On Publication, Refereeing, and Working Hard*

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September 17, 2015

Abstract

We present a model for academia with heterogeneous author types and endogenous effort to evaluate recent changes in the publication process in Economics. We analyze the implications of these developments on research output. Lowering the precision of refereeing signals lowers the effort choices of intermediate ability authors, but invites more submissions from less able authors. Increasing the number of journals stimulates less able authors to submit their papers. The editor can improve the journal's quality pool of submitted manuscripts by improving the precision of refereeing, but not by lowering acceptance standards. The submission strategy of an author is informative of his ability.

Keywords: academia, publishing, effort, refereeing, journals.

JEL: I23

1 Introduction

The publication process in Economics has changed significantly in recent decades. New journals have emerged, both general-interest and field-specific. More authors submit their papers for publication, and acceptance rates have gone down significantly. Submitted manuscripts have increased in length, the number of authors per paper has risen, and more time is spent on revising before acceptance. The evaluation of the costs and benefits

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of these changes for the profession in general requires understanding of how the authors' incentives have changed.

The problem of intermediated screening, where principals evaluate the output of agents, who spend effort on improving their products, is more general than the publication environment, but our model is parsimonious enough to provide intuition for similar economic decision-making environments. Examples include salesmanship, matrimonial decisions, venture financing, running for elections and job interviews. All the changes in the publication process that we study, such as changes in the quantity of opportunities, collaboration, competence of the decision-maker, and others, directly translate into other problems of intermediated screening. Since we—the authors as well as many of the readers of this paper—are familiar with the academic publication market, for illustrative purposes we frame our model to fit this specific environment.

We propose a model of *academia* in which authors with heterogeneous abilities decide whether to submit their research for publication to different journals. The decision to submit interacts with the editor's rule of acceptance based on the quality of articles as perceived by referees. Authors put effort into improving the quality of their manuscripts, which benefits acceptance chances.

Using our baseline model, we can represent most of the changes on the publication market mentioned above by varying the observable institutional parameters, ranging from the relative importance of noise in the refereeing process and increased competition among journals to changes in quality standards. We show that our heterogeneous author types are affected differently by changes in institutional settings, affecting individual effort and overall research quality. We find that if referees supply noisier reports, it encourages less able authors to submit their papers to journals for consideration, making competition harsher. Increased quality competition among journals increases the effort and quality of the papers submitted by more able authors, and reduces the quality of manuscripts and effort exerted by less able authors. The introduction of outside options, such as open-access journals, reduces the quality of research output. When a general interest journal competes with a specialized field journal, only the intermediate ability authors find it optimal to submit their manuscripts to field journals first. Coauthorship may improve the average quality of manuscripts, but only intermediate ability authors collaborate.

Following the literature review, we outline our baseline model, where authors choose between submitting their paper to a selective journal, or sending it off to an unread journal for certain publication. Then we extend our model to account for the possibility of writing multiple papers, coauthorship and sequential submission to multiple selective journals. Finally, we outline the informational content of the publication decisions, and conclude.

1.1 Literature Review

Since publications are among the most important factors regarding decisions on scientific development and career-related questions, there exists a thriving literature on the academic review process. We summarize the main results from this literature below.

Hamermesh (2013) analyzes publication data from the past sixty years. He finds significant changes in the methodology of published papers and a substantial increase in the number of authors per paper. Card and DellaVigna (2013) present a collection of stylized facts regarding trends in the academic publication market. The authors report that annual submissions to top journals in Economics have doubled since the 1970s but the total number of articles published in the same journals has declined, thereby reducing acceptance rates from around 15% to 6%. The length of research articles has tripled and the number of authors per paper has increased significantly. The authors assert that their insights are consistent with an increase in quality competition among economists in recent decades. Ellison (2002b) investigates trends in the academic review process and finds a substantial slowdown in turnaround times in the past 30 to 40 years (from 6 months to about 24 months) in top economic journals. He concludes that most of the slowdown is generated by shifts in social norms and increased competition in quality. Ellison (2011) stresses the impact of "outside" options such as the internet or open access journals on the refereeing and publication process, suggesting that the role of journals in disseminating research has been reduced. His results indicate that the existence of outside options lowers the attractiveness of high end authors to go through the peer review process.

The following empirical results are generally agreed.

Editors are active Laband (1990) analyzes the editorial decision making process in five top Economics journals. While editors are found to be concerned with maintaining and improving the quality of papers published in their journals, he also finds that the screening process is by and large inefficient. Laband and Piette (1994) investigate the impact of editorial favoritism on the publication process. They find that favoritism may increase efficiency, but it also increases the variance in quality of published articles.[1]

[1] Medoff (2003) argues that connected authors choose to publish their better papers at journals where their friends are editors.

Referees screen In Laband (1990), more frequently cited papers tend to have longer referee reports. Hamermesh (1994) presents various stylized facts about the refereeing process in Economics such as the matching of well known authors to better referees (positive sorting) and the general slowdown in the submission-acceptance times in top Economics journals. He also finds that monetary incentives may speed up the review process. Azar (2005) focuses on the first response times of journals and suggests that the observed slowdown in first-round turnaround times could be socially beneficial, since the effort costs of referees could have increased over time. Welch (2014) estimates the noise part in referee signals to be about twice as large as the common part.

Author identity matters Blank (1991) compares single- versus double-blind peer review systems via a randomized experiment using manuscripts submitted to the *American Economic Review*. Acceptance rates are lower for almost all researchers except researchers from the top 5 departments (who arguably are harder to anonymize), and reviewers are less constructive under a presumably more noisy double-blind peer review system. The decline in acceptance rate is strongest for authors from mid-ranked Economics departments. Bornmann (2011) provides a large scope overview over the academic refereeing process in different fields, finding mixed evidence of a gender bias. Baghestanian and Popov (2014) find evidence of significance of the authors' employment place and PhD program rankings on the publication success even for the top 100 authors in 6 areas of Economics.

Many relevant theoretical contributions are related to incentives in refereeing. Engers and Gans (1998) show that, when referees care about the journal's quality, monetary incentives may speed up refereeing, but may slow down the process of finding referees; this reduces efficiency and lowers journal quality. Chang and Lai (2001) show that it may be optimal for editors to incentivize referees in equilibrium if the referees gain reputation from the refereeing activity itself. Their results imply that higher quality journals find it less difficult to recruit referees, thus maintaining their quality advantage.

Author incentives were studied, too. Leslie (2005) shows that submission fees and slow turnaround times in high quality journals can increase journal quality by discouraging "long-shot submissions", and Cotton (2013) introduces author heterogeneity with respect to sensitivity to these tools in order to warrant the equilibrium usage of both. Atal (2010) derives conditions under which competition among journals lowers quality cutoffs for publications. Similarly, Barbos (2014) shows that two-sided informational incompleteness from the perspective of editors and that of authors may lead to a quantitative decrease in submitted papers.[2] Ellison (2002a) establishes the best policy of weighting the quality of the paper and efforts to satisfy editors rather than on a change in fundamentals on incentives for authors; moreover, our authors are heterogeneous. Taylor and Yildirim (2011) study the choice between blind and non-blind review, arguing that even though neither is dominant, the first provides ex-ante better incentives to authors, whereas the latter gives better ex-post paper selection. Oster (1980) and Heintzelman and Nocetti (2009) study the optimal submission sequence: the former is concerned with trading off faster publications against greater prestige, whereas the latter extend the results to risk aversion.

2 One Good Journal Model

In our baseline model, the *academia* consists of authors who submit their papers to a single journal for publication.

There is a continuum of *authors* of measure 1. Authors are heterogeneous with respect to their abilities θ: a paper produced by an author of type θ has innate quality θ. θ is distributed with a cumulative density function (cdf hereafter) $G(\cdot)$ and a continuous and strictly positive probability density function (pdf hereafter) $g(\cdot)$ with support $(-\infty, +\infty)$. Authors can spend effort e to boost their paper quality up to $q = \theta + e$, paying costs $c(e)$. The effort cost function is twice continuously differentiable, strictly convex and negligible at zero[3]: $c''(e) > 0$, $c(0) = 0$ and $c'(0) = 0$.

The *editor* would like to fill the journal with the best available papers, but she can only observe the quality of submitted papers with noise. That is, upon sending the paper of quality q to referees for evaluation, the editor receives a signal of $\tilde{q} = q + \alpha\varepsilon$, where α is a positive parameter representing the comparative importance of noise in the referees' evaluations, and ε is the paper-specific noise, distributed with cdf $F(\cdot)$, and twice differentiable pdf $f(\cdot)$, positive on full support[4] $(-\infty, +\infty)$. The editor then uses a cutoff rule: a paper is accepted for publication only if $\tilde{q}$ is larger than the exogenous threshold $\hat{q}$. The editor's mission is to maintain a standard; we discuss later what motivates this cutoff.

[2]Barbos (2014) investigates "project" submissions from a more general perspective, but the adaptation of the problem into the academic publishing process is straightforward. All intuition from our results in the publication framework is retained in this more general "project" submission framework.

