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ISET, Tbilisi State University and IZA

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IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

A Tale of Two Academic Tracks

Given asymmetric information, this paper explores the need for non-tenure-track jobs in academia alongside the usual tenure-track positions. It also explains the coexistence of these two types of jobs in research universities as an equilibrium phenomenon. The increased effort needed to produce research, accompanied by imprecisions in the academic editorial process, explains the recent increasing trend in the share of non-tenure-track jobs in academia as well as the widening wage gap between tenure-track and non-tenure-track academics.

JEL Classification: J21, J11, J24, J31, J41, J44, I23

Keywords: efficiency wages, tenure-track, coexistence of two contracts in equilibrium

Corresponding author:
Muhammad Asali
International School of Economics
Tbilisi State University
16 Zandukeli Street
Tbilisi 0108
Georgia

E-mail: muhammad.asali@gmail.com

A Tale of Two Academic Tracks

1 Introduction

Most jobs in academia are currently non-tenure-track positions (American Association of University Professors (AAUP) 2017). This is the result of a long-lasting increasing trend in the number of non-tenure-track jobs in academia at the expense of tenure-track jobs (Zhang, Ehrenberg, and Liu 2015; Ehrenberg 2004; Kasper 1986).

The trends in academic employment are apparent from Figure 1. Tenured and tenure-track jobs in American universities and colleges constituted the majority of the academic labor force in 1975 (approximately 57%). In a matter of twenty years, that percentage dropped to 42% and further decreased to 34% in 2015. While this downward trend is stark and clear, it appears to have become less steep over time, resembling a convergent process.

Ample literature has addressed the need for the tenure system in academia, or the lack thereof, for reasons such as obtaining academic freedom, facilitating risky projects, increasing teaching productivity, and offering incentives for hiring the best candidates (Carmichael 1988; Cater, Lew, and Smith 2008; Bhagwati and O'Flaherty 2001; Brogaard, Engelberg, and Van Wesp 2018), while other recent studies pointed to the possible optimality of non-tenure-track contracts in academia under some circumstances (Popov 2015; Kimmitt 2009; Chen and Lee 2009), although the findings from these studies relied on the assumption of heterogeneous

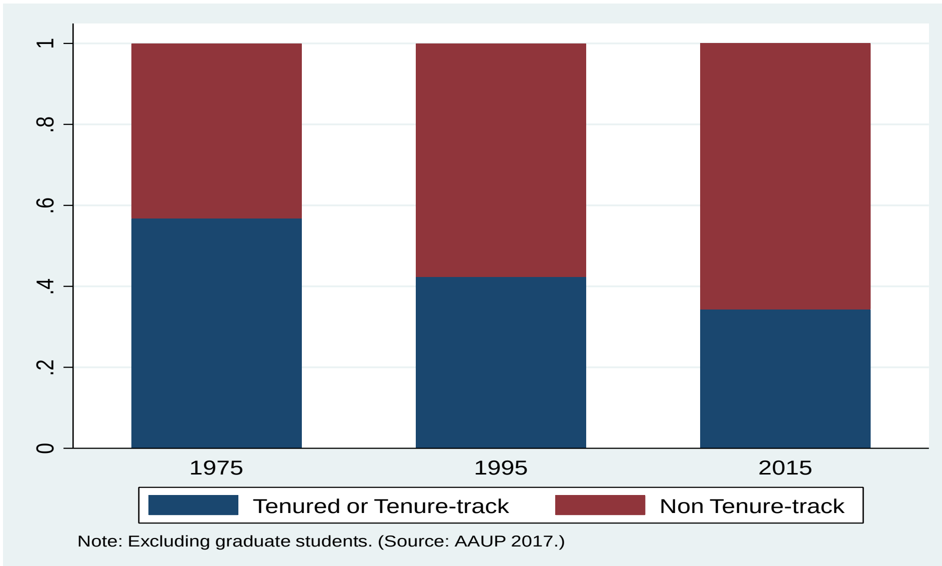

Figure 1: Trends in the Academic Labor Force (AAUP 2017)

academic workers (two types of abilities).

To the extent of our knowledge, no previous study has aimed to explain the coexistence of these two different kinds of contracts within academia and within the same university. Additionally, beyond the obvious, voiced reason of budget flexibility provided by the employment of non-tenure-track faculty (AAUP 1992), there has been no explanation offered for the increasing share of non-tenure-track jobs in academia. Moreover, whether that trend is going to accelerate or stabilize is uncertain. This study provides explanations and theoretical foundations for these phenomena.

Based on efficiency wage theory, as outlined by Shapiro and Stiglitz (1984), we build a basic model that implies the coexistence of tenure-track and non-tenure-track jobs in equilibrium. The model is based on the asymmetry of information regarding the research effort that academics exert to produce publishable research. Although successes in "star" jobs are rare and easier to observe (Baron and Kreps 1999), akin to research publications for academics, the efforts invested to produce such successes are unobservable. Additionally and probably equally importantly, a long period between investment of the effort and verification of the results is required (Ellison 2002). As Shapiro and Stiglitz (1984) noted, their framework can be used to study problems involving economies in which "there are important principal-agent (incentive) problems and in which the equilibrium entails *quantity constraints* (job rationing)."

The model also predicts a stabilizing, rather than exacerbating, trend in the share of tenure-track jobs in academia. This addresses the concerns raised by the AAUP regarding the eroding role and status of the tenure system in academia: "For higher education as a whole, the growing use of non-tenure-track faculty members, part-time and full-time, undercuts the tenure system, severs the connection between control of the curriculum and the faculty who teach it, and diminishes the professional status of all faculty members." (AAUP 1992, p.39)

Insights from the academic publishing industry are adopted to explain the stylized facts about the different types of contracts in academia (the increasing share of non-tenure-track jobs and the increasing wage gap between tenure-track and non-tenure-track jobs). In particular, the diminishing share of tenured and tenure-track faculty in academia is linked to the recently observed declining trends in the acceptance rates of papers for publication in journals of nearly all fields of science, sometimes, as outlined in Aarssen (2012) for ecology, only motivated by the interest to elevate the status of the journal by increasing its impact factor and competing with other journals for that status. See, for example, Wardle (2012) for ecology, Conley (2012) for economics, Nature Editorial (2012) for Nature, DiPiro (2013) for pharmaceutical studies, and the American Psychological Association (2017) for psychology. Moreover, journal editors are increasingly using a relatively newly introduced method of initial screening of papers before sending the papers for review by outside experts (a procedure known as summary rejection, desk rejection, immediate rejection, or bench rejection).

