peer review before the offer is made. Thus, unqualified professors in different universities will find it difficult to collude to bid up each others' salaries.

among college professors compared with university professors. In C89, tenured professors had on average 16.9 years of seniority at the time of the survey. Controlling for years of labor market experience, tenured professors in doctorate granting universities had on average 0.995 years less seniority than other tenured professors (Table 1: Col. 1.1). In their sample of 25 institutions, Rees and Smith (1991) found that liberal arts colleges have a smaller proportion of resignations and a higher proportion of retirements of tenured faculty than do universities.

Given its informational disadvantage, the university uses explicit and implicit peer review to hire, promote, and reward faculty appropriately.

IV. *Up or Out*

Kahn and Huberman (1988) provided the first argument for up or out rules and Waldman (1990) applied it to academia. Waldman argued that the employing university has more information about the human capital stock of its faculty than do competing universities. Thus, the incumbent employer is not forced to pay a wage premium to its more talented workers since these workers will not command a higher salary elsewhere. However, this lack of a wage premium means that workers have no incentive to invest in human capital. An up or out rule solves this firm opportunism problem. If the university, after a finite probationary period, has to dismiss or promote the non-tenured professors, it is likely to promote the most talented individuals since it cannot keep them otherwise. Once a promotion is known, able individuals are rewarded for their investment as other universities recognize the growth of reputation and will bid for their employment accordingly. In general, the up or out rule is not completely efficient because it forces the firm to dismiss non-tenured workers who may be suited for junior positions.

Demougin and Siow (1994), and O'Flaherty and Siow (1992, 1995) explained up or out rules by the scarcity of junior job slots. Siow (1995) applied this theory to universities. A junior job slot has two functions: contributing to current production (teaching and research), and allowing the profession to screen and/or train for potential promotion to senior rank. The number of junior slots is determined by overall teaching demand. If teaching needs are large and there is little demand for senior professors, junior slots are not scarce. In this case, a good teacher but poor researcher may be allowed to remain in his junior slot indefinitely. On the other hand, if teaching needs are low and the university feels pressed to show research achievement, the university will want more slots to search for good researchers. In this case, the university may fire a person considered good in teaching but poor in research in order to use that junior slot to train and/or screen another candidate with more promise for senior rank. Junior professors who are deemed successful researchers will be promoted. Unsuccessful junior professors are dismissed. The two rationales for up or out rules may apply simultaneously. When junior training *cum* screening slots are scarce, and firm opportunism is a problem, up or out rules are optimal.

In general, the scarce slot model does not impose an exact final date for making the up decision, as a university may need more time to train or screen the candidate in question. The lack of incentives for senior professors to provide careful and timely evaluations of their junior colleagues suggest a need for an explicit final up or out date. Even if a university wishes to practice up or out, it does not necessarily have the expertise to make the decision, nor know when a decision should be made. Without a final date or external offer, the decision to bring a candidate forward for tenure review will be up to the senior faculty. However, senior faculty has little incentive to do a timely tenure review. Since a review requires substantial effort even if the

candidate is qualified, there is a tendency at the margin to postpone the review. If the candidate is marginally unqualified and should be dismissed, the senior faculty has an even stronger preference to postpone the unpleasant task until the next year. Next year, the decision can be postponed again until the marginally unqualified candidate has *de facto* tenure. Since up or out is optimal, the university is willing to impose a final date for review to put an upper limit on the procrastination (McPherson and Winston 1983; Rosovsky 1990). The final date does impose a cost by forcing a few premature decisions.

How does the scarce slot theory accord with the historical record? In the early history of universities, there was no scarcity of research slots as research was not particularly valued. So the two track system where pure teachers had *de facto* tenure prevailed. Research has become more specialized over time[16]. Since the turn of the century, universities have experienced a proliferation of departments and courses. As the number of specialized courses and fields of research increased, there is an increasing scarcity of junior slots to screen or train researchers in each area. As the importance of research and specialization grew, universities moved to the standard contract with up or out and tenure.

The scarce slot theory has a prediction for the future. Specialization in research is likely to continue to grow in the next 20 years. Universities already practice up or out. Where will new

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[16] The extent of specialization is not easy to quantify. Price (1986) and Menard (1971) showed that there has been exponential growth in scientific journals over the last century. But this may mean only more articles on the same subjects, although the names of new journals suggest that they are getting increasingly specialized. Price also showed that the number of single authored articles in *Chemical Abstracts*, has fallen from over 80% in 1910 to less than 30% in 1960. An alternative explanation to specialization is that the cost of experiments may be prohibitive for a single researcher to bear. Menard provided some evidence that the number of papers published per chemist has fallen over time. Barnett, Ault, and Kaserman (1988) also found increasing numbers of co-authored articles in economics.

slots come from? Universities may look increasingly covetously at the slots occupied by senior faculty who are no longer active in research. When a senior professor retires, that slot can be used to hire another active or potentially active researcher. If there is declining or stable undergraduate enrolment and increasing specialization in research, there will be more and more complaints about the institution of tenure and unproductive tenured professors. Thus, there will be increasing pressure on the university to provide explicit or implicit incentives for older professors to retire early. Explicit schemes include monetary bonuses for retirement[17]. More likely, a university may also implicitly encourage early retirement by not aggressively responding to external offers. This will make research academics much more like baseball players. If this paper is correct, in the future, tenured professors will leave major research universities at earlier ages than they do now, even though mandatory retirement was abolished in the U.S. in 1993. Interestingly, Rees and Smith (1991) reached the opposite conclusion. They expect the average age of tenured faculty in universities to rise slightly with no mandatory retirement. The difference in our predictions is due to our different assumptions about the exit behavior of tenured faculty. Rees and Smith, in their forecasts, used historical nonretirement separation rates, and lowered the retirement rate due to the end of mandatory retirement. I expect both nonretirement and retirement separation rates for university professors to increase in the future.

V. *Models of Tenure*

[17] Rosovsky (1990) also suggested systematic buying out of older faculty to finesse the end of mandatory retirement.

The first and most popular justification for tenure is based on the need to protect academic freedom[18]. Simply put, the argument is that some potentially valid ideas may not have current academic, public or political support. If the proponents of these ideas are protected by tenure, potential innovative thinking is not inhibited by the threat of job loss. Society will gain in the long run when some of these "heretical" ideas turn out to be beneficial.

The second justification for tenure, as expounded by the AAUP, is to provide "a sufficient degree of economic security to make the profession attractive to men and women of ability."[19] The AAUP statement presumes a likely depreciation of the human capital stock of older professors, and the universities will have an incentive to replace these professors[20]. From a consumption smoothing perspective, this justification is incomplete. If universities have to subsidize older professors, these same professors will have paid for the subsidy with lower wages when they were young. For example, professional athletes have an even shorter active career, but they do not demand that their sports team retain their services for 20 or more years. Instead, they are highly paid for the few years they are active. The question for academia is, then, why should income support for older professors be tied to continued service?

When the standard contract gained popularity, Alchian (1959) criticized the institution of tenure. He argued that tenure is an implicit minimum wage guarantee, encouraging tenured professors to shirk. The shirking problem remains the most common and compelling argument

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[18] Commission; Machlup (1964); Rosovsky and Van Alstyne (1971). Part of the appeal of this argument to academics is its agreeable self image, that of Galileo besieged by Philistines.

[19] "1940 Statement of Principles on Academic Freedom and Tenure" AAUP (1984), *Policy Documents and Reports*, 3. Also reprinted in Commission.

[20] See also Machlup; McPherson and Winston.

against tenure.