[3]In proofs, we never use the assumption that $c(0) = 0$. For a single journal framework, one can incorporate submission costs by assuming that $c(0) = \bar{c} > 0$. In the case of many journals, submission costs can be incorporated in the spirit of Heintzelman and Nocetti (2009).

[4]Results can be extended with technical caveats if errors have a bounded support.

The author's problem is twofold. Authors can attempt to submit their paper to the journal that has an audience (just *journal* hereafter). If the paper is accepted, the author scores 1 publication; we normalize the utility of this outcome to 1. If the paper is rejected, the author can send it to an all-accepting journal that has no readers (*bad journal* hereafter), and collect $\delta\bar{u} < 1$ of reservation utility, where $\delta \in [0,1)$ represents the time discounting costs, and $\bar{u} \in [0,1)$ is the payoff from having one more line in a CV. Alternatively, the author can send his paper to the bad journal immediately, and harvest $\bar{u}$ of utility. Thus, the author who attempts submission will choose effort based on maximizing

$$\overbrace{P(\theta + e + \alpha\varepsilon > \hat{q})}^{P(\text{accept})} + \overbrace{P(\theta + e + \alpha\varepsilon \leq \hat{q})}^{P(\text{reject})}\delta\bar{u} - c(e) = 1 - \overbrace{[1 - \delta\bar{u}]}^{>0} F\left(\frac{\hat{q} - \theta - e}{\alpha}\right) - c(e).$$

We are interested in studying the optimal policies of the authors: a collection of the author's self-selection cutoff level $\hat{\theta}$; and the author's effort choice level $e^*(\theta)$ such that

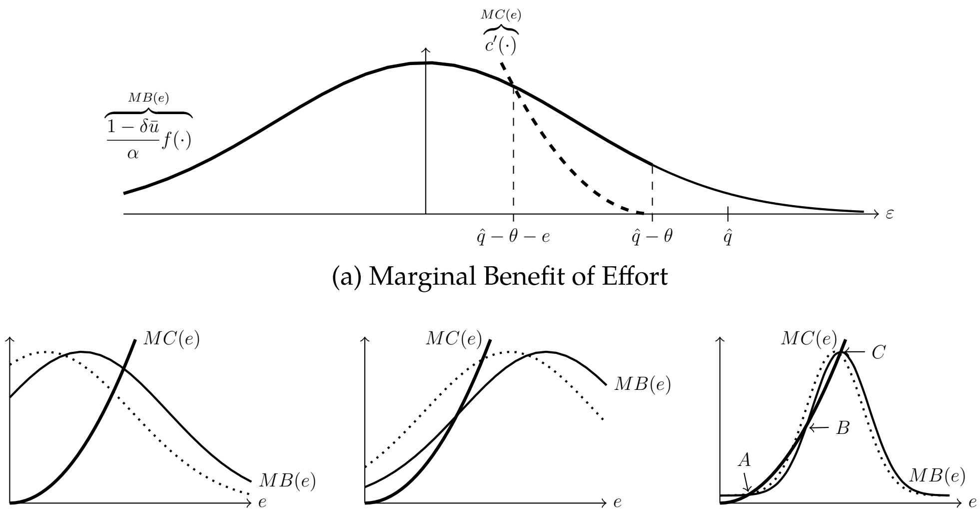
- $e^*(\theta)$ solves the Effort Choice Problem of the author whose ability is $\theta \geq \hat{\theta}$:

$$e^*(\theta) \in \arg\max_e \left\{1 - [1 - \delta\bar{u}] F\left(\frac{\hat{q} - \theta - e}{\alpha}\right) - c(e)\right\}.$$

- the author's self-selection cutoff level $\hat{\theta}$ is such that only authors of $\theta > \hat{\theta}$ find it optimal to submit their papers:

$$1 - [1 - \delta\bar{u}] F\left(\frac{\hat{q} - \theta - e^*(\theta)}{\alpha}\right) - c(e^*(\theta)) \geq \bar{u} \text{ iff } \theta \geq \hat{\theta}.$$

Below, we study the effects of the changes in an author's incentives driven by the fundamentals. We show that different authors have different responses to the same changes in fundamentals, both in magnitude and in the direction of change. The shape of the distribution of submitted papers' qualities, therefore, changes ambiguously on our level of generality of assumptions. While we could have restricted our assumptions for the ease of characterizing equilibrium effects (for instance, limiting ourselves to binary effort choices), we would lose the economically significant variety in an author's responses. We therefore focus on his incentives and responses to changes in other participants' actions in isolation from other participants' feedback. We reflect on the editor's feedback along the narrative path, along with a discussion of other potential stakeholders' reactions.



(a) Marginal Benefit of Effort

(b) High θ, one intersection (c) Small θ, one intersection (d) Two Intersections

Note: On Figures 1b–1d, the intersection of solid marginal benefit (MB) lines and dashed marginal cost (MC) lines represent the amount of effort chosen by authors of various levels of θ. Dotted lines represent the change of the marginal benefit due to an increase in θ. See Proof of Lemma 1 for the discussion of how Figure 1d conveys intuition that the jump in endogenous effort can only be upwards, from intersection A to intersection C.

Figure 1: Optimal Effort Choice

2.1 Effort Choice Problem

Consider an author with ability level θ who chooses effort level e. The first-order condition of this problem is

$$\left[\frac{1-\delta\bar{u}}{\alpha}\right] f\left(\frac{\hat{q}-\theta-e}{\alpha}\right) = c'(e). \tag{1}$$

The left-hand side of the equation represents the marginal benefit (MB) of the spent effort; the right-hand side represents the marginal cost (MC) of effort. Figure 1a illustrates this choice: each author, if not spending any effort, would submit a paper that would be rejected if $\varepsilon < \hat{q}-\theta$. If this author spends $\tilde{e}$ of effort, all referees' noise outcomes in $[\hat{q}-\theta-\tilde{e}, \hat{q}-\theta]$ region will no longer get the paper rejected. Because marginal benefit is not monotone, the maximum effort is exercised by authors of intermediate ability. For high θ, Figure 1b shows that an increase in ability θ will lead to a *lower* level of chosen effort, whereas for small θ, as on Figure 1c, an increase in ability θ will *increase* effort.

The necessary local second-order condition is

$$-\frac{1-\delta\bar{u}}{\alpha^2} f'\left(\frac{\hat{q}-\theta-e}{\alpha}\right) - c''(e) < 0. \tag{2}$$

This shows that the problem that we study is not necessarily convex. Figure 1d shows that there may be multiple maxima. However, the optimal effort is finite: even very great e cannot provide more than 1 unit of total utility, and for big enough e, $c(e) > 1$ by strict concavity. Moreover, since $f(\cdot) > 0$ and $c'(0) = 0$, zero effort is always suboptimal. Therefore, the effort choice is finite and upper hemicontinuous.

Assumption 1. *$f(\cdot)$ is single-peaked, with peak at 0, and ε has a finite mean.*

$f(\cdot)$ is single-peaked whenever $f(\cdot)$ is log-concave, which is a common assumption for "noise". This is not a necessary assumption for the following results, but it is a useful property that allows a concise characterization of many findings.

Let us denote with θ_0 the value of θ such that the quality of the paper written by an author with $\theta = \theta_0$ crosses $\hat{q}$:

$$\theta_0 : \begin{cases} \lim\limits_{\theta \to \theta_0 -} \theta + e^*(\theta) \leq \hat{q}, \\ \lim\limits_{\theta \to \theta_0 +} \theta + e^*(\theta) \geq \hat{q}. \end{cases} \tag{3}$$

Without jumps in $e^*(\theta)$ at $\theta = \theta_0$, this endogenously defined author type publishes his paper if and only if $\varepsilon > 0$. For symmetric $f(\cdot)$, such an author's chance to publish is $1/2$.

Lemma 1. *$e^*(\theta)$ is single-peaked.*[5] *If there are two solutions to the effort choice problem at $\check{\theta}$, $\lim_{\theta \to \check{\theta}-} e^*(\theta) < \lim_{\theta \to \check{\theta}+} e^*(\theta)$, so the "jumps" in $e^*(\theta)$, if any, are only upward. The maximum effort is exercised by an author with ability θ_0.*

Because of Lemma 1, many of the results discussed below hold even if $e^*(\theta)$ is not continuous, as in Figure 1d, including the following one.[6]

Lemma 2. *The quality of a submitted paper, $\theta + e^*(\theta)$, is increasing in type θ.*

2.2 Author's Best Response and Comparative Statics

In this subsection, we analyze the effects of changes in variables that are exogenous to an author's problem. The following result analyzes the effect of increased quality standards.

Proposition 1. *An increase in $\hat{q}$ increases the effort level of more able submitters ($\theta > \theta_0$) and decreases the effort level of less able submitters ($\theta < \theta_0$). The chance to publish and the utility of all authors go down.*

[5] Taylor and Yildirim (2011), Barbos (2014), and Grant (2014) obtain similar single-peakedness results.