The implications of the model are consistent with some regularities observed in the academic job market. Additionally, the model suggests possible explanations for the recent decline in the share of tenure-track jobs in academia, in particular in the economics profession, such as the increased difficulty of conducting research or concerns about efficiency in academic editorial processes.

The study proceeds as follows. The following section outlines the simple model, which describes the population of academics, their production function, and determination of their effort. The next section also describes the mechanism that determines some of the model's main parameters, characterizes the market equilibrium, and offers basic comparative statics. Section 3 reports stylized trends in the academic labor market and suggests ways of calibrating the model to explain the stylized trends or to predict future trends. Section 4 provides some concluding remarks.

2 A Simple Model

2.1 Academic Personnel and the University

The academic labor force is composed of P people, including two types: researchers, R, who can both teach and perform research (henceforth referred to as "tenure-track" academics), and teachers, T, who can only teach (henceforth referred to as "non-tenure-track" academics).

$$P = R + T$$

After normalizing the academic workforce to one, we define the share of tenure-track academics as $\Omega = R/P$ and define the share of non-tenure-track academics as $t = T/P = 1 - \Omega$.

Academics, as well as individual departments, are assumed to be risk neutral. In particular, researchers and teachers have the following linear utility function: $U = w - e$, where w is the net income (earnings net of any observable effort) and e is the *unobservable* effort.

We assume that the unemployment benefits, if they exist at all, are less than $\bar{w}$, which represents the wage of teachers. Therefore, without loss of generality, in equilibrium, all non-researchers (or non-tenure-track academics) serve as teachers. Teaching involves only observable effort; however, successful research necessitates some unobserved amount of effort, $e > 0$.[1]

[1] Here, e is a discrete amount of effort, either $e = 0$ or $e > 0$. Considering effort as a continuous variable does not impact the qualitative results of the model.

The "production function" of the academic institution (hereafter referred to as the "university") is given by $f(R_i, T_i)$, where R_i is the number of tenure-track academics in university i and T_i is the number of non-tenure-track academics in university i. There are N identical universities such that $R = \sum_{i=1}^{N} R_i$ and $T = \sum_{i=1}^{N} T_i$. The aggregate production function, $F(R,T) = \sum_{i=1}^{N} f(R_i, T_i)$, is given by:

$$F(R,T) = \bar{w} \times (R + T) + g(eR)$$

where e is the effort invested in conducting research; $g(0) = 0$, $g'(x) > 0$ and $g''(x) < 0$. Essentially, $x = eR$ is the number of effective researchers. The first term refers to the input into teaching: R and T are perfect substitutes in terms of teaching. The second term refers to the product of researchers—which can also include a deviation in teaching quality from the base level to distinguish the teaching product of tenure-track academics from that of non-tenure-track academics.[2]

We assume that, with full information, $f_R(P, 0) > \bar{w} + e$; that is, full employment of all

[2] The literature is not unanimous on this matter. While some studies show that there is zero correlation between the quality of teaching and the performance of research (Hattie and Marsh, 1996, 2004), others find that the increase in the share of non-tenure-track faculty at American universities has adversely affected the graduation rates of undergraduate students (Ehrenberg and Zhang, 2005). Other studies have attributed the improved learning outcomes of undergraduates in their first term to teaching by contingent (non-tenure-track) faculty in contrast to tenure-track or tenured faculty (Figlio, Schapiro, and Soter, 2015). Yet other studies find that teaching productivity—the university's benefit from such teaching—is positively associated with a good research record (Cater, Lew, and Smith 2008).

academics as researchers is efficient. This alternatively means $g'(eP) > 1$.

2.2 The Publication Process

All researchers write working papers. Working papers produced without effort are considered low-quality research (referred to as "bad papers"). Only working papers produced with effort are considered high-quality research (simply referred to as "good papers"). While the product of research (working papers or published papers) is observable to the department, the effort invested in research (e) is not observed. An indication of that effort is gleaned from the publication process.

To maintain a tenure-track position, a researcher must secure publication of her paper in a representative journal.[3] Writing papers is a verifiable action; hence, it is performed by all academic researchers. The effort invested in a paper, however, is not verifiable by the department. The probability of rejecting a paper—leading to dismissal of the academic from the tenure (research) track—is higher for bad papers than for good papers. In particular, the editor is assumed to have some ability to discern good papers from bad papers. If she receives a bad paper, then she summarily ("desk-rejects") it with probability α :

$$\Pr(\text{Desk Reject } | e = 0) = \alpha$$

[3] For simplicity, we assume there is a single good journal in the profession in which the publication of research matters to the department. Using the terminology of Baghestanian and Popov (forthcoming), this is the "one good journal model."

with α ideally being close to 1.[4] If she does not reject a bad paper, she forwards it to referees for further review.

The editor most likely forwards good papers for review by referees, but there is room for misjudgment here, that is, a small probability of summarily rejecting good papers, to which we refer as a "type I error":

$$\Pr(\text{Desk Reject } |e > 0) = \beta$$

with β ideally being close to zero. Naturally, $\alpha > \beta$. Next, upon receiving a paper for evaluation from the editor, the referees reject a good paper with probability d_1 and reject a bad paper with probability d_0 :

$$\begin{aligned}
\Pr(\text{Referee Reject } |e = 0) &= d_0 \\
\Pr(\text{Referee Reject } |e > 0) &= d_1 \\
d_0 &> d_1
\end{aligned}$$

A good paper might be rejected with probability s :

$$s = \Pr(\text{Reject}|e > 0) = \beta + (1 - \beta) d_1$$

However, a bad paper is more likely to be rejected—an increased probability of $c > 0$. In particular:[5]

$$c = \Pr(\text{Reject}|e = 0) - \Pr(\text{Reject}|e > 0) = \alpha + (1 - \alpha) d_0 - \beta - (1 - \beta) d_1$$

[4] α is a measure of the "power" of the test, as $1 - \alpha$ is the probability of committing a type II error (accepting a bad paper).