Alchian provided one of the first rent seeking rationales for tenure. He recognized that competition would drive out inefficient practices even among nonprofit institutions. Since tenure is inefficient, he argued that it thrives because state governments subsidize their public universities. Tenure and the associated shirking allow the faculty to capture part of the rents (subsidies) earned by public universities. Due to its nonprofit status, a public university does not have sufficient incentive to prevent this rent seeking on the part of the faculty. It is important to reiterate that tenure and up or out were introduced by private universities. Alchian's arguments cannot apply to those institutions. Alchian, with some trepidation, predicted the demise of private universities.

Tenure supporters dispute the tendency of tenured professors to shirk. Because of either superior moral fiber or peer pressure, shirking is a minor problem[21].

The second defense, advocated by legal scholars partial to tenure, is that tenure is not a lifetime employment guarantee. Through reading of U.S. case law, they contend that tenure merely ensures that a tenured professor may be dismissed only after the university has shown adequate cause[22]. While the exact definition of adequate cause is unclear, these legal scholars and the AAUP consistently insist that adequate cause includes shirking in teaching, administration, or research[23]. Thus, the second defense argues that shirking is not an issue because it is considered

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[21] McPherson and Winston (1983), Rosovsky.

[22] Brown and Kurland (1990), Hendrickson (1988) Lovain (1983), Morris (1992) and Van Alstyne (1971).

[23] Morris contains an excellent summary of the US courts' interpretation of adequate cause.

grounds for dismissal.

An argument that tenured professors seldom shirk is necessary to support the academic freedom justification for tenure. The vast majority of professors do not produce anything that raises a concern about loss of academic freedom. If shirking is widespread under tenure, then tenure as insurance for academic freedom is very costly. Independent of tenure, U.S. courts are willing to protect the academic freedom enjoyed by professors[24]. Whether current legal safeguards are strong enough is irrelevant for this essay. They can be made strong enough within the framework of the current U.S. constitution. Commitment to the freedom of expression is less well established in Canada. But because all Canadian universities and colleges in Canada are public institutions, tenure cannot provide more safeguards to academic freedom than what the government is willing to concede.

Medical schools provide a stark counter example to the academic freedom justification. Most medical teachers and researchers, full-time and part time, do not have tenure. Medical teaching and research are among the most controversial, publicly monitored, publicized activities of universities. It is surprising, then, that these teachers and researchers do not have tenure if the primary purpose of tenure is to protect academic freedom. At least for medical schools, the fear of misallocation of effort caused by tenure outweighs concern for academic freedom.

With the possibility of shirking under tenure, a long probationary period prior to the tenure award, and a low incidence of infringement of academic freedom, the standard contract would appear an inefficient mechanism for protecting academic freedom. Tenure as income maintenance for older professors is also costly if shirking is a problem, since the alternative of

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[24] Byrne (1989); Brown and Kurland (1990), Metzger (1988).

spot wages is efficient.

Dissatisfied with the standard justifications for tenure, economists proposed some of their own. Freeman (1977) also applied an insurance argument for tenure. He argued that academic research is risky. Thus, risk averse researchers would like to insure themselves against poor research outcomes. Tenure, which is an implicit minimum wage, provides that insurance. *Ex post facto* successful researchers cannot be forced to subsidize unsuccessful researchers since the successful researcher can leave the university. Freeman (1977) concluded that non- tenured professors pay for the insurance before they secure tenure.

Risk taking in research is a dilemma for some professors, but the majority of the faculty in universities and colleges do little research[25]. In particular, professors sort themselves into more or less research oriented universities[26]. Most universities and colleges have tenure. If shirking is a problem with tenure, why are faculty members in non-research oriented schools buying costly insurance for a non-existent risk?

McPherson and Winston (1983) proposed a broader definition of risk taking. It is not risk taking as a tenured professor that matters; rather, it is the long and specialized training required to become a competent academic that is the problem. If the market value of that training falls after the individual has completed the training, the individual will suffer a large capital loss. So, if demand fluctuations are important, individuals without insurance will be unwilling to undertake

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[25] In C89, 18.3% of full-time faculty never published a book or article.

[26] In C89, 4.5% of full-time faculty in doctorate-granting universities had never published compared with 26.9% of full-time faculty in non-doctorate granting institutions. In economics, Graves, Marchand and Thomson (1982) showed that less than 50 universities published more than 12 pages per faculty member in the top 24 journals in economics between 1974-1978. One hundred universities published between 1 to 2 pages per faculty member.

the substantial investment necessary to become competent. Tenure provides insurance against demand fluctuations for a professor's skills. McPherson and Winston's view of risk taking applies to almost all professors. Thus, it does not suffer from the criticism of Freeman (1977) discussed earlier.

One problem with McPherson and Winston's view is that tenure is only awarded after graduate school and a long probationary period. By this time, the individual in question has already invested heavily in a specific area. If demand falls before tenure is awarded, or if the individual fails to secure tenure, there is no recourse against the employer. Considering the amount of residual risk, is tenure more efficient than compensating wage differentials to insure against demand fluctuations?

Carmichael (1988) argued that the frontier of knowledge is constantly changing. Senior professors, because they are in the field, are best able to recognize the talented junior faculty associated with promising innovative ideas. If the new ideas devalue the senior professors' human capital, the university has an incentive to dismiss senior professors or lower their wages after it hires the talented junior faculty. Thus, senior professors will prefer not to reveal promising, new, junior faculty to the university if they threaten the market value of the senior professors. As tenure removes this threat, senior faculty would be more likely to share their knowledge of promising new junior faculty and ideas.

Carmichael's insight on the informational asymmetry between the university and faculty is important. His particular solution raises the problem of nepotism by the senior faculty. Tenure makes the nepotism problem worse because senior faculty are not penalized for bad promotion decisions. As discussed earlier, peer review alleviates the nepotism under tenure. Carmichael's

concern and nepotism arise because senior professors are not accountable for the performance of the junior faculty that they select. Why do universities not hold senior faculty more accountable for the junior faculty?[27]

Finally, some observers speculate that tenure is a prize in a tournament scheme that induces effort among non-tenured faculty[28]. There are two difficulties with this idea. First, many tenured faculty are hired externally. It is unclear if the standard tournament schemes remain optimal with external tenured hiring (i.e., no junior faculty winning the prize). Second, even if a prize is necessary to induce effort, why should universities tie the prize to service? Since there is up or out, the university may propose a scheme in which it pays a faculty member a monetary bonus after "x" years if it wishes to continue the employment after "x" years. So, a non-tenured faculty member who performs well collects a bonus and may remain in the university. Otherwise, the member has to leave the university. The university cannot renege on the bonus because it cannot continue to get the service of the faculty member otherwise. This bonus scheme is more efficient than tenure as a prize because it avoids the shirking problem associated with tenure.

Finally, Harris and Weiss (1984) presented a model that has elements of tenure and an out rule. They studied on-the-job screening with finitely lived and risk averse workers. Tenure applies in their model because, it is too costly for a dissatisfied worker to move, if this dissatisfation is realized late in a career. With risk aversion, a worker does not move late in a career because of a

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[27] Senior professors in Continental Europe and Japan have more property rights over the actions of their junior colleagues (Altbach 1977; Clark 1987). In Continental Europe, those property rights have been weakened since the 1960s (Neave and Rhoades 1987).

[28] Lazear and Rosen (1981); Nalebuff and Stiglitz (1983); Carmichael (1983); and Malcomson (1984).

built-up insurance fund in the firm through deferring wages earlier in their career to insure against bad outcomes later. There is no promotion in their model. An employee performs at the same level with or without tenure.