[6] Hereafter, we omit caveats about situations when $e^*(\theta)$ suffers a jump in a specific point of interest: they are not generic, and they are handled similarly to the handling of issues with θ_0 in Lemma 1.

The intuition behind the previous result is straightforward. When it gets harder to publish, those who have good chances of publication ($\theta > \theta_0$) find it optimal to spend more effort to overcome some of the higher hurdles, whereas those who have lower chances of publication ($\theta < \theta_0$) simply give up.

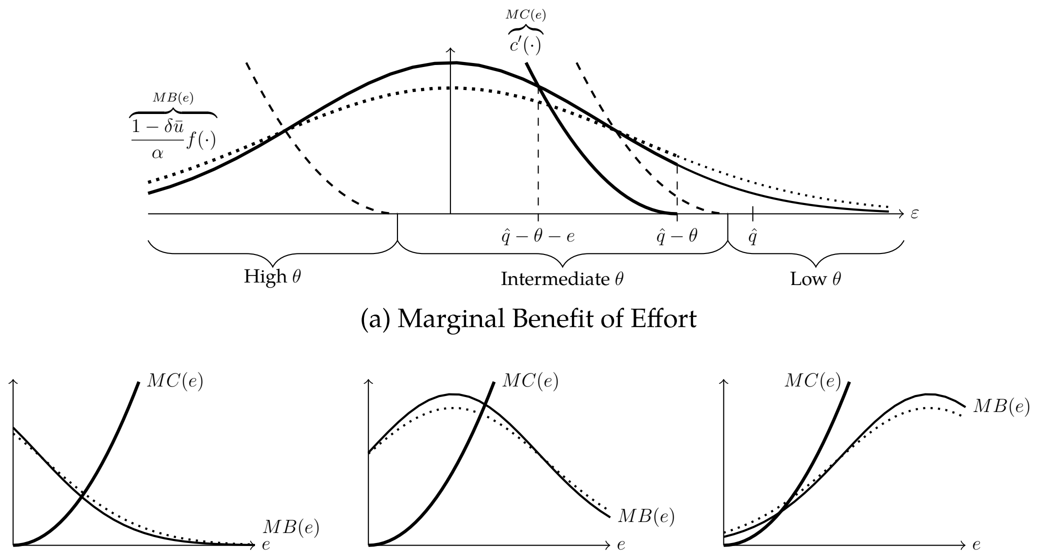
Empirically, it is hard to observe effort of those who seek publication. To empirically test our findings, one could use a proxy, such as the time between revisions, and study whether a change in the threshold (such as a change in the editorial board) changes the amount of time authors spend on revisions, and whether authors of higher ability, measured by recent citations or affiliation, behave differently from authors of lower ability. Quite a few authors, starting with Ellison (2002b), find that, on average, total time to revise comoves with lowering acceptance rates; finer data on individual revisions, along with proper handling of the nonlinearity of the effect, are necessary to test this proposition properly. Ignoring the nonlinearity might still provide an estimate of the average effect, but unaccounted nonlinearity would make it look less statistically significant than it is.

Proposition 2. *For almost every θ, an increase in $\bar{u}$ or δ reduces the effort level, lowers the chance to publish, but increases the utility of those who submit. More authors submit their papers if δ increases, and fewer authors submit papers if $\bar{u}$ increases.*

If the bad journal starts being more attractive, it cannot reduce the utility of authors. A higher payoff associated with a publication in the bad journal limits the losses if the paper is not accepted, making the expenditure of effort less attractive. A simultaneous increase of $\bar{u}$ and a decrease in δ cannot affect efforts, but lowers submissions. If we had modeled a submission fee explicitly, it would not have increased the benefits of publication directly, and hence would not have affected effort, but it would have lowered the participation of authors.

Even without heterogeneity with respect to comparative acuteness of monetary versus time costs (à la Cotton, 2013), the difference in the effects of time and monetary costs on endogenous effort and participation rates can create variability in the application of the two across disciplines, simply due to the difference in the relative importance of effort and submission pool size in different disciplines.

Empirically, large increases in $\bar{u}$ and δ, such as the award of tenure, should manifest themselves in lower effort, which would be hard to distinguish from the age effect (see Oster and Hamermesh (1998)); if, however, tenure leads to *no output*, particularly among those who were struggling to publish before, age is unlikely to be the cause.



(b) High θ (c) Intermediate θ (d) Low θ

NOTE: On Figures 2b–2d, the intersection of the solid Marginal Benefit (MB) line and the marginal cost (MC) line represents the effort choice for for the different values of θ. Dotted lines represent the change of the marginal benefit (MB) due to an increase in α. Dashed MC lines help determine the subregions of θ where the direction of change in effort is defined based on Proposition 3.

Figure 2: Change in Effort Because of the Change in Refereeing Quality

2.3 Refereeing Quality

Proposition 3. *For almost every θ, an increase in α:*

- *lowers the effort level for authors in the neighborhood of θ_0, endogenously defined by* (3);
- *increases the effort level for some author types above and some author types below θ_0 (in particular, high enough author types and low enough author types increase efforts);*
- *if $f(\cdot)$ is strictly log-concave, there exist $\check{\theta}_1$ and $\hat{\theta}_1$ where $\check{\theta}_1 < \theta_0 < \hat{\theta}_1$, such that effort decreases on $(\check{\theta}_1, \hat{\theta}_1)$, and increases on $(-\infty, \check{\theta}_1) \cup (\hat{\theta}_1, +\infty)$;*
- *lowers the expected utility from submitting papers for able authors ($\theta > \theta_0$), and increases it for less able authors ($\theta < \theta_0$).*

If $\hat{\theta} > \theta_0$, the quantity of submissions goes down; it goes up if $\hat{\theta} < \theta_0$.

Figure 2 illustrates the mechanism. Figure 2a mirrors Figure 1a, showing how the increase in α affects the marginal benefit component of authors' effort choice problems. When the noisiness of referees' evaluations increases, authors with very high θ face a higher chance of Type II error, and they increase their effort because the marginal cost of their effort is small, since they apply little effort; Figure 2b illustrates. But authors with very low abilities face a higher chance of acceptance due to an increase in Type I errors:

referees might provide very favorable reports to inferior papers, and the editor might publish such papers even if they were not very well written. These authors, simultaneously, do not exert much effort; thus, the marginal cost of effort for them is small. See Figure 2d for illustration. Only authors of papers with quality approximately equal to the editor's imposed threshold reduce their efforts (see Figure 2c). The marginal product of effort for these authors is smaller, because the same amount of extra effort compensates less noise, which leads to lower choices of effort.

A poorer quality of refereeing does not have to be detrimental for the total amount of effort exerted by authors; some authors may even find it optimal to increase effort.[7] In any case, increasing α makes submission a better opportunity for less able authors, and a worse opportunity for authors whose work is above the editor's threshold.

These insights provide a new possible explanation why referees, many of whom are prominent faculty with significant opportunity costs of foregone consulting, work on referee reports even though their pecuniary payoff from refereeing is meager. Poorer quality in referee reports hurts able authors in equilibrium, and referees in Economics journals are sophisticated enough to acknowledge this indirect effect. Demotivating less able authors from attempting submission will lower the amount of refereeing, which is another possible explanation.

One could test our predictions empirically if one could access the publication data for different outlets, as does Welch (2014), and measure the change of α over time. These data however are not readily available: most participants of the publication process prefer their communication to be discreet. One could, however, could estimate the distribution of quality of published papers over time, using citations from, e.g., 5 years after publication as a proxy for the paper's quality, and then compare the dynamics of density of this distribution in time, which, assuming little change in the remaining fundamentals, can hint at the change in α. A change in the lower tail of the distribution will be hardest to observe: the limit of at most zero citations is binding.

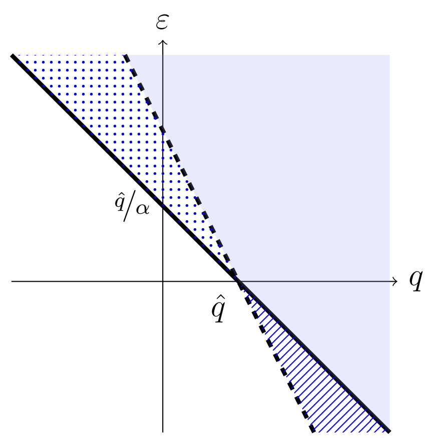
2.4 The Strategic Editor

Editors are strategic actors. Editors face constraints, such as journal capacity, limited refereeing resources, readership response to journal composition, and their own research time.

[7] Indeed, it can in principle be the case that all authors who attempt submission improve their efforts as a result of a decrease in α. However, if $f(\cdot)$ is symmetric, such outcome would require that authors who'd have a 50% acceptance chance choose not to submit their papers, which is not the case in Economics.