[5] Since $\alpha > \beta$ and $d_0 > d_1$, we see that $(1 - \beta) / (1 - \alpha) > 1$ and $(1 - d_0) / (1 - d_1) < 1$. Alternatively,

An increased level of precision in the editorial process occurs with a greater ability of editors to identify bad papers (higher α and lower β) and a greater ability of referees to distinguish bad papers from good papers (a higher rejection rate of bad papers by referees, d_0, and a lower rejection rate of good papers by referees, d_1).

2.3 Effort Determination

The structure of incentives for researchers and determination of their effort follow the model of involuntary unemployment by Shapiro and Stiglitz (1984). In particular, a researcher's decision to invest effort will be induced and maintained by the wage gap between researchers and teachers (i.e., between tenure-track and non-tenure-track academics).

A researcher who is not investing enough effort into his research work is labeled nR, which stands for "non-research." The probability of a teacher joining the tenure track for research is ρ. The expected lifetime utility of a good researcher (one who invests effort in writing papers), as inferred from the fundamental asset equation, is given by:

$$\begin{aligned} V_R &= \frac{(w-e) + sV_T + (1-s)\,V_R}{1+r} \\ V_R &= \frac{w-e+sV_T}{r+s} \end{aligned} \tag{1}$$

where $w-e$ is the instantaneous utility and V_T is the expected lifetime utility of a teacher,

$(1-\beta)\,/\,(1-\alpha) > (1-d_0)\,/\,(1-d_1)$. Rearranging the equation, $(1-\beta)\,(1-d_1) > (1-\alpha)\,(1-d_0)$, or $\alpha + (1-\alpha)\,d_0 - \beta - (1-\beta)\,d_1 = c > 0$.

to which a good researcher turns with probability s, representing the likelihood that the researcher's good paper is rejected. With probability $1-s$, he keeps his tenure-track job. The discounted expected lifetime utility of the non-research (nR) track is similarly defined:

$$\begin{aligned} V_{nR} &= \frac{w+(s+c)\,V_T+(1-s-c)\,V_{nR}}{1+r} \\ V_{nR} &= \frac{w+(s+c)\,V_T}{r+s+c} \end{aligned} \tag{2}$$

Of note, the tenure-track academic who does not invest enough effort into his research faces a higher probability (by $c>0$) of being moved from a tenure-track position to a teaching, non-tenure-track job. Likewise, we define the lifetime utility of the non-tenure-track academic:

$$\begin{aligned} V_T &= \frac{\bar{w}+\rho V_R+(1-\rho)\,V_T}{1+r} \\ V_T &= \frac{\bar{w}+\rho V_R}{r+\rho} \end{aligned} \tag{3}$$

The non-tenure-track academic has an instantaneous utility from teaching of $\bar{w}$ and faces a probability of ρ of obtaining a tenure-track job and thus proceeding with its utility of V_R.[6] Otherwise, with probability $1-\rho$, the academic remains in his non-tenure-track teaching job.

[6] This assumes that, in equilibrium, those who join the tenure track start immediately as good researchers—that is, they do not even consider the option of not investing effort in research. This is true given the "research effort condition," to be defined shortly. However, the same result can be achieved in two steps: first, one can assume an intermediate step of V_{tt} for joining the 'tenure track,' and second, this can be proven to be equal to V_R.

The researcher will choose to invest effort in his work if and only if doing so brings him higher lifetime utility. In other words, the following condition must be satisfied:

$$V_R \geq V_{nR}$$

which we call the *research effort condition (REC)*. Isolating V_T and substituting the relevant terms into the REC condition yields:

$$w \geq \hat{w} = \bar{w} + \frac{e}{c}\left(c + r + s + \rho\right)$$

In the steady state, the number of people who change jobs from the tenure track to the non-tenure track (with probability s) is equal to the number of people who change jobs from the non-tenure track to the tenure track (with probability ρ):

$$\rho\left(P - R\right) = sR.$$

Note that this implicitly assumes that, in equilibrium, all researchers will be investing effort—given that they satisfy the REC—and thus, the only source of being moved from a research tenure-track to a teaching non-tenure-track is the overall probability that their good papers are rejected, s. The frontier of the lowest wage to secure research effort in equilibrium is thus given by:

$$\hat{w} = \bar{w} + \frac{e}{c}\left(c + r + s\frac{P}{P - R}\right)$$

which is clearly increasing in R, the number of tenure-track academics. Using shares rather than absolute numbers of academics, this can be expressed as:

$$\hat{w} = \bar{w} + \frac{e}{c}\left(c + r + s\frac{1}{1 - \Omega}\right)$$

recalling that the share of tenure-track academics from the entire academic population P is $\Omega = R/P$.

Evidently, the instantaneous utility from working as a researcher, $\hat{w} - e$, is greater than $\bar{w}$ (the instantaneous utility from teaching) at all levels of employment. This maintains the desirability of tenure-track jobs at all levels of employment. Expressing c and s in terms of the model parameters determined in the publication process, the REC frontier becomes:

$$\hat{w} = \bar{w} + e + \frac{e}{\alpha + (1-\alpha)\, d_0 - \beta - (1-\beta)\, d_1}\left(r + \frac{\beta + (1-\beta)\, d_1}{1-\Omega}\right) \tag{REC}$$

2.4 Market Equilibrium and Comparative Statics

Market equilibrium occurs where the aggregate labor demand for tenure-track jobs, given by $w = F_R = \bar{w} + eg'(eR)$, intersects the REC frontier. This determines the wage of researchers such that

$$F_R = \bar{w} + e + \frac{e}{\alpha + (1-\alpha)\, d_0 - \beta - (1-\beta)\, d_1}\left(r + \frac{\beta + (1-\beta)\, d_1}{1-\Omega}\right)$$

which also determines the employment share of tenure-track academics, Ω. The remaining portion of workers, $1 - \Omega$, are employed as teachers with a wage $\bar{w}$ that is equal to their marginal productivity.[7] This equilibrium is depicted in Figure 2.