In summary, the factors identified above to justify tenure are important concerns in academia. While tenure will alleviate these concerns, it has other difficulties. In particular, if shirking under tenure is prevalent, as it will be unless deterred, the cost of tenure may easily outweigh the benefits.

VI. *Shirking under Tenure*

In any industry, seniority rules (such as tenure) can serve to smooth consumption if (i) worker productivity eventually declines with age, (ii) there is a role remaining in the firm for the worker with decreased productivity, and (iii) shirking under the rule can be deterred. But why are seniority rules preferred to spot market wages when there is a well functioning capital market? A seniority rule is preferred if (iv) the rule provides *additional* benefits that paying spot market wages do not.

The first part of this section summarizes evidence for the first three conditions listed above. That is, it shows that tenure may be used to smooth consumption. The evidence is closest to, and also draws from, Rees and Smith (1991) who also concluded that research productivity falls after mid-career whereas age is not an important factor in student evaluations of teaching effectiveness. The second part of this section considers additional benefits of tenure that a spot market will not provide.

Many professors conduct research as part of their job[29]. To produce publishable research, professors must continually invest in new knowledge as the frontiers of knowledge expand. With rapid depreciation of human capital and a finite life horizon, standard on-the-job training models such as Ben-Porath (1967) suggest that the life-cycle research productivity profile will increase with age, peak, and then decline.

Beginning with Lehman (1953), researchers have shown that the empirical life-cycle research output profile has an inverted U shape with the peak occurring well before retirement age[30]. While the life-cycle research output profiles have an inverted U shape, research productivity may not follow the same age pattern because hours of research also vary over the life-cycle. Table 2 presents regressions of research output and hours of research per week by age, using C89. The sample is restricted to tenured faculty, ages above 30, in doctorate granting universities. Column 2.1 presents a median regression of number of articles published in the last two years (ARTICLES) on a cubic function of age (AGE, AGE SQUARED, AGE CUBED), a male dummy (MALE) and *Carnegie Classification of Academic Institutions* dummy variables (RESEARCH I, RESEARCH II, DOCTORAL I). See Appendix A for variable descriptions. OLS estimates are in column 2.2. I used median regressions as well as OLS when bottom or top coding of the dependent variable is significant. Sometimes, there are significant differences between OLS and the median estimates. When differences arise, the median estimates are more relevant because they describe the behavior of the representative professor. Since the estimated age coefficients are

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[29] See James and Neuberger; Rothschild and White; Youn; and Siow (1995) on the benefits that universities and colleges derive from their faculties' research.

[30] See also Diamond (1986b); Levin and Stephan (1991) and the references therein.

difficult to interpret individually, Figures 1 and 1' plot the estimated median and mean number of ARTICLES respectively by age, holding the values of all the other regressors at their means. The median plot shows an initial increase in the number of articles, a peak around age 40 and a steady decline after that. The mean plot shows a steady decline in the number of articles by age[31]. Between ages 40 and 60, both plots show declining output with age and the estimates are precisely estimated. The pattern of declining research output with age is consistent with those found by Diamond (1986b), and Levin and Stephan (1991). Since older professors have more outlets for publications and ARTICLES do not control for quality, the decline in output controlling for quality may even be larger.

Columns 2.3 and 2.4 in Table 2 present median and OLS regressions on the hours per week spent on research (HRS RES) on the same regressors as the earlier two regressions. Figure 2 and 2' plot the estimated median and mean HRS RES respectively by age[32]. The initial and level behavior of the two plots are different. But between ages 40 and 60, hours of research per week decline with age in both figures. The small upturn in hours of research among the oldest faculty is likely due to selection where those who were uninterested in research retired.

The results in Figure 1, 1' and 2, 2' may be combined to estimate life-cycle research productivity profiles. Since ARTICLES refer to articles published or accepted for publication in the last two years, I decided to lead ARTICLES by two years before dividing it with HRS RES to get a contemporaneous measure of research productivity ($ARTICLES_{t+2}$/$HRS\ RES_t$). Figure 3 and

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[31] Rees and Smith reported the same pattern with the same data set but different samples.

[32] Other regressors are held at mean values.

3' plot research productivity against age[33]. The median estimates show that research productivity rises gently until the peak around age 35 and then declines. There is no rise before age 35 according to the mean estimates. Otherwise, the patterns in the two figures are similar. The drop in research productivity between age 40 and 60 is particularly steep. Figure 3 and 3' show that the research productivity of a typical professor falls by half over his tenured career.

A skeptic may argue that the observed declining research productivity is high because of shirking under tenure. However, note that hours of research did not decline with age as much as output. Using another measure of research productivity, Rees and Smith also reported that grant awards for research declined with age in two data sets, C89 and the grant records of a single university. This measure of declining research productivity by age is immune to the shirking problem because grants confer real resources to the recipients.

With declining research productivity profiles, professors are interested in some form of income maintenance for when they get older. But why are universities willing to grant tenure when hours of research and research productivity decrease with age? The answer is in two parts. First, universities also value teaching, and teaching productivity may not decrease as fast with age. Second, the university assigns more teaching and administrative duties to older professors.

There is no measure of teaching productivity in national data sets of professors. Kinney and Smith (1992) showed that teaching productivity, as measured by teaching evaluations by

[33] One cannot just regress ARTICLES/HRS RES on age with micro data to estimate life-cycle research productivity because ARTICLES refers to past two years output whereas HRS RES refer to past year output.

students in one university, does not decrease as rapidly with age as research productivity[34]. They also pointed out that other factors affecting teaching ratings, such as the level of the course, dominate the aging effect. So the university has other tools to ameliorate any deterioration of teaching productivity due to aging.

I analyzed a small sample (99 observations) from the University of Toronto[35]. In regressions of teaching evaluations on age and other characteristics, there is no discernible effect of age on teaching evaluations. Other factors, such as the teacher's level of English, affected teaching evaluations significantly. Summarizing, the results of Kinney and Smith, and Siow suggest that at a first approximation, teaching productivity is unaffected by age.

Since students care more about teaching productivity, the university will assign more teaching responsibilities to older faculty members. Table 3 presents evidence on hours of teaching and administration by age. Columns 3.1 and 3.2 present median and OLS regression results of hours of teaching and administration per week (HRS T&A) on a function of age, male dummy variable and *Carnegie Classification* dummy variables. Teaching hours refer only to scheduled hours of classroom instruction and do not include preparation time or office hours[36]. The sample consists of tenured faculty over age 30 in doctorate granting universities. As before, the effects of age on hours of teaching and administration are easier to see in Figures 4 and 4'. The plots show that nonresearch hours increase with age, peak between 50 and 55, and decline. From

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[34] The problems of using teaching evaluations as a measure of teaching quality are well known (Doyle 1979). Yet, this measure is widely used because it is quantitative and available.

[35] Detailed results are in Siow (1993).

[36] A broader definition of teaching time resulted in much more missing values.

age 30 to the peak, mean and median nonresearch hours increase by 48% and 61% respectively. These plots are consistent with the theory that universities assign more teaching and administrative responsibilities to older faculty members when their research productivity and hours of research decline[37].

For tenured faculty in doctorate granting institutions, the correlations between the OLS residuals from Columns 2.2, 2.4, 3.2 of ARTICLES and HRS RES; ARTICLES and HRS T&A; HRS RES and HRS T&A; were 0.338, -.151 and -.438 respectively. These correlations suggest that beside age considerations, universities systematically trade research for teaching and administration with tenured faculty.