Our findings can be used to obtain predictions about editors' constraints. For instance, more submissions imply harder pressure on the capacity constraint if $\hat{\theta} < \theta_0$. Proposition 2 suggests that a decrease in δ will lead to more submissions; Proposition 1 suggests that lowering standards would not work to decrease submissions, so an editor who wanted to keep the same journal capacity would, as a response to either higher α or lower δ, *raise* the admission standard. However, beyond journal capacity concerns, the editor's response is somewhat harder to analyze.

One specifically interesting problem that an editor faces is to find appropriate reviewers. Improving the match of the referee's interests to the paper, the editor can effectively improve the quality of a referee's signal, α. Here we show that editors may have a strategic interest in perpetuating noise in the review process.



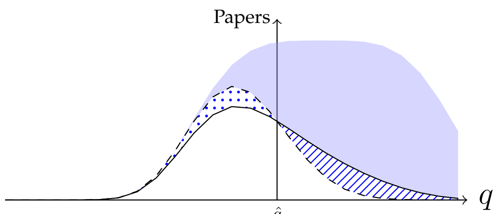
NOTE: The thick diagonal line shows the original acceptance threshold. Papers to the right of the thick line are accepted. The dashed line shows the acceptance threshold after a decrease in α. Areas shaded with are the papers that are accepted both before and after a decrease in α. Areas filled with depict the papers that get accepted after the decrease in α, but were not before; areas filled with are the papers which were accepted before, but not after.

Figure 3: Editor's Selection Process

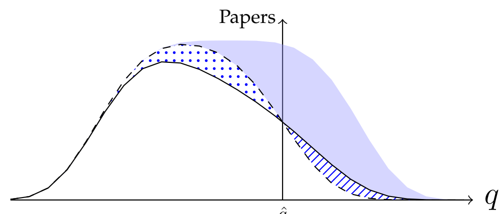
If an editor who wonders whether to spend more effort on picking better referees to lower α ignores the effect that he has on the effort choice of the authors $e^*(\cdot)$, the outcome is straightforward to characterize. The decrease in α always improves the resulting selection of θ. Figure 3 illustrates: an author with a paper of quality of $q = \theta + e^*(\theta)$ needs to obtain a sufficiently high signal from the referee to be above the thick diagonal line, and the lower is α, the steeper is the slope. Authors with a paper of quality $\hat{q}$ are unaffected, and authors with a paper of quality $q = 0$ need a much more favorable referee to pass the threshold. Clearly, filtering based upon signals with lower α produces a better distribution of $\theta + e^*(\theta)$ in the likelihood ratio sense, and, by the monotonicity of $\theta + e^*(\theta)$, a better distribution of θ as well. Therefore, if an editor cares only about selecting the most able authors, she will try to minimize noise in the refereeing process.

The editor, however, may also care about the effort exerted by authors, and hence about the quality of submitted papers. Indeed, higher total effort leads to an increase in quality, which may lead to more journal subscriptions. If the editor decreases α, then the most able authors, whom the editor is more likely to publish after lowering α, are also the authors who exert less effort. One can see that the capacity of the journal might matter in this context: in the case of Figure 4a, the mass of additional papers accepted by the journal (the area shaded with ⫽) can be larger than the mass of additional papers which are rejected (shaded with ::). The opposite holds for selective journals: see Figure 4b for comparison.

If the editor is strategic in the Stackelberg sense, she will also take into account the response of authors to changes in the referees' precision. In Figure 3, the editor anticipates that an increase in α will be accompanied by a change in the quality distribution of submitted papers. If the editor attempts to improve the signal's quality, he will face some reduction of effort among those authors who are significantly above the acceptance threshold, and some increase among those who are in the close vicinity of the threshold. Moreover, if the editor cares about the whole profession, not only about the journal, one can construct examples in which an increase in α results into an increase or a decrease in the total effort exerted by authors. The three ability areas in the support of θ, which respond differently to changes in α (see Proposition 3), translate into three areas in the equilibrium quality distribution, which are affected by changes in α. To illustrate the change, consider Figure 5a. The figure illustrates the relative changes, in comparison to the scenario in Figure 4a, if the editor anticipates that the effort choices of authors will be affected by a decrease in α. As illustrated in the figure, the shape of the paper quality distribution changes. Both Figures 5a and 5b show the same patterns. The new distribution of quality of submitted is shifted to the left, with a perturbation around the admission threshold, which is



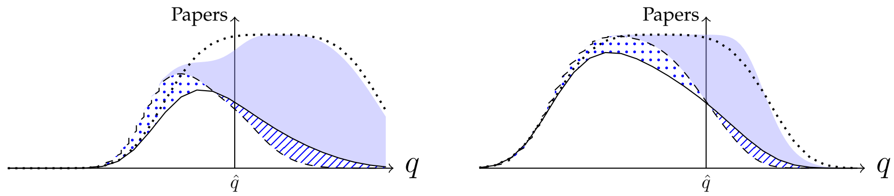
(a) Less selective journal (low $\hat{q}$)



(b) More selective journal (high $\hat{q}$)

NOTE: The figures show the effects of a decrease in α on the equilibrium quality distributions of accepted and rejected papers. The area which includes the black solid line and the shaded region is the overall quality distribution of papers. Areas shaded with are the papers that are accepted both before and after a decrease in α. Areas filled with ⫽ depict the papers that get accepted after the decrease in α, but were not before; areas filled with :: are the papers which were accepted before, but not after.

Figure 4: First-Order Changes in the Composition of Accepted Papers: Decrease in α



(a) Less selective journal (low $\hat{q}$) (b) More selective journal (high $\hat{q}$)

NOTE: Areas shaded with are the papers that are accepted both before and after a decrease in α. Areas filled with depict the papers that get accepted after the decrease in α, but were not before; areas filled with are the papers which were accepted before, but not after. Dotted densities denote the shape of the paper quality distribution before the change in α.

Figure 5: Strategic Editor Takes The Change in Effort into Account When Lowering α

governed by Proposition 3. Thus, a strategic editor may actually prefer a quite noisy refereeing process: the right tail of the paper quality distribution improves in the first-order stochastic dominance sense with refereeing noise. Editors with concave preferences over the published paper types might find that the paper quality distribution improves in the second-order stochastically dominating sense if the threshold for attempting to publish $\hat{\theta}$ is significantly above the lower critical author type that chooses the same level of effort in both more- and less-noise environments.

3 Applications

In the following applications we will normalize α to 1 except when we need it explicitly.

3.1 Two Good Journals, One Paper

Assume that, instead of one good journal, there are two good journals, indexed by 1 and 2. What are the implications of more competition between journals on authors?

SAME JOURNALS Assume that a publication in either journal yields 1 unit of utility to the author. Assume the editors apply the same standard $\hat{q}$ as they would use if they were in the framework with one journal, providing similar chances for publishing a the paper of quality q. Therefore, the only difference to the benchmark scenario is the possibility of resubmission.[8] Would the outcome discussed in Section 2 remain?

Authors submit papers to one of the journals for review; we will discuss simultaneous submissions later. If the editor of the chosen journal chooses to reject a paper, the

[8]This makes authors indifferent between two journals. However, the publication outcomes might be different: if all authors submitted first to Journal 1, Journal 2 would get only the rejects of Journal 1 in its submissions, and the average quality of published papers in two journals might be different.

paper is resubmitted[9] to another journal. We assume that editors do not treat first- and second submissions differently (for instance, always rejecting all papers which were not submitted to their journals as a first choice): after all, the editors know that the authors are indifferent between the two journals.[10] Rejection, however, is an informative signal, and editors would like to know about it, but since it is an unfavorable signal, authors do not, in practice, advertise prior rejections in cover letters. The editor in our two-period model can learn that the paper was once rejected by looking at the calendar, but editors in practice do not have a perfect signal about the quantity of prior rejections, and can only infer it from the relative rank of their journal: similarly ranked journals are likely to face similar prior journal submission pathways over time.

Authors who submit to Journal 1, and then to Journal 2, choose the effort to maximize

$$1 - F(\hat{q} - \theta - e) + F(\hat{q} - \theta - e)\delta\left(1 - F(\hat{q} - \theta - e) + F(\hat{q} - \theta - e)\delta\bar{u}\right) - c(e).$$

The author then compares the expected value to the outside option $\bar{u}$, and submits the paper if the former is larger. The author's submission strategy decision changes insignificantly: each author will either submit to one journal, and after rejection to another, or not submit at all.

The author's effort choice problem changes, too. We will retain $e^*(\cdot)$ to denote the optimal effort choice. The new first-order condition is

$$\left[1 - \delta + 2\delta F(\hat{q} - \theta - e)(1 - \delta\bar{u})\right] f\left(\hat{q} - \theta - e\right) = c'(e). \tag{1'}$$

Lemma 2 remains valid: the quality of a paper increases with the author's ability. This monotonicity result is helpful in characterizing the change in effort.