[7] If $g(eR)$ is a constant-returns-to-scale function, the marginal product of researchers will be equal to their average product, in which case the market equilibrium will coincide with the condition of maximal aggregate social welfare and will thus be deemed as socially optimal.

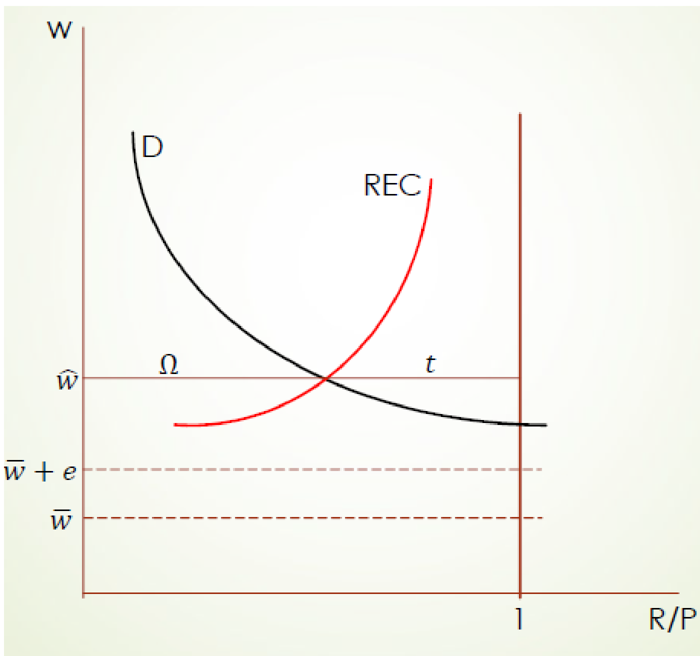

Figure 2: Tenure/Non-Tenure Market Equilibrium

As is clear from the graph, the wage of researchers $\hat{w}$ is higher than the wage of teachers $\bar{w}$ by more than e. It is also clear that, in equilibrium, the share of researchers does not converge to zero or one. In other words, in equilibrium, there is a nontrivial share of academics who serve in each track: non-tenure-track teachers as well as tenure-track researchers. Neither type of job is a priori dominating or completely crowding out the other. The wage gap between tenure-track and non-tenure-track academics is also maintained in equilibrium.[8]

Define the researcher-teacher (tenure-track vs. non-tenure-track) wage gap as $G = \hat{w} - \bar{w}$, so:

$$G = \Delta w = \frac{e}{c}\left(c + r + \frac{s}{1-\Omega}\right)$$

where $s = \beta + (1-\beta)\, d_1$ and $c = \alpha + (1-\alpha)\, d_0 - \beta - (1-\beta)\, d_1$. The effect of a change in the parameters of the model on the wage of researchers and, thus, the wage gap is easily verifiable. In particular, an increase in the discount rate, r; an increase in the required effort to produce good papers; and a decrease in the precision of the editorial process, corresponding to an increase in the probability of rejecting a good paper s, diminish the incentive for researchers to exert effort and thus necessitate an increase in the wage gap (or a greater increase in the

[8] As graphed, if R/P approaches 1, corresponding to full employment of all academics as researchers, the wage of researchers and, thus, the wage gap will need to approach infinity for researchers to exert effort in the steady state. Alternatively, lower wages will pull R/P down toward zero such that most academics are teachers (or non-tenure-track academics); the wage under this condition will be slightly higher than $\bar{w} + e$, where the academic will be indifferent between investing effort in research and only teaching.

wage of tenure-track faculty relative to that of non-tenure-track faculty):

$$\begin{aligned}
\frac{\partial G}{\partial r} &= \frac{e}{c} > 0 \\
\frac{\partial G}{\partial e} &= \frac{c + r + s/\left(1-\Omega\right)}{c} > 0 \\
\frac{\partial G}{\partial s} &= \frac{e}{c\left(1-\Omega\right)} > 0
\end{aligned}$$

Such changes shift the REC curve upward while leaving the research labor demand unchanged, resulting in an increase in the wage gap, G, and a decrease in the share of tenure-track faculty.

On the other hand, an improvement in the editorial process—such that editors increase their desk-rejection rates of bad papers and referees increase their rejection rates of bad papers that were not desk-rejected by the editor—increases the incentive for researchers to exert effort and thus contributes to a smaller wage gap and a higher share of tenure-track positions in academia (increasing Ω).

In terms of the terminal parameters of the publication process, α, β, d_0, and d_1 (representing the probabilities of editors desk-rejecting bad papers, editors desk-rejecting good papers, referees rejecting bad papers sent for review, and referees rejecting good papers sent for review, respectively), the wage of researchers, or the researcher-teacher wage gap, responds in the following manner:

$$\begin{aligned}\frac{\partial G}{\partial \alpha} &= \frac{e\left(d_0-1\right)\left[r\left(1-\Omega\right)+\beta+\left(1-\beta\right)d_1\right]}{\left(1-\Omega\right)\left[\alpha+\left(1-\alpha\right)d_0-\beta-\left(1-\beta\right)d_1\right]^2}<0\\ \frac{\partial G}{\partial \beta} &= \frac{e\left(1-d_1\right)\left[r\left(1-\Omega\right)+\alpha+\left(1-\alpha\right)d_0\right]}{\left(1-\Omega\right)\left[\alpha+\left(1-\alpha\right)d_0-\beta-\left(1-\beta\right)d_1\right]^2}>0\\ \frac{\partial G}{\partial d_0} &= \frac{e\left(\alpha-1\right)\left[r\left(1-\Omega\right)+\beta+\left(1-\beta\right)d_1\right]}{\left(1-\Omega\right)\left[\alpha+\left(1-\alpha\right)d_0-\beta-\left(1-\beta\right)d_1\right]^2}<0\\ \frac{\partial G}{\partial d_1} &= \frac{e\left(1-\beta\right)\left[r\left(1-\Omega\right)+d_0+\left(1-d_0\right)\alpha\right]}{\left(1-\Omega\right)\left[\alpha+\left(1-\alpha\right)d_0-\beta-\left(1-\beta\right)d_1\right]^2}>0\end{aligned}$$

Once again, increasing the precision of the editorial process on the part of referees and, especially, editors (increased α and d_0 and reduced β and d_1) contributes to a smaller wage gap and increases in the amount of good research and the share of tenure-track academics, thus improving the overall welfare of society.