A summary measure of total effort by age is captured in Figures 5 and 5' which plot median and mean total hours of work per week by tenured faculty in doctorate granting universities against age. The total hours of work is a sum of HRS RES and HRS T&A. The plots were generated from estimated regressions as before, with the regressors held at mean values. The plots show that there is a small increase in hours of work before age 40. After age 40, there is a gentle decline. The largest difference in hours between ages 40 to 70 is less than 10%.

Do tenured faculty shirk on research? There are two defenses against shirking when research productivity is not decreasing with age. First, tenure is not awarded until achievement in research is shown. Second, a university may reward tenured, prolific researchers with wage increases. In fact, the incentive to publish is great since each wage increase is permanent, due to tenure. Researchers have consistently found that the salaries of academics are determined by the

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[37] The ages at which median ARTC and HRS RES are maximized are 37 and 38 respectively. The age at which the median HRS T&A is maximized is 52.

stock of citations and publications amassed to date rather than the current output (Diamond 1986a; Hamermesh et. al. 1982; Sauer 1988; Tuckman and Leahey 1975). Using panel data, Siow (1991) showed that earlier publications and citations have a greater current monetary payoff than later publications and citations[38]. Universities are more concerned than colleges about research and therefore have to provide stronger incentives for professors to do research. Consistent with this discussion, Ransom (1993) also showed that earnings grow faster with experience for professors in universities than in colleges.

After a professor's research productivity peaks, there is less monetary incentive to continue to do research. Since research effort subtracts from teaching time, it is efficient for the university to encourage professors to put more effort into teaching and less effort into research as research productivity falls. In other words, the standard of adequate cause for dismissal of tenured faculty excludes low research productivity. In C89, 4.7% and 36.4% of tenured faculty in doctorate granting and non-doctorate granting institutions respectively claimed they had no publications in the previous two years, and also were also not engaged in any current research[39]. Yet, in review of U.S. case law, legal scholars did not cite a single case in which a university or college primarily used low research productivity to justify dismissing a tenured professor.[40]

If the university is going to make less active researchers engage in more teaching and

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[38] Using cross-section data, Kenny and Studley (1992) have contrary results.

[39] Over 50% of the tenured faculty in non-doctorate granting institutions did not have any publication in the last two years.

[40] Morris reviewed over 160 cases, the majority of them involving involuntary dismissal of tenured faculty for other than immoral behavior. Hendrickson (1988) reviewed 41 cases involving removal of tenured faculty for cause decided between 1982 to 1987. Also see Lovain (1983).

administration, it should have checks to ensure they do not shirk on these tasks. The tenure contract does not allow the teacher to shirk on teaching or administration. In reviews of U.S. case law, the same legal scholars found that poor teaching and administration are commonly used to justify dismissing tenured professors[41]. That is, tenure provides protection only for low research productivity and not low teaching productivity[42]. The previously presented evidence on teaching productivity by Kinney and Smith (1992) and this paper show that, as a first order approximation, there is no significant depreciation of teaching, productivity associated with aging. This is all the more impressive since older professors are assigned more teaching, and standard production theory implies there should be diminishing marginal productivity in teaching. In other words, there are sufficient mechanisms---technological, economical, and otherwise---such that shirking in teaching by tenured professors is not quantitatively important.

Thus far, this paper has addressed only the supply of effort and output by faculty in research oriented institutions. What is the situation in institutions where faculty research is unlikely to be important? In C89, the median ARTICLES for tenured professors, for every decade beginning at age 30, in non-doctorate granting institutions was 0. That is, the typical tenured professor in such institutions does not produce publishable research. Columns 3.3 and 3.4 present median and OLS regression estimates of HRS T&A on a function of age, male dummy,

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[41] There is no up-to-date systematic study of the case law in Canada (but see Soberman 1965; Hurtubise 1966; and Hudson 1975). In the first and recently concluded dismissal hearing for a tenured professor at the University of Toronto, the university charged that the professor engaged in inappropriate teaching and consulting activities. It ignored his minimal research record.

[42] In evaluating the employment protection granted by tenure, consider the following mental experiment. What are the likely responses of the university and the judicial system to (a) a tenured professor who skipped classes for a month, and (b) one who has not published for three years?

and other *Carnegie Classification* dummies for the C89 sample of tenured faculty in non-doctorate granting institutions. The estimated age effects are displayed in Figures 6 and 6'. There is an initial increase in HRS T&A[43]. There is essentially no variation in HRS T&A between ages 40 and 60. Thus, there is little evidence of shirking by tenured faculty in non-research oriented institutions.

The evidence on shirking must be qualified. I have shown there is little evidence of shirking induced by tenure over the life cycle. The question of the level of compensation is not addressed. That is, some faculties may capture rents from their public universities in the form of higher lifetime salaries. The role of tenure in facilitating this transfer is not explored here[44].

While this paper has shown that there is a trade-off between research and the areas of teaching and administration, the theory does not require a decrease in research output to be compensated by a proportionate increase in teaching and administration. Tenured professors may reduce research and switch into consulting for personal income and/or leisure. As pointed out by Boyer and Lewis (1984), consulting and/or leisure reduces the wages that universities have to pay those faculty members. Unless the consulting and/or leisure detracts from their teaching productivity, the university is not necessarily concerned about this diversion of effort. Consulting practices differ enormously by disciplines and departments within a single university. Most of these activities occur with at least implicit consent and knowledge of the university.

Based on the above evidence, this paper suggests that tenure serves two roles. First, it

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[43] This initial increase is not explained by a declining interest in hours of research. A potential explanation is that younger faculty spend more time advising students and preparing for classes.

[44] Rent seeking in public universities is also often tied to unionized faculty behavior which is beyond the scope of this essay (Ashraf 1992; Barbezat 1989).

disentangles earnings profiles from productivity profiles. Over a professor's career, the allocation of tasks is based on productive efficiency (i.e., comparative advantage), while the earnings profile is based on consumption smoothing (i.e. the life-cycle consumption model). Like baseball players, professors want income support when they become old. Unlike baseball, where players have no role on the team when they can no longer play, a professor whose research productivity has declined can switch out of research into teaching. It is important to note that when a professor ages, switching to teaching and administration cannot fully compensate the employer for the loss of research productivity. If the switch was fully compensating, tenure would be unnecessary. In other words, tenure has bite. Other institutions of equivalent quality will not be willing to hire an older tenured professor at his current wage.

While tenure can smooth consumption, why not pay professors their market value at every age and let professors save for themselves? Employers will pay young tenure quality professors more than their current tenured wage. As argued in this paper, employers should be willing to hire older professors at a lower wage than their current tenured wage. Without tenure, professors would have to decide for themselves how they want to save for old age.

The above question raises the additional benefits of tenure that a spot market cannot provide. It is important at this point to reiterate that the other benefits of tenure discussed in section V remain relevant; the issue is the *cost* of using tenure to do so. This section suggests that the loss of teaching productivity under tenure is minimal, and so, within the university, there is an effective role for tenured professors who are no longer active researchers. Thus, it is efficient to use tenure to solve the other problems as well.

The two-role theory of tenure explains why some faculty members do not qualify for

tenure. First, full-time researchers who are supported by external grants and consulting income do not qualify for tenure. When the external funding ends, the university is not obligated to support these researchers. Since their roles as teachers are not valued, there is no way for the university to deter shirking under tenure. A university may value the research and yet not grant tenure to these researchers. Second, some full-time lecturers do not qualify for tenure. These lecturers teach various introductory and service courses and are not expected to do any research. Teaching productivity does not deteriorate sharply with age. Thus, there is no consumption smoothing role for tenure. Moreover, tenure is not required to help shift a lecturer's effort from research to teaching as the lecturer's job is to teach full-time. As a result, these lecturers do not qualify for tenure.