Proposition 4. *There is an ability level θ_1 such that, when comparing one-journal academia to two-journal academia, among the latter, effort is higher for authors with ability $\theta < \theta_1$ and lower for authors of ability $\theta > \theta_1$.*

[9] We omit the possibility of interim revision, since, by assumption, authors know the type of their papers, and can learn nothing from referee reports. Authors have no uncertainty about acceptance thresholds either. Inability to invest or disinvest efforts in between can be relaxed to obtain additional effects on effort allocation over time.

[10] If the noise about the paper quality ε was correlated across journals, the rejection in another journal would be informative for the author. We, however, want to minimize the change between the behavior of one editor and two editors, to concentrate on the effects that arise simply from two submission options instead of one. Having a lower standard for those who submit as a first choice, compensated by a higher standard for the re-submitters, can encourage some authors, and prevent some resubmissions, lowering the referee load, but can also admit papers of worse quality.

Even if the author gets an unfortunate review in the first round, his paper fails only if both reviews are unfortunate. Only authors with a small probability of publication might get motivated to exercise more effort. Since every author who found it optimal to submit his paper originally will still find it optimal to submit his paper when he has a chance to resubmit to another good journal, there will be more total submissions.

To test this proposition empirically, one could attempt to obtain data on time authors spend revising their papers, whether from editors of journals or from surveying authors themselves. At times when new journals appear (such as the *American Economic Journal* series from the AEA), one should expect a change in the efforts of authors who work in the relevant fields. The proposition above suggests that the effect will be different for authors of different ability, not only in magnitude but also in a sign; one could use properly normalized citations of solo papers by authors as a proxy for the author's ability.

The symmetric threshold outcome is unlikely to be stable generically: if the editor of Journal 2 by chance imposes a somewhat weaker admission threshold, authors would prefer to submit to Journal 2 first. The most important consequence of this outcome is that Journal 2 would have a better distribution of papers under consideration: after all, Journal 1 will get only those papers that were rejected by the referees of Journal 2. This will affect the readership, the refereeing load in both journals, and the reward from publication. Therefore, when there are two journals, they are likely to be different.

Different Journals Assume that a publication in Journal 1 yields 1 unit of utility to an author, and a publication in Journal 2 yields $\gamma < 1$ utility. The expected payoff of an author who submits to Journal 1 first, and to Journal 2 afterwards, is then

$$1 - F(\hat{q}_1 - \theta - e) + F(\hat{q}_1 - \theta - e)\delta\left(\gamma\left(1 - F(\hat{q}_2 - \theta - e)\right) + F(\hat{q}_2 - \theta - e)\delta\bar{u}\right) - c(e).$$

If editors apply the same standard $\hat{q} = \hat{q}_1 = \hat{q}_2$, providing the same chances for publication for an author whose paper quality is q, authors who find it optimal to submit their papers to Journal 2, find it worth submitting to Journal 1 too. The reverse is not true.

Proposition 5. *If $\gamma > \bar{u}$, the authors' ability space splits into three intervals: all authors from the lower ability interval abstain from submission; all authors from the highest ability interval submit their papers to Journal 1, followed by resubmission to Journal 2; and authors of intermediate ability interval submit to Journal 1 without attempting to resubmit to Journal 2 if they fail to publish in Journal 1. The intermediate interval is not empty if γ is not too high.*

While fairly few authors share the history of their attempts to publish their papers, a survey, or a CV-collecting web crawler, can reveal at least a part of it; proxying the ability with solo citations, affiliation, or collected awards would allow to study the differences. No paper, as far as we know, has tried to analyze resubmission patterns; editors and publishers themselves would be interested in an analysis of this kind.

Since we assume that ε is uncorrelated across journals, a new small but demanding journal with low payoff of acceptance can, in fact, obtain a better average quality of published papers than the equally demanding more prominent "old" journal. While it is true that the new journal's submissions will consist only of the rejections of the old journal, the support of submitters to the new journal will be narrower: authors of relatively low ability will abstain from resubmitting of their rejected papers. Lowering the admission standards will not help to attract able authors.

Proposition 6. *Let $f(\cdot)$ be log-concave. Consider a choice between*

- *Strategy 1: submitting first to Journal 1 (with payoff from publication of 1 and editor's threshold $\hat{q}_1$), and resubmitting in case of rejection to Journal 2 (with payoff $\gamma < 1$ and editor's threshold $\hat{q}_2 < \hat{q}_1$), and*

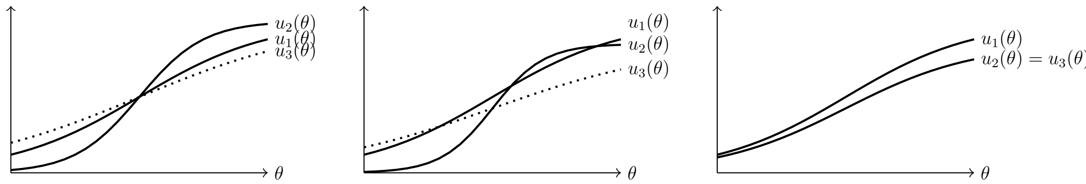
- *Strategy 2: submitting first to Journal 2, and resubmitting to Journal 1 in case of rejection.*

When Journal 2 has marginally lower admission standards and marginally lower payoff from publication, there is a unique type $\bar{\theta}$ such that all types $\theta < \bar{\theta}$ choose Strategy 2, and types $\theta > \bar{\theta}$ choose Strategy 1. This separation result is generically non-local.

Other options, such as submitting to one journal only before sending the paper off to a bad journal, are also possible, but are not relevant when differences in payoffs are small.

Field Journals To illustrate the decision making in submissions and resubmissions to a field journal, we modify the *different journals* framework to represent the journals' specialization. The referees in a journal are frequently authors in the same journal. At best, the editor in a general interest journal can provide an author with the same match of referees as in a specialized journal, but this is not in the interest of an editor of the general interest journal: this editor wants the paper to be understandable and interesting for a general audience. Therefore, the referees' noisiness in the field journal $\alpha_2 = \alpha$ is less than in the first journal: $\alpha_1 = 1 > \alpha$.[11]

[11] One can argue that top general-interest journals could use better referees than field journals do, because of the inherent multi-period game between the editor and the referees, so it is fair to assume that $\alpha > 1$. In



(a) $\alpha \lesseqgtr 1, \gamma = 1$ (b) $\alpha \lesseqgtr 1, \gamma < 1$ (c) $\alpha = 1, \gamma < 1$

NOTE: $u_1(\theta)$ is the expected payoff of submitting to a general interest journal. $u_2(\theta)$ is the expected payoff of submitting to a field journal with a maximum payoff of γ, but with a refereeing precision of $\alpha < 1$. $u_3(\theta)$ is the utility of submitting first to a field journal with the refereeing precision of $\alpha > 1$. Figure 6a represents the intuition of Proposition 3, Figure 6c represents the intuition of Proposition 5, Figure 6b shows the intuition of Proposition 7: what changes in Figure 6a if γ becomes slightly less than 1.

Figure 6: Field Journals as First Choice

Since the reduction in referees' noisiness improves the utility of submitters, able authors might be more interested in submitting their papers to field journals. However, since the payoff from publishing a paper in a field journal may be lower than that from publishing the same paper in a general interest journal (because the readership is lower, or because the tenure committee thinks so), the most able authors whose papers get published with a probability close to 1 would prefer a general interest journal. For less able authors, lower α is a deterrent for submission, so both effects, noisiness and payoff, discourage submission.

Proposition 7. *Among those who submit to both journals sequentially, even in cases of marginal difference, authors of low ability and authors of a high enough ability prefer to submit to the general interest journals first. If the difference in publication payoff (γ vs 1) is not too large compared to the difference in refereeing precision (α vs 1), some authors submit first to field journals. If $f(\cdot)$ is log-concave, there are two types, $\underline{\theta}$ and $\bar{\theta}$, such that all types $\theta \in (\underline{\theta}, \bar{\theta})$ submit first to the field journal, and all types from $(-\infty, \underline{\theta}) \cup (\bar{\theta}, +\infty)$ prefer to submit to general interest journal first.*

Submitting to only one journal, or not submitting at all, might be an even better strategy, but, when α is in the neighborhood of 1, one can invoke Proposition 5 to rule out single-journal strategies. Figure 6 illustrates: because $\gamma < 1$, all authors find submitting to a field journal worse than to the field journal when the precision of the field journal is as good as the precision of the general interest journal (Figure 6c). If $\alpha < 1$ but there is no penalty, the field journal becomes more attractive to able authors, which follows from Proposition 3 and is illustrated in Figure 6a. When both change together, there may be types for which the former effect is smaller than the latter, as in Figure 6b. The contribu-

the following, we study *small* differences between journals, assuming that both γ and α are close to 1; in this case, we believe, the intrinsic motivation based on authors' interest in their own fields dominates potential payoffs from befriending the editor of the general interest journal. Bardhan (2003), among others, is the source for our intuition. If one assumes that the field journal's α is > 1, one can establish a result similar to our Proposition 7: as long as the change in γ is not too large, authors separate into at least three groups.

tion of Proposition 7 is to demonstrate that these types, if they exist, constitute an interval if the difference between journals is not too big. The dotted lines in Figure 6 represent the case when the referees of the field journal are *less* precise than the referees of the general interest journal: the proof of Proposition 5 can be refurbished to demonstrate that, in this case too, there may be types who prefer to submit to the field journal first, but this would be a *different* interval.