3 Stylized Trends and Basic Calibration

There has been a noticeable increase in full-time and part-time non-tenure-track positions in academia at the expense of tenure-track positions in recent decades (AAUP 2017). Moreover, the wage gap between tenure-track/tenured professors and non-tenure-track contingent faculty has continued to increase, as shown in Figure 3.

Plotting, for example, the wage gap between tenure-track assistant professors and instructors and their non-tenure-track counterparts against the share of tenure-track faculty in American universities and colleges in the last four decades yields a curve that seems to track the demand curve for tenure-track jobs, as shown in Figure 4.

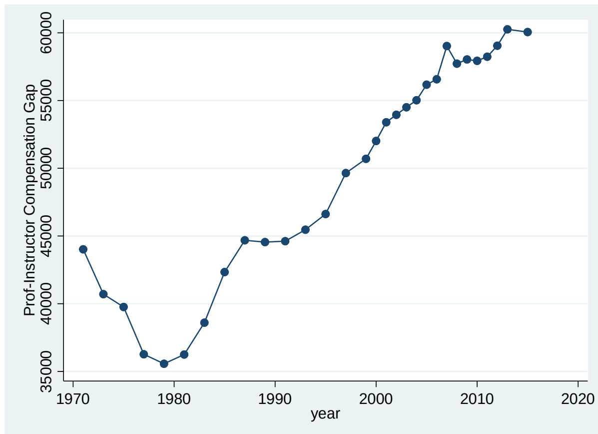

Figure 3: Assistant Professor/Instructor Wage Gap

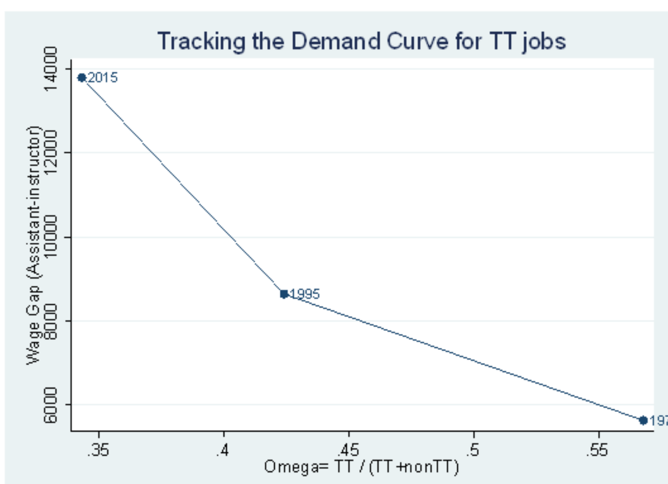

Figure 4: The Demand for Tenure-Track Jobs

An event that is likely consistent with these stylized facts—diminishing tenure-track jobs, decreasing Ω, an increasing wage gap G, and an increasing wage of researchers $\hat{w}$—is an upward shift in the REC curve. Given the comparative statics shown above, one concludes that a combination of the following may have happened: an increase in the discount rate r, an increase in the effort in producing good research e, an increase in the probability of rejecting good papers, and a decrease in the ability to detect bad papers.

While a combination of all these changes might have been occurring, the change in the interest rate is less likely, given the actual decrease in the national interest rates in the last four decades. The increase in the effort needed to produce good research is, however, a very likely candidate and is indeed well-documented in the literature (Ellison 2002; Card and DellaVigna 2013; Berk, Harvey, and Hirshleifer 2017).

The trends are also consistent with the hypothesis of a declining precision of the editorial process in academic journals. In particular, good papers are being rejected at an increasing rate, which is driven by artificial space constraints imposed by commercial publishers or by the desire of editors to increase the apparent quality of their journals: "Surely a journal with an acceptance rate of 5% is higher quality and more prestigious than one with a rate of 20%." (p.7, Conley 2012). As implied by our model, this can go a long way in explaining the eroding share of tenure track jobs in academia.

3.1 An Example from Economics

Assuming that in a pre-steady-state situation, at some disequilibrium point, there are p researchers who produce papers with effort $e > 0$ and $(1 - p)$ researchers who do not invest effort, the overall probability of desk rejection (DR) of papers by editors is given by:

$$\begin{aligned} \Pr(DR) &= \Pr(DR|e = 0) \times \Pr(e = 0) + \Pr(DR|e > 0) \times \Pr(e > 0) \\ &= \alpha(1 - p) + \beta p \end{aligned}$$

Likewise, the overall probability of referee rejection (RR) is given by:

$$\Pr(RR) = d_0 (1 - \alpha)(1 - p) + d_1 (1 - \beta) p$$

As is clearly seen, the observed desk-rejection rate—which is usually public information that is reported by most journals, at least journals in economics—is a function of not only the amount of bad papers but also of the percentage of high-quality researchers in the profession or the editors' beliefs about this percentage. From the reported shares of desk rejections and referee rejections, therefore, we cannot identify the parameters of the model: α, β, d_0, d_1, and p. In the steady state, however, given that researchers satisfy the REC, we know that $p = 1$: there are no tenure-track academics who do not invest effort. In this case, $\Pr(DR) = \beta$, and $\Pr(RR) = (1 - \beta) d_1$.

In Figure 5 below, we report the rates of desk rejection and referee rejection, which have been gleaned from the reports of the editors of the American Economic Review (AER) over the last decade.