Consider the case of medical schools, which by and large do not grant tenure. First, the majority of the teaching in medical school is done by physicians who exchange teaching for admitting privileges at university hospitals. These faculty members do little research. Second, faculty members that do a lot of research obtain external grants. They also see paying patients. The insurance motives for tenure by Freeman (1977), McPherson and Winston (1983) are less relevant because faculty members can switch to treating paying patients when their research producitivities fall. Senior members of departments retain substantial property rights over their junior members including the sharing of revenue generated by these junior members. Thus, Carmichael's concern is also less relevant. So tenure has minimal benefit and substantial cost if it encourages doctors to shirk from treating paying patients or doing externally funded research.

The theory of tenure developed above is broadly consistent with the historical development of tenure in Canada and the U.S. The problem of research obsolescence emerges

only when research prowess is valued. Canadian and American universities only began to emphasize research after the turn of the century, and agitation for tenure began shortly thereafter. Full conversion to the standard contract did not occur until the 1960s. Tenure was granted first by universities and spread subsequently to colleges. Colleges, with a low volume of research activity, have less to gain by awarding tenure. On the other hand, they are not penalized by tenure because shirking on teaching and administration is not protected by tenure. So why did tenure spread to colleges?

Metzger (1973) conjectured that tenure spread in the 1960s because it enabled colleges to demand more teaching services from their professors without an exceptional increase in pay. As discussed earlier, the 1960s coincided with an unprecedented increase in enrollments in higher education. Figure 7 shows that the student faculty ratio was essentially stable until the sixties, at which point, it increased by 70% and has remained at the higher level[45]. It also shows that the increase in the student faculty ratio after the 1960s is due to an increase in the rate of enrollment and not changes in the technology of higher education. Figure 8 shows that the average wage of professors, relative to lawyers and other college graduates, did not increase in the 1960s to keep pace with the increase in student faculty ratio[46]. The granting of tenure to professors in research oriented universities enabled those institutions to reduce emphasis on research and increase teaching, just as the demand for teaching increased. In colleges and less research oriented universities, the granting of tenure made it easier for a tenured professor to lower the

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[45] Data for Figure 7 is from U.S. Department of Education (1992), Table 159.

[46] Due to data problems, each series is spliced together from several public sources. Details are available from the author. Part of the decline in relative average wages is due to demographic effects. (Laitner and Stafford 1994).

unquantifiable dimensions of teaching effort. In all institutions, the increased job security of tenure also meant that employers could demand more quantifiable teaching services (i.e., higher student teacher ratio or more classroom hours) with no exceptional increase in pay. Unquantifiable shirking induced by tenure was of secondary concern, because even without tenure, low quality professors in the 1960s were unlikely to be dismissed because of the increased teaching demand. The long run consequences of the widespread adoption of tenure are unclear. There is discontent with and abandonment of tenure in some colleges, but not in universities[47].

VII. *The Negative Seniority Wage Premium*

In cross-section data, after controlling for labor market experience, the earnings of professors decline with institutional seniority (Ransom 1993; Hallock 1994; Moore, Newman and Turnbull 1994; Hoffman 1976; and Siow 1979). Ransom found this inverse correlation in three national samples of academics and one university. Using one of his data sets, the 1969 *Carnegie Survey*, Siow (1979) found the same results. Hoffman also reported inverse correlations for two universities. Moore et. al. found the same results for a sample of economists at six universities. Within a single university, Hallock also found that tenured hires from the outside are paid more than insiders with the same labor market experience. With cross-section data, there is a positive seniority wage premium for the general population as a whole (Altonji and Shakotko 1987; Topel 1991). Thus, any explanation for the negative seniority wage premium must point out the difference between academia and elsewhere which drives this difference.

The implicit peer review theory discussed above provides an explanation of the negative

[47] *New York Times*, B13, April 20, 1994; *Wall Street Journal*, B1, October 10, 1994.

seniority wage premium. Professors who experience a significant increase in market value may solicit external offers to obtain wage raises. However, when the professor in question has made the effort of generating an external offer, the probability of the individual leaving his present employer, even as it counter bids, is not negligible. Professors who do not experience a substantial increase in market value will not be able to generate such handsome external offers. As moving costs are high, these professors are unlikely to move. Movers consist mostly of professors with substantial increases in market values. Non-movers are a mix of professors with no external offers and some professors with external offers who did not leave. Due to moving costs, professors with external offers who did not move usually stayed for counter bids lower than rejected external offers. Thus, movers, controlling for labor market experience, will have higher wages than non-movers. This implicit peer review strategy for awarding pay increases may explain the observed inverse correlation between salary and institutional seniority. Since research is less prevalent in colleges, professors in colleges are less able to use external offers to generate wage increases. Ransom also found that the inverse correlation between wages and seniority was less pronounced at non-research oriented universities and colleges.

Alchian (1959) also predicted a negative seniority wage premium. In his model, tenure provides for a downward rigid minimum wage. Professors who shirk, or otherwise experience low productivity, remain with their university and collect the minimum wage. High productivity professors will try to get external offers, and the incumbent firm has to raise their wages if it wishes to keep them. As before, some of these workers who receive external offers will leave. Thus, movers have higher wages than stayers, generating again the negative seniority wage premium. Freeman (1977) insurance theory has a similar prediction since tenure in his case is also

a downward rigid minimum wage. Both theories apply only to professors with tenure.

The minimum wage theory of tenure generates the negative seniority wage premium using a selection argument that is the same as the implicit peer review theory. However, under the minimum wage theory, there is no economic justification for using external offers to generate pay increases. As discussed earlier, resources are used in generating external offers and there is also inefficient mobility. So, if the market value of professors is known, it is inefficient to have professors generate external offers before offering them wage increases.

The implicit peer review theory does not distinguish between tenured and non-tenured faculty although a university can respond to an external offer to a non-tenured professor by awarding tenure. Thus, the negative seniority wage premium may not apply to non-tenured faculty. The "tenure as minimum wage" theory should not apply to professors without tenure. Ransom did not distinguish between tenured and non-tenured faculty in his regressions. Siow (1979) ran separate earnings regressions for tenured and non-tenured faculty using the *1969 Carnegie Survey*. I found strong negative seniority wage premiums for both tenured and non-tenured faculty. I repeated separate earnings regressions for tenured and non-tenured faculty with C89. While the tenured faculty continued to experience strong negative seniority wage premiums, the untenured faculty experienced a strong positive seniority wage premium.

Ransom, Black and Lowenstein (1991) have another argument for the negative seniority wage premium. They argued that different professors have different unobserved moving costs. Universities discriminate against professors with high moving costs by paying all professors a below market wage. Professors with high moving costs will accept the low wages and accumulate advanced seniority. Professors with low moving costs will move and accept a higher wage

elsewhere. Thus movers have high wages and low seniority.

Moore et. al. tested the moving cost theory by including measures of the quality of a professor's publications in some of their cross-section earnings regressions on a sample of academic economists. When they did not include the quality measures, they also found a negative seniority wage premium. When they added the quality measures, they could not find a negative seniority wage premium. Moore et. al. interpreted their finding as detrimental to the moving cost theory. Their findings are consistent with both the implicit peer review theory and tenure as minimum wage theory. Their measure of publication quality is based on citation counts, which is apparently close enough to information revealed by external offers. They also did not distinguish between tenured and non-tenured faculty. Hallock also found that the negative seniority wage premium disappears when fields or departments are included in his regressions. This finding is difficult to reconcile with the above theories.