Empirically, to test this proposition, one would need data about the submission sequences of authors published in both journals (from a survey of authors, from publishers, or from automated CV collection), and a proxy of authors' ability, such as solo paper citations. For junior colleagues, one can look at the first submission outlet for the job market paper (many candidates include it in their job market CVs) and attempt to correlate this with placement in 10 years, or any other measure of ability.

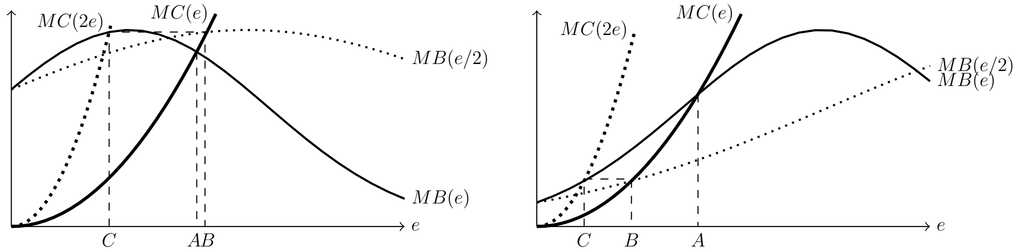
Simultaneous Submission In Economics, most journals explicitly require authors to claim that the article has not been submitted to other journals. In other areas of science, such as Law, this is not so. With our model, switching to simultaneous submissions will lower the time costs of the authors (more so if δ is further away from 1, or if the probability of acceptance in the first choice journal is low), and all authors would prefer to make simultaneous submissions, all else being equal. The editors will face competition for the best papers, enforcing lower turnaround times and competing for readership.

However, lowering the effective time costs will also lower authors' effort, and will increase the referees' workload—under sequential submission, all the papers accepted in the first journal are not considered by the editor in the second journal. This may not translate into reading each paper twice, since some referees of the first journal might get the same paper to referee for the second journal. Unless editors coordinate perfectly, simultaneous submission will increase the referees' workload. The overall payoff for the profession does not have to be higher as a result.[12]

3.2 Two Papers, One Journal

Many scholars, including present authors, produce more than one paper at a time. This allows them to apply their innate ability more than once per period, but requires spending more total effort. This can be interpreted positively (the simultaneously incepted papers

[12] There are other effects detrimental to the overall quality of the papers beyond the scope of our study (revision between submission rounds could be useful; the author might want to wait for the replies of all journals to pick the best, which increases the publication time; and so on).



(a) High θ (b) Small θ

NOTE: Point A represents the effort choice of writing a single paper. Point B represents the total effort when writing two papers, point C represents the effort per paper.

Figure 7: Effort when Writing Two Papers

do not have to be about the same topic) or negatively (salami slicing). Let us model the choice to author two papers at a time by postulating the payoff from writing two papers, spending e of effort per paper, to be[13]

$$2\left(1-(1-\delta\bar{u})F(\hat{q}-\theta-e)\right)-c(2e),$$

where we put in an implicit assumption that submitting two papers of equal quality provides a higher expected utility than submitting one paper of high quality and another of quality θ. This is true when $1-F(-x)$ is a concave function of x, which should hold when x is high, since $f(-x)$ has to decrease eventually, so that $\int_{-\infty}^{+\infty} f(x)\,dx$ has to be equal to 1. That is, able authors, of high $\theta+e$, are likely to split their efforts equally. In the same spirit, authors whose $\theta+e$ is small face a locally convex $1-F(-x)$. If this convexity is not dominated by the convexity of $c(e)$, the less able authors might want to submit two papers: one with a quality as if they were submitting only one paper, and another of quality θ. If these authors submit one paper, they will submit two: the second paper comes with no effort attached. This is also strictly better than submitting only one paper if $\bar{u}$ is small enough.

The first-order condition that characterizes $e_2^*(\theta)$, the effort choice when submitting two papers, is

$$[1-\delta\bar{u}]f(\hat{q}-\theta-e)=c'(2e). \tag{4}$$

Figure 7 compares incentives when choosing the effort level of writing one paper against incentives when choosing the effort level needed to write two papers. When writing one paper, authors equalize $MB(e)$ and $MC(e)$, two solid line curves, as on Figure 1a. Their intersection produces point A, showing on the abscissa the effort that is spent by an author of given ability when he chooses to write one paper. When writing two papers, authors

[13]The implicit assumption here is that writing two papers and sending them to a bad journal yields $2\bar{u}$ of utility. In case of salami slicing, the utility of having two identical papers unpublished is at most $\bar{u}$.

equalize the marginal benefit of spending effort on each paper, $MB(e)$, and the marginal cost of writing each paper, $MC(2e)$. Their intersection produces point C on the abscissa, which represents effort per paper, and it is clear that point C will always be below point A because $MC(2e) > MC(e)$ by the concavity of $MC(e)$. To evaluate the total effort spent by the authors who decide to write two papers, we use point B: it is the abscissa of the intersection of $MB(e/2)$ and $MC(e)$, and their intersection clearly coincides with double the effort represented by point C. Point B can be smaller or larger than point A: authors of high ability θ find that, when writing two papers, they may have a good chance to publish both, so they spend more total effort (see Figure 7a). This effect ensues when $MC(2e)$ curve intersects $MB(e)$ closer to its maximum than curve $MC(e)$, which happens for all θ large enough. At the same time, authors of low ability find that concentrating their efforts on one paper more than doubles their chances of publishing it, as in Figure 7b, the effect that can be observed when $MC(e)$ intersects $MB(e)$ closer to the maximum of $MB(e)$ than $MC(2e)$ does.

Proposition 8. *For almost every θ, authors who submit two papers spend less effort per paper than they would if they submitted only one paper. There is a $\bar{\theta}$ such that the total effort spent by any author of type $\theta > \bar{\theta}$ on writing papers is larger than the amount of effort spent when concentrating on one paper, and the reverse holds if $\theta < \bar{\theta}$.*

Effectively, if authors write multiple papers, from the point of view of the editor, it is as if there were more authors, each exercising less effort because the per-paper effort is more costly. Which authors prefer to submit a single paper, and which authors prefer to submit multiple papers?

The able authors, whose θ permits them to hope for a high chance of acceptance, will submit two papers, harvesting more than 1 in total expected payoff. The less able authors might find it optimal to submit only one paper, spend all their effort on it, and write the second one for the bad journal. The total submissions will increase, there will be more papers, so the right tail of the paper quality distribution may improve. The editor will have to either raise the acceptance standard or increase the journal's capacity (special editions). The first method will discourage submissions from the less able authors, but will, in general, hurt the utility of authors, in particular of those who author a single paper. The second method of handling paper proliferation will increase the referee load.

Empirically, an analysis of the CVs of freshly minted PhDs would reveal whether the market believes that writers of many papers are of high ability. Indeed, job market candidates frequently list their working papers in their CVs. According to our model, authors from higher ranked institutions, whose ability is unclear but who are between "high" and "medium", on average would have a job market premium for having more working papers; whereas authors from lower ranked institutions, whose ability is unclear but who are between "medium" and "low" would benefit from having *fewer* working papers on their CV. Again, simply running a linear regression on a clearly nonlinear relationship is likely to obtain an estimate of an average effect that looks like an insignificant linear effect.

3.3 Coauthorship, One Journal

Many scholars, including the present authors, coauthor papers. They benefit from combining their different backgrounds, sharing their erudition and specializing in tasks. The single-dimensional ability model that we have can be extended to the decision of collaboration: we will assume that two coauthors sacrifice their independent research pursuits and morph into a single fictitious author. Let the productivity of a collaboration of two authors with abilities θ_1 and θ_2 be $\Theta(\theta_1, \theta_2)$ and let it be increasing in θ_i. Then each author will be interested in pairing with a better coauthor. If the matching process is perfect[14], the coauthors will be of equal ability, and their ability will be $\Theta(\theta, \theta)$. We will shut down the channel of the relative efficiency improvement, and assume that $\Theta(\theta, \theta) = \theta$. If this assumption does not hold and $\Theta(\theta, \theta) > \theta$, collaboration would be more attractive automatically, since Lemma 2 applies.

The allocation of credit for coauthored papers is an issue in itself. Some credit an author of a paper with N coauthors with $1/N$ of credit; some argue that having coauthors is not a reason to discount publications.[15] Here we will assume that each of the two coauthors obtains a credit of $\gamma \leq 1$ for single-authored papers.