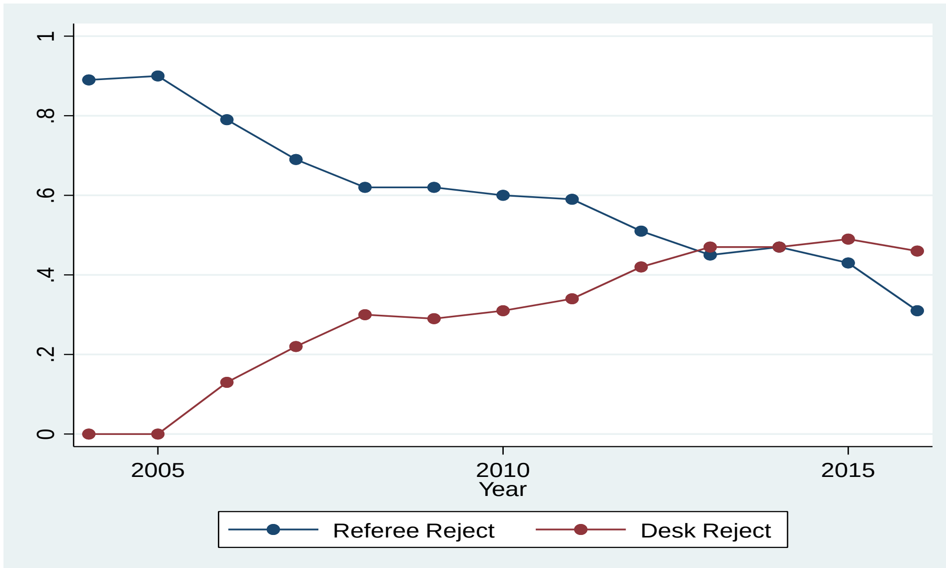

Figure 5: Referee and Desk Rejection Rates at the American Economic Review

Assuming that the profession is now at or near its steady state, we can assume that the overall reported probability of editors desk-rejecting good papers without seeking the input of additional reviewers and referees, β, and the probability of a referee rejecting a good paper that was not desk-rejected, d_1, can be identified as above; or, in the least, we can learn about the direction of change in these parameters.

Even if d_1 did not decrease, as might be inferred from the decline in the overall $\Pr(RR)$, and even if the current state does not precisely coincide with the steady state, the stark increase in the likelihood of desk rejection of papers might be partially attributed to an increase in β (the probability of desk-rejecting good papers). The simulation from the following subsection shows how such a circumstance can be detrimental to the tenure-track system in academia.

3.1.1 Simulated Comparative Statics

Assuming hypothetical values for the probability of rejecting good papers, s, and the probability detecting and rejecting a bad paper, $s + c$, we simulate the REC condition to calculate the likely percentage of tenure-track or tenured academic employees in the steady state. We use a subjective discount rate of $r = 10\%$. For an estimate of the effort needed to produce an article, e, we rely on estimates of the "value" of an article in the literature.

Tuckman (1976) conjectured that the differentials in rewards (salary) for publishing papers between different fields are due to the differentials in the costs of "article production." We thus take the reward for an article as a proxy for e, the effort of producing it. Sauer (1988) estimated that a standard article in the AER was worth \$723 in 1982 dollars (\$1798 in 2016 dollars, or a wage increase of approximately 2%).[9] The lifetime discounted value of this increase is equivalent to \$17980. Attema, Brouwer, and Van Exel (2014) estimated the "willingness to pay" for an AER paper to be \$12658 (an 8% wage increase). We use the latter, more conservative value for the simulation.

From the American Economic Association's universal questionnaire summary statistics (Scott and Siegfried 2017), focusing on PhD-granting institutions, we observe an average

[9] Incorporating the added value of citations, the reward was estimated to be \$1602 (\$3985 in 2016 dollars), representing a 3.8% increase in compensation at the time.

wage gap of \$68,948 between a tenured full professor and a tenure-track assistant professor.[10] Using this value as a proxy for the wage gap between a researcher and a teacher ($G = \hat{w} - \bar{w}$) and using the above figures as proxies for the amount of research effort, e, and the given subjective discount rate, r, along with different hypothetical probabilities of paper rejections, Figures 6 and 7 show the predicted share of tenure-track academics (Ω, or $\%R$) in equilibrium under different scenarios of editorial processes—in particular, the probability of referee rejection of good papers in the absence of a desk-rejection policy and with a good or bad desk-rejection policy. In addition to using the above values for the different parameters of the model in this simulation, we assume the probability of a referee rejecting a bad paper to be 0.9: $d_0 = 0.9$.

The first observation from these figures is that the increase in the likelihood of rejecting good papers decreases the share of tenure-track faculty in academia, at a supralinear rate. Eventually, the high probability of rejecting good papers does not justify the effort invested in producing these papers, leading to a complete annihilation of the tenure-track position in academia.

Figure 6 describes different scenarios of the good desk-rejection policy, that is, when the probability of editors desk-rejecting a good paper is zero: $\beta = 0$. Then, $\Pr(\text{Reject a good paper}) = \beta + (1 - \beta) \times d_1 = d_1$, where d_1 is the probability of a referee rejecting a good paper. Therefore, the probabilities on the x-axis of this figure can be simply viewed as the probabilities

[10] Between an associate professor and an assistant professor, the wage gap is \$20,052.

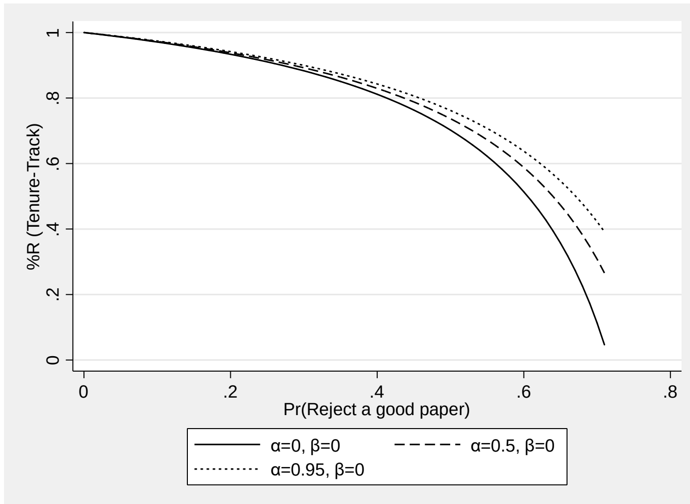

Figure 6: The share of tenure-track or tenured academics under different good desk-rejection policies

of referee rejection of good papers.

The solid line describes the benchmark case of no desk-rejection policy: $\alpha = 0$ (recalling that α is the probability of an editor desk-rejecting a bad paper). The dashed and dotted lines correspond to the cases in which the editors have the option of desk rejection: a good policy, when $\alpha = 0.5$, and a better policy, when $\alpha = 0.95$. Evident from the graph is the positive relationship between the ability of an editor to detect a bad paper and the share of tenure-track faculty in academia. Namely, when α increases, the tenure-track share frontier shifts upward, increasing the share of tenure-track faculty for each probability of referee rejection of a good paper.