VIII. *Conclusions*

Different models have been proposed to explain various features in the organization of the market for professors. There is no unified model because there is no agreement on the objectives and environment in which universities and colleges operate. For example, the role of research in academia is unclear. Yet, most of the models discussed in this paper appeal to one aspect of research or another. A goal of future research is to clarify these objectives and environment.

The organization of the market for professors has evolved. Even when a labor market practice remains, such as tenure, its role has evolved. With the abolition of mandatory retirement in the U.S., the future of tenure in its current form is unknown. Features that we currently regard

as trademarks of the industry may apply more selectively in the future.

Appendix A: Data Summary

The national individual level data set used in this paper, C89, is the 1989 *Survey among College and University Faculty* sponsored by the Carnegie Foundation for the Advancement of Teaching. It is a stratified random sample of faculty members in two years and four years colleges and universities. The colleges and universities are classified into nine Carnegie Classifications: Research I, Research II, Doctorate Granting I, Doctorate Granting II, Comprehensive I, Comprehensive II, Liberal Arts I, Liberal Arts II, Two Year Colleges/Institutions. The classification is listed in declining order of importance of research. For further information on the classification scheme, see Carnegie Foundation for the Advancement of Teaching (1987), *A Classification of Institutions of Higher Education*, Princeton University Press.

The original data set has 5450 observations.

The sample used in this paper consists only of full-time faculty (4978 obs). Definitions of the variables used in this study are as follows:

AGE	Age
SENIORITY	Years employed full-time in current institution.
EXPERIENCE	Years employed full-time in higher education.
MALE	1 if male, 0 otherwise.
RESEARCH I	1 if current institution is classified as Research I, 0 otherwise.
RESEARCH II	1 if current institution is classified as Research II, 0 otherwise.
DOCTORATE I	1 if current institution is classified as Doctorate Granting I, 0 otherwise.
DOCTORATE	1 if current institution is classified as Research I, Research II, Doctorate Granting I or Doctorate Granting II, 0 otherwise.

ARTICLES	Number of professional writings published or accepted for publication in last two years.
HRS RES	Hours per week spent on research in current term. See construction below.
HRS T&A	Sum of hours per week spent on (i) formal classroom instruction in undergraduate courses, (ii) graduate courses, and (iii) administrative services. See construction below.

The main difficulty in construction hours of work on different tasks is that there are substantial missing values in the original data set. Hours of graduate teaching is set to zero if it was coded as missing and the institution was not a DOCTORATE institution (1524 obs). HRS RES and HRS T&A are set to missing if (i) the sum of all the non-missing values of HRS RES and HRS T&A exceed 80 (22 obs), (ii) hours of formal undergraduate instruction exceed 40, or (iii) hours of formal graduate classroom instruction exceed 25. Total hours of work is the sum of HRS RES and HRS T&A. It does not include office hours, preparation time for teaching and other tasks. Using a more expansive definition of total hours work would result in many more missing values.

All calculations reported using C89 are weighted.

Descriptive statistics of the variables used in this study are as follows:

FULL SAMPLE	MEAN	STD DEV
RESEARCH I	.116	
RESEARCH II	.123	
DOCTORATE I	.126	
DOCTORATE	.486	
AGE	48.3	9.47
SENIORITY	13.4	8.86
EXPERIENCE	16.5	9.30
MALE	.720	
HRS RES	13.4	11.4
ARTC	2.34	3.59
HRS T&A	16.4	8.52
TENURED	.697	

TENURED FACULTY IN DOCTORATE INSTITUTIONS OVER AGE 30	MEAN	MEDIAN	STD DEV
AGE	51.1		8.45
SENIORITY	16.8		8.30
EXPERIENCE	20.5		8.26
MALE	.844		
ARTC	4.51	3	4.56
HRS T&A	14.7	12	9.23
HRS RES	18.2	15	12.2

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Table 1: Seniority, Experience and Institutional Type

	(1.1)
METHOD	OLS
DEPENDENT VAR	SENIORITY
CONSTANT	1.77 (.246)
EXPERIENCE	.789 (.0106)
MALE	-.295 (.198)
DOCTORATE	-.995 (.170)
R^2 N	.646 3145

(S.E.)

Table 2: Research Output and Hours Worked by Age

	(2.1)	(2.2)	(2.3)	(2.4)
METHOD	MED	OLS	MED	OLS
DEPENDENT VAR	ARTICLES	ARTICLES	HRS RES	HRS RES
CONSTANT	-16.0 (17.5)	11.4 (17.8)	-15.9 (25.3)	45.1 (49.4)
AGE	1.22 (1.04)	-.297 (1.06)	1.45 (1.52)	-1.59 (2.95)
AGE SQUARED	-.0260 (.0204)	.00251 (.0208)	-.0311 (.0298)	.0228 (.0579)
AGE CUBED	.000165 (.000131)	-8.09e-06 (.000134)	.000211 (.000192)	-.000101 (.000373)
MALE	1.23 (.291)	1.43 (.299)	4.94 (.431)	4.21 (.821)
RESEARCH I	2.05 (.255)	2.18 (.334)	9.27 (.379)	6.48 (.944)
RESEARCH II	1.48 (.248)	1.42 (.390)	5.04 (.370)	3.77 (1.09)
DOCTORATE I	.598 (.248)	.744 (.391)	3.03 (.373)	1.31 (1.10)
R^2 or Pseudo R^2 N	.0510 1692	.0768 1692	.0499 1616	.0628 1616

(S.E.)

Table 3: Teaching and Administration Hours by Age

	(3.1)	(3.2)	(3.3)	(3.4)
METHOD	MED	OLS	MED	OLS
DEPENDENT VAR	HRS T&A	HRS T&A	HRS T&A	HRS T&A
CONSTANT	-18.8 (64.2)	29.5 (48.3)	-14.7 (23.0)	-39.3 (30.8)
AGE	1.72 (3.86)	2.23 (2.92)	2.06 (1.40)	3.37 (1.87)
AGE SQUARED	-.0272 (.0763)	-.0314 (.0578)	-.0406 (.0279)	-.0623 (.0372)
AGE CUBED	.000136 (.000494)	.000120 (.000375)	.000261 (.000183)	.000377 (.000243)
MALE	-2.31 (1.10)	-1.10 (.827)	.364 (.346)	.326 (.489)
RESEARCH I	-1.87 (.971)	-2.06 (-.963)		
RESEARCH II	-1.97 (.945)	-1.70 (1.11)		
DOCTORATE I	-.988 (.951)	-1.92 (1.12)		
OTHER CLASSIFICATION DUMMIES	NO	NO	YES	YES
R^2 or Pseudo R^2 N	.0133 942	.0227 942	.0379 1269	.0221 1269

(S.E.)