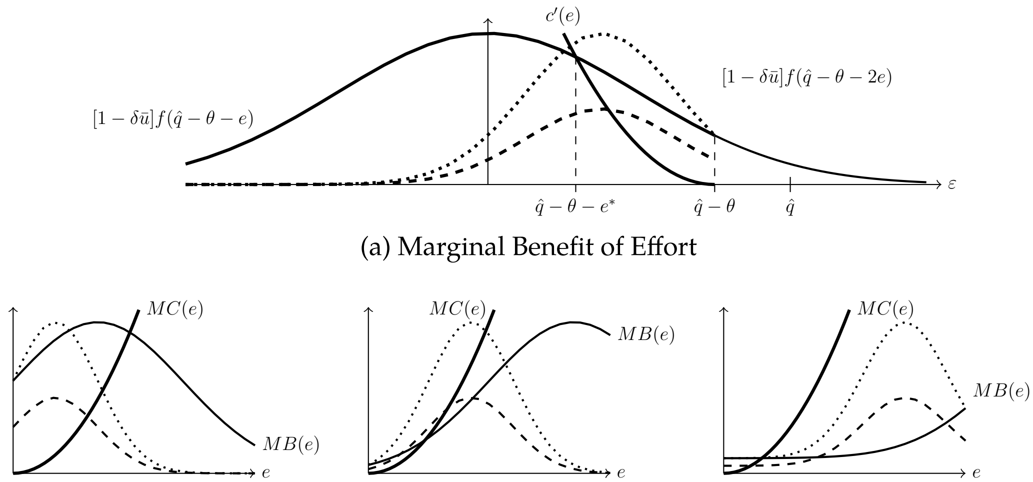
Let the effort of the two coauthors be expected to be equal. Then, in a symmetric equilibrium, in collaboration, each author[16] spends $e_2^*(\theta)$ of effort, where $e_2^*(\theta)$ solves:

$$e_2^*(\theta) = \arg\max_e \gamma \left(1 - [1 - \delta\bar{u}]F(\hat{q} - \theta - e_2^*(\theta) - e)\right) - c(e).$$

[14]Introducing an imperfect matching process is straightforward, but will need additional assumptions. For instance, the collaboration of the junior faculty member and a well-established professor, unlike our simpler perfect matching, is quite frequent, but so much richer strategically, that it cannot be contained in a short extension and warrants a separate study. Uneven sharing of both effort and credit will be part and parcel of a layer of reputation building, and all these considerations are complementary to our current model.

[15]Bikard et al. (2015) estimates the weight to be more corresponding to $1/\sqrt{N}$ than other alternatives.

[16]This is the Nash equilibrium effort allocation outcome. We abstain from the discussions of first-best equilibrium outcomes, asymmetric outcomes, and of how would the results change if N agents were collaborating simultaneously, for brevity.



(a) Marginal Benefit of Effort

(b) High θ (c) Intermediate θ (d) Low θ

Note: On Figures 8b–8d, the intersection of the solid Marginal Benefit (MB) line and the marginal cost (MC) line represents the solo-authoring effort choice for the different values of θ. Dotted lines represent the change of the marginal benefit (MB) used to obtain coauthorship effort when $\gamma = 1$. Dashed MB show what happens when $\gamma < 1$.

Figure 8: Effort Solo and Effort in Collaboration

It is easy to establish that $e_2^*(\theta)$ is single-peaked, and that $\theta + 2e_2^*(\theta)$ is increasing in θ. The first-order condition for the coauthoring author is:

$$\gamma\left([1 - \delta\bar{u}]f(\hat{q} - \theta - 2e_2^*(\theta))\right) = c'(e_2^*(\theta)). \tag{5}$$

Effectively, in collaboration, the marginal benefits are collected faster: if it makes sense to increase effort, both authors increase it. This might lead to a smaller effort per person, but only for higher θ. One can see that arg $\max_\theta e_2^*(\theta)$ is smaller than arg $\max_\theta e^*(\theta)$, obtained from (1). Figure 8 illustrates the per person effort choice.

Effort may be higher in collaboration (Figure 8c). It is trivial to see that the effort per person is lower for collaborators for high θ even when $\gamma = 1$ (Figure 8b). It is somewhat harder to see that for $\gamma < 1$, for small enough θ, the effort per person is lower than the effort that each partner would spend if working solo (Figure 8d). This allows us to assess the type of author who is more likely to collaborate.

Proposition 9. *For $\gamma < 1$, if an author prefers coauthoring, this author's ability is neither extremely high nor extremely low. Such authors exist if γ is not too low.*

The total quantity of submissions can decrease if some of the collaborating authors would otherwise submit *solo*, but may increase if the set of potential collaborators includes the authors who preferred not to submit. The average quality of submitted and published papers, net of entry, will increase; the proportion of rejections, net of entry, may decrease, because the total effort on multi-author papers is higher, and therefore the quality of high-quality papers may increase.

Empirically, many authors have found that there are more coauthors on average in recent published papers (see Hamermesh (2013), for example). This is in part due to the change of the profession (such as more labor-intensive experimental work). However, little research has been conducted on who is coauthoring with whom (Bikard et al. (2015) is one exclusion; networking papers such as Fafchamps et al. (2010) assume that the chance to collaborate is random). One way to test our proposition would be to study who would coauthor his or her job market paper with a fellow student; again, to our knowledge, no one has yet conducted a study of this kind.

4 Discussion

4.1 Feedback from Refereeing

Referees of journals are frequently authors of papers published in the very same journals. Many factors affect their efficiency; a few interact with submission outcomes.

The refereeing load, which is related to the amount of submissions, is unlikely to improve the referees' efficiency. The increase in workload, holding the quality of work constant, will make the needed time to finish work longer, and the maintenance of the same referee report deadline times will reduce the quality of reports. As with any tradeoffs, most likely a small worsening in both dimensions is going to be optimal. Every result that leads to an increase in submissions is then likely to increase the noisiness of referee reports α, or to increase the time costs. Some results are reinforced by this feedback. For instance, an exogenous increase in α leads to more submissions (see Proposition 3), which will increase the load of referees.

The writing of referee reports and the writing of the original research is likely to involve similar human resources. Therefore, a higher marginal cost of the authoring effort is likely to increase the marginal cost of refereeing effort.

4.2 Policy Implications

Every policy implication will need, besides a good understanding of the author's motivation, the understanding of the public benefit from publications, some understanding of the editor's motivation, and an understanding of the payoff of the author from the publication. The editor is concerned with better readership; society is interested in better research quality; the author is interested in signaling his own ability and disseminating his own ideas and results. Every change in the market for publications affects editors' and authors' welfare differently: the amount of submissions, the amount of refereeing, the effort and ability of differently able authors whose work is accepted for publication. Stronger results can be established with a better understanding about the way that these factors contribute to society, to the quality of the journal and to the author. For instance, the editor who maximizes the average quality of papers published in his journal, without any regard for the benefit to society, can set an extremely high publishing standard: she can publish one paper in 10 years, but be sure that the average ability is quite high.

Our model enables us to make some statements about the effect on the components of society, the editor, and the author's welfare as a result of some of the changes mentioned above.

More Open-Sourced Journals Many authors (e.g. Bergstrom (2001)) call for more open-sourced journals, to increase competition with for-profit journals, to motivate shorter refereeing delays or to drive down the fees for libraries. Assuming that new journals will recruit the necessary editorial reviewing resources, they will be in the situation of the second-but-same journal, discussed above: the effort level of the most able authors will decline, the number of submissions will increase, and higher total capacity will drive down publication standards. Even if publication standards remain unchanged, having more journals lowers research effort. To attract the best authors, new journals should generate higher payoffs from publication than for-profit journals do. Without this, or sabotaging old journals, however, having more journals in the short run will curtail the incentives of the most able authors.

Refereeing Delays Many authors discuss the potential of monetary incentives to reduce refereeing delays (Engers and Gans (1998); Chang and Lai (2001)), treating the delays as referee's leisure. However, refereeing is deeply intertwined with publishing, and many aspects of it are not contractable. Shortening time delays in a way that worsens the quality of referee reports will benefit only the less able authors; lowering time delays so that the quality of refereeing is improved will benefit more able authors—and some of them will exert more effort—potentially improving the quality distribution of publications.[17]

[17] One way to achieve the latter is to make it easier to quantify the refereeing impact of a scholar. Administrators can aggregate information about publications and citations, but not about refereeing engagement. Some journals provide the names of those who provided a referee report in their annual reports; some journals have an award for the best referee report; some journals employ their best referees as editors. However,

Many Referees Obtaining reports from multiple referees provides a better estimate of a paper's virtues, but increases the load on the refereeing body, potentially lowering the quality of the referee reports. Editors can vary the number of referees for any individual paper, depending on preliminary evaluations: papers sufficiently far away from the acceptance threshold might get one reviewer to confirm the editor's preliminary opinion, whereas papers on the verge of acceptance can have more reports[18], requested sequentially or simultaneously. The effects on effort are straightforward: those authors who expect higher scrutiny—the authors whose papers are more likely to be perceived as the ones near the threshold—will exercise just enough effort to be above the threshold, whereas those whose outcome is likely to be determined solely by the editor are likely to exert more effort.