Figure 7 outlines the cases of good and bad desk-rejection policies. A bad desk-rejection

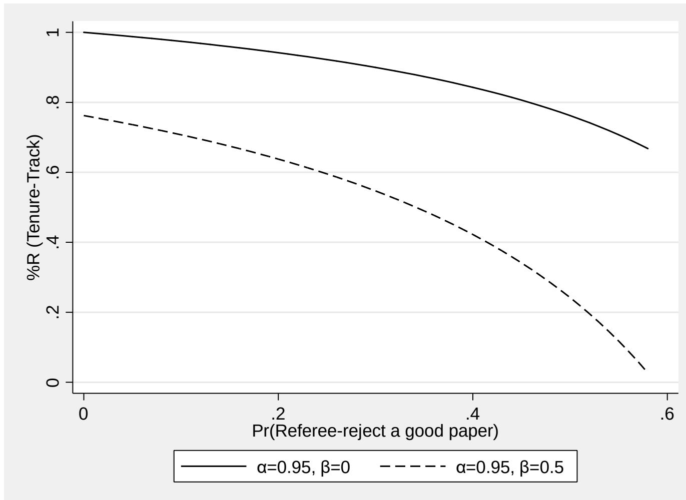

Figure 7: The share of R (TT) under good and bad desk-rejection policies

policy refers to the case where β, the probability of an editor desk-rejecting a good paper without seeking the advice of reviewers, is positive. Apparent from the figure is that a bad desk-rejection policy is associated with the diminishing role of the tenure system in academia. A higher probability of rejecting good papers is associated with a decreased share of tenure-track faculty, especially when the rejections are predominantly desk rejections. Put differently, the precision in the editorial process of discerning good papers from bad papers, both at the editor level and at the reviewer level, contributes to the share of hard-working tenure-track faculty in academia and thus contributes to the overall quality of teaching and research in academia.

Finally, note that an increase in e, the difficulty of conducting research, and a reduction in the wage of tenure-track academics reduce the share of tenure-track jobs in academia (a downward shift in the share frontier in the above figures). On the other hand, reasonable values of these parameters and an increased, albeit imperfect, precision and stability of the editorial process lead to an equilibrium in which tenure-track and non-tenure-track positions coexist in academia at nontrivial levels.

3.1.2 The Case of Economics Departments

The above rejection rates for the AER, in the relatively stable period of 2008-2011, if taken as a representative example of the field, cannot be made consistent with the steady state if this is defined as a case where $p = 1$ (that is, all tenure-track academics invest the needed effort and thus produce good papers). In that case, if editors never desk-reject good papers and always desk-reject bad papers and assuming that the probability of referees rejecting (good) papers is 0.5, we would expect the share of tenure-track employees to constitute approximately 76.5% of the economics academic labor force—much higher than its actual level.[11]

Moreover, the given rejection rates are not consistent with the assumption that editors are not susceptible to type I error (that is, desk-rejecting good papers) and type II error (not rejecting bad papers). The rejection rates from other periods support the same conclusion. The current state being contingent, that is, satisfying neither of these two extremes, we seek

[11] From the pool of tenure-track assistant professors and non-tenure-track academics in PhD-granting economics departments, the tenure-track assistant professors constituted 52.7% in 2010 (see Scott and Siegfried 2011).

to reconcile the figures with the likely state of nature.

Taking the above-mentioned rejection rates for 2010 (60% referee rejection, 30% desk rejection, see Figure 5) as an example, if we assume that referees always reject bad papers (i.e., $d_0 = 1$) and that editors make no type I errors ($\beta = 0$) but desk-reject bad papers with a probability of only 41% and given the 52.7% share of tenure-track assistant professors of economics (from the pool of tenure-track assistant professors and non-tenure-track economists in 2010; see Scott and Siegfried 2011), approximately 30% of academics actually invest effort in their research and produce good papers.

Taking the rejection rates of 2012 ($\Pr(DR) = 41.7\%$, $\Pr(RR) = 50.8\%$) and holding all the parameters as assumed above except for the share of tenure-track assistant professors, which was then 51.7%, the share of effort-investing academics would decrease to 22.5%, and the precision of editors in desk-rejecting bad papers (the power of the test, or α) would increase slightly to 53.8%.

However, the more likely scenario, more reasonably assuming that the share of effort-investing academics is stable at 30% over this short period of two years, is that the increase in the probability of type I error among the editors is greater than the decrease in the probability of type II error. Namely, the probability of desk-rejecting good papers has likely increased. If this rate persists, then the share of tenure-track academics will decrease to 27.1%. This scenario is more readily reconcilable with the observed constantly diminishing share of these positions. Equally consistent with these facts is the likely increase in the probability of referees rejecting good papers (type I error).

While gains in the profession might accrue from more precise, and more prompt, desk rejection of bad papers by the editors, a worrying sign is that these gains might be overshadowed by an increase in the probability of committing type I error, rejecting good papers, among both editors and referees. Taking the “cautious approach” by preferring the rejection of good papers to the acceptance of bad papers (or by simply increasing the rejection rate in general) is *not* a step in the right direction: it will likely diminish the number of hard-working academics and reduce the share of tenured and tenure-track faculty in academia, eventually decreasing the quality of research and teaching in institutions of higher education.

4 Conclusions

While tenured and tenure-track jobs had been the norm for a long time in academia, the share of tenured and tenure-track jobs has been declining in the last four decades. Full-time and part-time non-tenure-track jobs are increasingly replacing traditional tenure-track jobs. Based on the AAUP’s predictions and warnings, one can expect this trend to proceed unhampered up to the abolition of tenure in academia.

While ample motivations were offered in the literature to support either tenure-track or non-tenure-track contracts in academia, the coexistence of these two tracks was neither convincingly argued nor explained. A dominance of one track over the other, therefore, is the expected outcome under different circumstances.