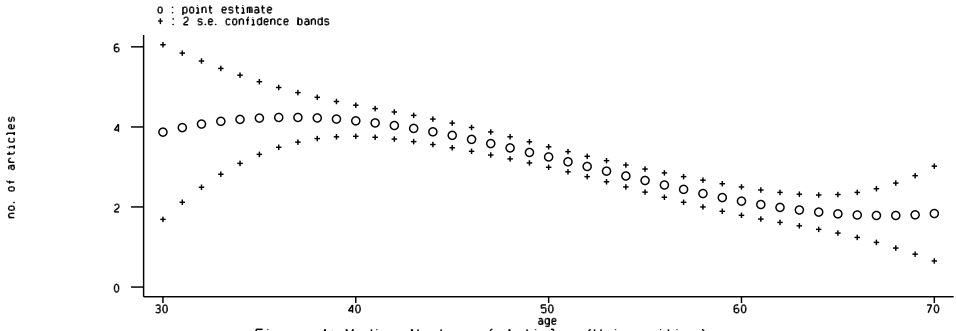

Figure 1: Median Number of Articles (Universities)

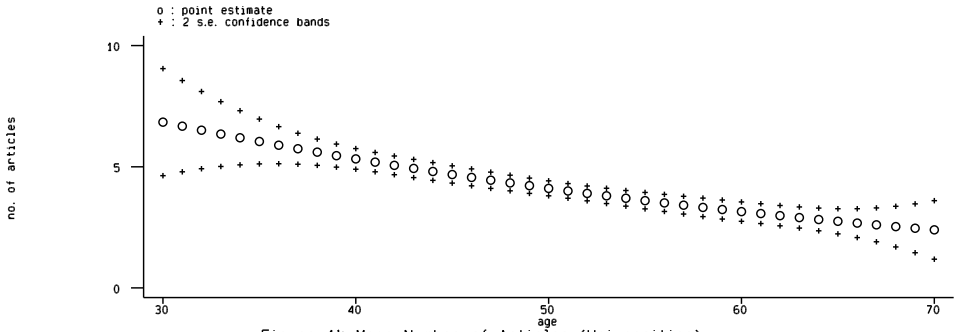

Figure 1': Mean Number of Articles (Universities)

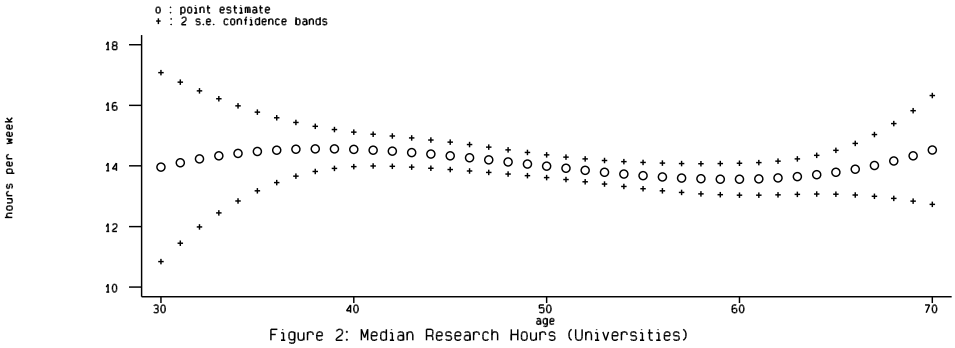

Figure 2: Median Research Hours (Universities)

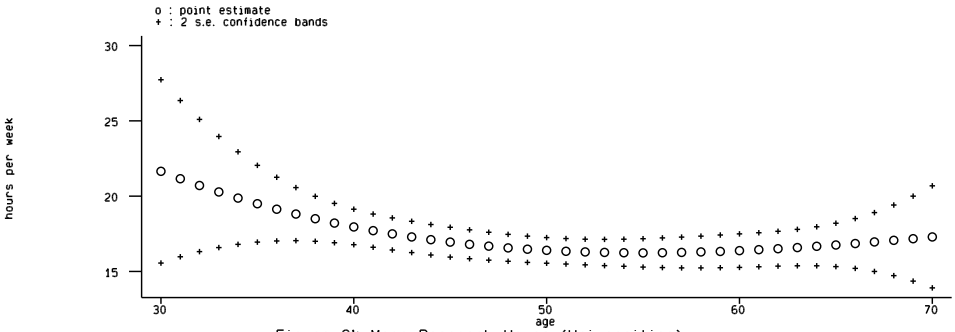

Figure 2': Mean Research Hours (Universities)

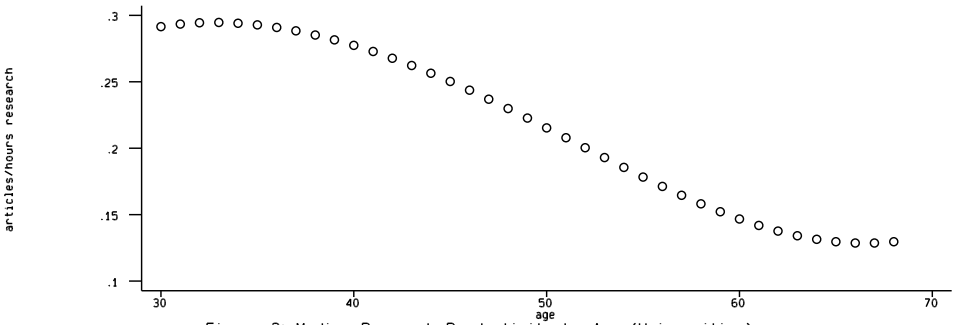

Figure 3: Median Research Productivity by Age (Universities)

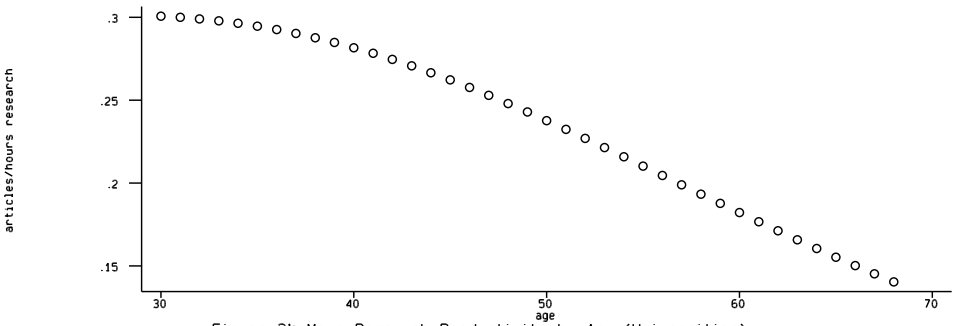

Figure 3': Mean Research Productivity by Age (Universities)

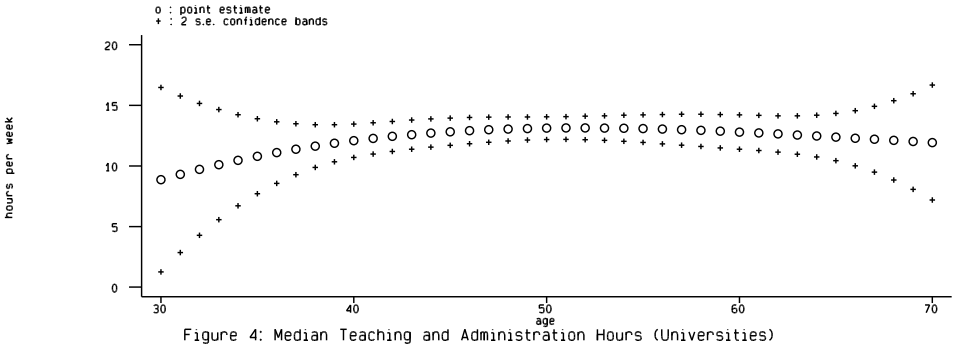

Figure 4: Median Teaching and Administration Hours (Universities)