The current study addresses both puzzles in that it explains and argues for the coexistence of these two tracks in universities and colleges. However, this study also points to the possibility that this coexistence is an equilibrium phenomenon: the trend of decreasing tenure-track jobs is not going to be indefinite. It postulates a nontrivial steady-state share of tenure-track (and non-tenure-track) jobs in academia.

The difficulty of producing academic research and the challenge of the academic publication/editorial process explain the changes in the composition of the academic labor force. The recent declining trend in the share of tenure-track academic jobs and the increasing wage gap between tenure-track and non-tenure-track jobs are consistent with the documented fact that academic research is becoming more difficult and are consistent with the likely increasing imprecision in the academic editorial process, as implied by our theory. This imprecision might be manifested in editors summarily rejecting good papers that would have survived the review process had they been forwarded to referees for additional evaluation and in the high level of arbitrariness in the review process and in the work of referees (as postulated by Berk, Harvey, and Hirshleifer 2017).

References

Aarssen, L.W. 2012. "Are peer-review filters optimal for the progress of science in ecology and evolution?" *Ideas in Ecology and Evolution* 5:9–12.

American Association of University Professors. 2017. "Visualizing Change: The Annual Report on the Economic Status of the Profession, 2016-17." *Academe* 103(2): 4-26.

American Association of University Professors. 1992. "On the status of non-tenure-track faculty." *Academe* 78(6): 39-48.

American Psychological Association. 2017. "Summary report of journal operations, 2016." *American Psychologist* 72(5): 499-500.

Attema, Arthur E.; Brouwer, Werner B. F.; and Van Exel, Job. 2014. "Your right arm for a publication in AER?" *Economic Inquiry* 52(1): 495-502.

Baghestanian, Sascha and Popov, Sergey V. forthcoming. "On Publication, Refereeing, and Working Hard." *Canadian Journal of Economics.*

Baron, James N., and Kreps, David M. 1999. *Strategic human services: Frameworks for general managers.* New York: Wiley.

Berk, Jonathan B.; Harvey, Campbell R.; and Hirshleifer, David. 2017. "How to Write an Effective Referee Report and Improve the Scientific Review Process." *Journal of Economic Perspectives* 31(1): 231-44.

Bhagwati, Jagdish, and O'Flaherty, Brendan. 2001. "Professors who defend tenure: Are they hypocrites?" *Chronicle of Higher Education* B24.

Brogaard, Jonathan; Engelberg, Joseph; and Van Wesp, Edward. 2018. "Do Economists Swing for the Fences after Tenure?" *Journal of Economic Perspectives* 32(1): 179-194.

Card, David, and DellaVigna, Stefano. 2013. "Nine Facts about Top Journals in Economics." *Journal of Economic Literature* 51(1): 144-61.

Carmichael, H. Lorne. 1988. "Incentives in Academics: Why Is There Tenure?" *Journal of Political Economy* 96(3): 453-472.

Cater, Bruce; Lew, Byron; Smith, Barry. 2008. "A Theory of Tenure-Track Contracts." *Education Economics* 16(2): 203-218.

Chen, Zhao; Lee, Sang-Ho. 2009. "Incentives in Academic Tenure under Asymmetric Information." *Economic Modelling* 26(2): 300-308.

Conley, John P. 2012. "Low acceptance rates, commercial publishing, and the future of scholarly communication." *Economics Bulletin* 32(4): A37.

DiPiro, Joseph T. 2013. "Acceptance and rejection of manuscripts for publication in the American journal of pharmaceutical Education." *American Journal of Pharmaceutical Education* 77(4): 66.

Ehrenberg, Ronald G. 2004. "Prospects in the Academic Labor Market for Economists." *Journal of Economic Perspectives* 18(2): 227-238.

Ehrenberg, Ronald G.; Zhang, Liang. 2005. "Do Tenured and Tenure-Track Faculty Matter?" *Journal of Human Resources* 40(3): 647-659.

Ellison, Glenn. 2002. "The slowdown of the economics publishing process." *Journal of Political Economy* 110(5): 947–993.

Figlio, David N.; Schapiro, Morton O.; and Soter, Kevin B. 2015. "Are tenure track professors better teachers?" *Review of Economics and Statistics*, 97(4): 715-724

Hattie J. & Marsh H. W. (1996). "The relationship between research and teaching: A meta-analysis." *Review of Educational Research* 66 (4): 507-542.

Hattie J. & Marsh H. W. (2004). One journey to unravel the relationship between research and teaching. Paper presented at Research and Teaching: Closing the Divide? An International Colloquium, Winchester, March 18-19.

Kasper, Hirschel. 1986. "On Understanding the Rise in Non-Tenure Track Appointments." WP-Working Papers (Industrial Relations Section, Princeton University).

Kimmitt, Michael C. 2009. "A Model of Adjuncts in Higher Education." *Economics Letters* 105(1): 68-70.

Nature Editorial. 2012. "A decade in numbers." *Nature Materials* 11: 743-744.

Popov, Sergey V. 2015. "Tenure-Track Contract Helps Self-Selection." *Economics Bulletin* 35(4): 2482-2486.

Sauer, Raymond D. 1988. "Estimates of the returns to quality and coauthorship in economic academia." *Journal of Political Economy* 96(4): 855-866.

Scott, Charles E., and Siegfried, John J. 2017. "American Economic Association Universal Academic Questionnaire Summary Statistics." *American Economic Review: Papers & Proceedings* 107(5): 678-680.

Scott, Charles E., and Siegfried, John J. 2011. “American Economic Association Universal Academic Questionnaire Summary Statistics.” *American Economic Review: Papers & Proceedings* 101(3): 664-667.

Shapiro, Carl; Stiglitz, Joseph E. 1984. “Equilibrium Unemployment as a Worker Discipline Device.” *American Economic Review* 74(3): 433-444.

Tuckman, Howard P. 1976. *Publication, Teaching, and the Academic Reward Structure.* Lexington, Mass.: Heath.

Wardle, David A. 2012. “On plummeting manuscript acceptance rates by the main ecological journals and the progress of ecology.” *Ideas in Ecology and Evolution* 5: 13-15.

Zhang, Liang; Ehrenberg, Ronald G.; Liu, Xiangmin. 2015. “Changing Faculty Employment at Four-Year Colleges and Universities in the United States.” *NBER* No. 21827.