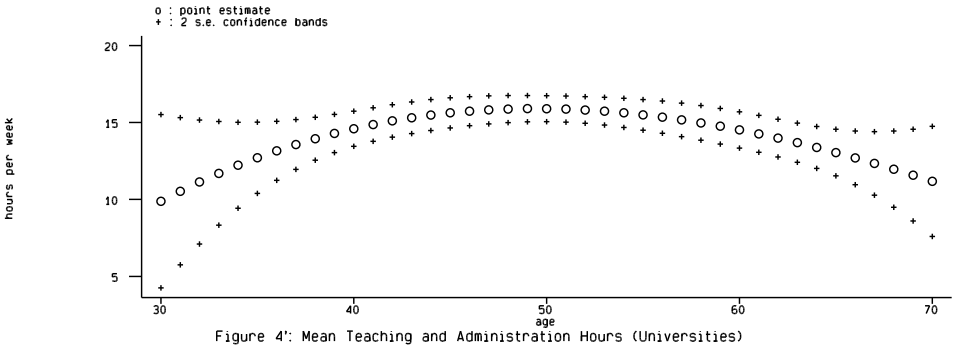

Figure 4': Mean Teaching and Administration Hours (Universities)

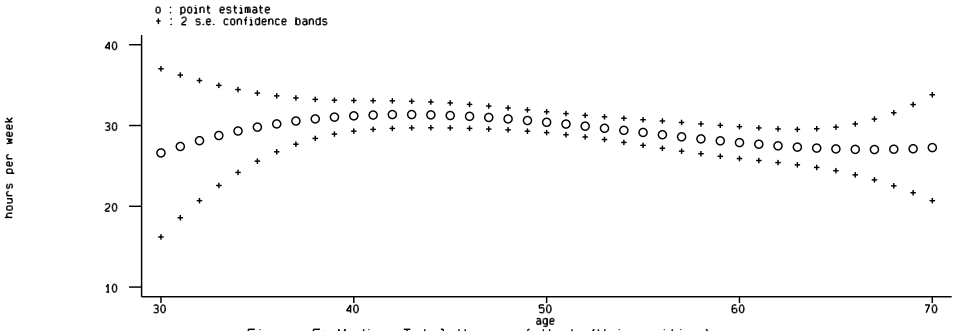

Figure 5: Median Total Hours of Work (Universities)

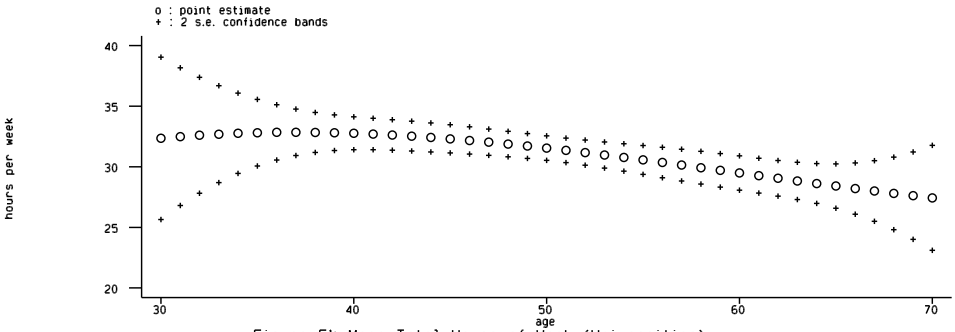

Figure 5': Mean Total Hours of Work (Universities)

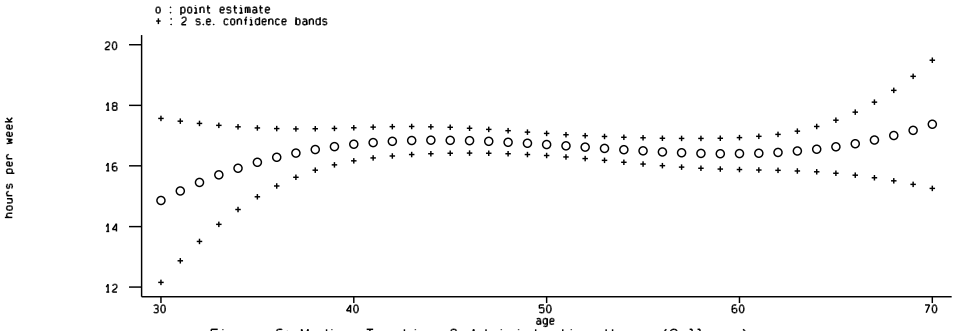

Figure 6: Median Teaching & Administration Hours (Colleges)

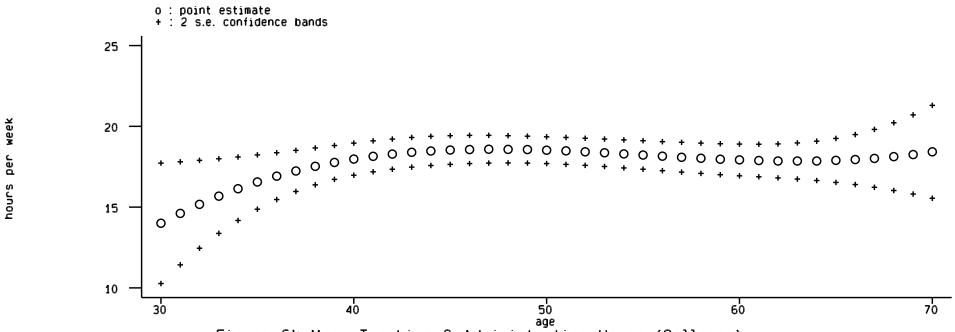

Figure 6': Mean Teaching & Administration Hours (Colleges)

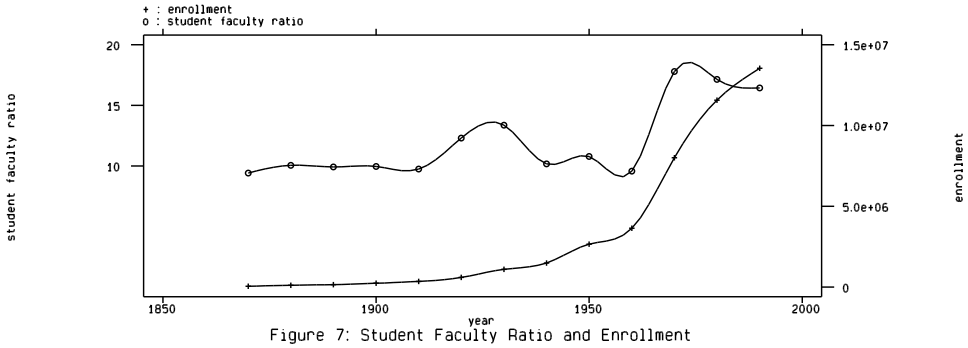

Figure 7: Student Faculty Ratio and Enrollment

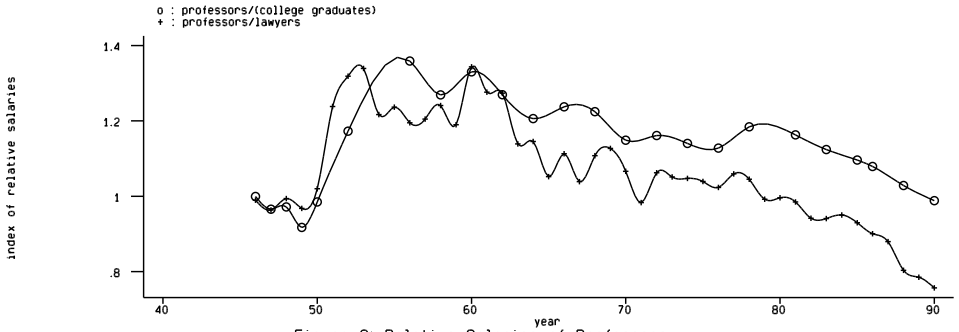

Figure 8: Relative Salaries of Professors