Single-, Double- and Triple-Blind Inferring the paper's quality from the identity or affiliation of the author may improve the publication process. It is easier to obtain a signal of equal quality if more information is available *ex ante*. This, however, is likely to worsen the incentive for the referees to acquire information: if the *ex ante* signal is very persuasive, why spend time on reading the paper? For these reasons, it may or may not be useful to inform referees about the identity of the author. One could argue a step further: is it really necessary for the editor to know the author's name and affiliation?... [19]

5 Conclusion

In our study, we supplied a general model for the publication market. Using it, we reconciled various stylized facts which characterize differences in the publication process in Economics over time and against other disciplines. The main takeaway message of our study is that the heterogeneity of authors regarding their ability leads to different effects of changes in the publication process's fundamentals. We explain why able authors take the effectively non-paid refereeing job: they are the ones who benefit from the overall improvement of the refereeing technology. The separation of authors into "more able" and "less able" is endogenous in our model, and it depends on the admission criterion that the editor applies. Not all separations are monotone: if some authors prefer to submit to field journals first—even if more valuable general interest journals require the same

many economists do not put their refereeing contribution into their CV: they think the informational content of a refereeing contribution is not valuable.

[18]One of the authors is aware of an instance in which 5 referees were employed in a single round.

[19]Taylor and Yildirim (2011) explore this question.

cutoff—these authors are likely to be of intermediate ability. Hence, for many changes in the fundamentals, there are winners and losers. A claim about the inherent benefit of a change requires an implicit assumption about the comparative importance of the actors involved in the process.

Our model suggests the empirical consequences of several changes in the academic publication market, discussed in the introduction. While most of what we study is kept discreet by the participants of the publication process, such as the sequence of submissions, identities of referees, referees' recommendations and editors' priors, the empirical literature can proxy some unobservables with observables. For instance, the measure of paper quality can be proxied with citations (as Bikard et al. (2015) do); the ability may be deduced from citations of solo papers written in a given year (after all, the absolute value of ability does not matter that much) or average performance across years (as Fafchamps et al. (2010) do); and the individual effort may be measured by time spent on rewriting, which can be obtained from surveys. Submission sequence decisions can be observed in CVs if they are updated frequently enough, or obtained from big publishers. An interesting source of the empirical data, it seems, are the CVs of freshly-minted PhDs: they clearly indicate where they submit their job market papers (and in many cases, these are first submissions), they show the number of working papers and the number of their coauthors, and they have little individual reputation besides affiliation.

Our model does not impose much structure on the underlying institutional processes, and its predictions can be applied directly to other contexts where agents compete for limited slots. For instance, job market applicants exert effort to overcome an interviewer's expectations regarding acceptable candidates. A model similar to ours will predict in this context that most effort will be exerted by applicants marginally below the acceptance threshold, which in turn has implications on the duration of a job market search. Other contexts include advertising, political competition, start-up businesses soliciting venture funding, real estate agents actively pushing their properties, and courtship in the marital market—any context where effort is needed to overcome the threshold for acceptance will inherit the intuition we provide in our model.

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A Proofs

Lemma 1. The monotonicity of the optimal effort corresponds directly to the monotonicity of $f(\cdot)$. When the solution of (1) is unique, the proof is immediate from Figures 1b and 1c (dotted lines show what happens to the $MB(e)$ curve when θ increases). If for some θ optimal effort started to decline with θ, it will be declining for $\theta' > \theta$ by single-peakedness of $f(\cdot)$, and for the same reason if for some θ optimal effort increases with θ, it will increase for $\theta' < \theta$.

Let there be two global maxima of

$$U(e|\theta) = 1 - [1 - \delta\bar{u}]F\left(\frac{\hat{q} - \theta - e}{\alpha}\right) - c(e)$$

when $\theta = \bar{\theta}$. Generically, the continuity of derivatives of $U(e|\theta)$ with respect to all variables implies that there are at least two local maxima of $U(e|\theta)$ in the neighborhood of $\theta = \bar{\theta}$. Let $e_1(\theta)$ and $e_2(\theta)$ be locations of two local maxima of the Effort Choice Problem such that $e_1(\bar{\theta}) < e_2(\bar{\theta})$, and both $e = e_1(\bar{\theta})$ and $e = e_2(\bar{\theta})$ maximize $U(e)$ for $\theta = \bar{\theta}$.

By the Envelope theorem and because Equation (1) should hold at both $e_1(\bar{\theta})$ and $e_2(\bar{\theta})$,

$$\frac{\partial}{\partial\theta}U(e_i(\theta)|\theta)|_{\theta=\bar{\theta}} = c'(e_i(\bar{\theta})) \text{ for } i = \{1, 2\}.$$

By strict convexity of $c(\cdot)$, this implies that $U(e_1(\theta)) > U(e_2(\theta))$ for $\theta < \bar{\theta}$, and $U(e_1(\theta)) < U(e_2(\theta))$ for $\theta > \bar{\theta}$.

Because $c'(\cdot)$ is increasing in its argument, the maximum effort corresponds to the maximum marginal cost of e. Since marginal benefit is bounded by $\frac{1-\delta\bar{u}}{\alpha}f(0)$, maximum effort must be exercised by an agent for which $\hat{q} - \theta - e(\theta) = 0$, if there is such a θ. If not, it means that for some θ, there are two solutions to the Effort Choice Problem, one that delivers $\theta + e(\theta) < \hat{q}$, and another one that makes $\theta + e(\theta) > \hat{q}$; effort increases for all θ smaller than this one, and declines for all θ larger than this one. □

Lemma 2. When the solution of the effort choice problem is not unique, it means that an increase in θ comes with a jump upwards in $e^*(\theta)$, according to Lemma 1. When the solution of the effort choice problem is unique, we can apply the implicit function theorem. Differentiate (1) with respect to θ:

$$-\frac{1 - \delta\bar{u}}{\alpha^2}f'\left(\frac{\hat{q} - \theta - e^*(\theta)}{\alpha}\right)\left(1 + \frac{de^*(\theta)}{d\theta}\right) = c''(e^*(\theta))\frac{de^*(\theta)}{d\theta}.$$

The derivative of $\theta + e^*(\theta)$ is

$$1 + \frac{de^*(\theta)}{d\theta} = 1 + \frac{-\frac{1-\delta\bar{u}}{\alpha^2}f'\left(\frac{\hat{q}-\theta-e^*(\theta)}{\alpha}\right)}{c''(e^*(\theta)) + \frac{1-\delta\bar{u}}{\alpha^2}f'\left(\frac{\hat{q}-\theta-e^*(\theta)}{\alpha}\right)} = \frac{c''(e^*(\theta))}{c''(e^*(\theta)) + \frac{1-\delta\bar{u}}{\alpha^2}f'\left(\frac{\hat{q}-\theta-e^*(\theta)}{\alpha}\right)}.$$

The denominator is positive because of the second order condition (2), the whole fraction is positive because $c(\cdot)$ is convex. □

Proposition 1. The change in $\hat{q}$ is mathematically the same as the change in θ, except that the sign is reversed. The single-peakedness of effort yields the result about the change in effort. Observe that $\hat{q} - \theta$ determines the level of effort. The chance to publish is monotone in $\hat{q} - \theta - e^*(\theta|\hat{q})$, and for the reason for which $\theta + e^*(\theta)$ is increasing in θ, $\hat{q} - e^*(\theta|\hat{q})$ is decreasing in $\hat{q}$ (see the proof of Lemma 2). The utility part of the statement is obtained with the Envelope theorem. $\square$

Proposition 2. Consider first the effects of the changes in δ and $\bar{u}$ on effort choice. Since (1) depends on the product of δ and $\bar{u}$, establishing the result for δ would be sufficient. Differentiate (1) completely with respect to δ:

$$-\frac{\bar{u}}{\alpha} f\left(\frac{\hat{q} - \theta - e^*(\theta)}{\alpha}\right) + \left(\frac{1-\delta\bar{u}}{\alpha^2} f'\left(\frac{\hat{q} - \theta - e^*(\theta)}{\alpha}\right)\right)\left(-\frac{\partial e^*(\theta)}{\partial \delta}\right) = c''(e^*(\theta))\frac{\partial e^*(\theta)}{\partial \delta} \Rightarrow$$

$$\frac{\partial e^*(\theta)}{\partial \delta} = \frac{-\frac{\bar{u}}{\alpha} f\left(\frac{\hat{q}-\theta-e^*(\theta)}{\alpha}\right)}{\underbrace{c''(e^*(\theta)) + \frac{1-\delta\bar{u}}{\alpha^2} f'\left(\frac{\hat{q} - \theta - e^*(\theta)}{\alpha}\right)}_{>0 \text{ because it's SOC (2)}}} < 0.$$

Simultaneously, the Envelope theorem suggests that authors are better off:

$$\frac{\partial}{\partial \delta}\left(1 - [1-\delta\bar{u}]F\left(\frac{\hat{q} - \theta - e^*(\theta)}{\alpha}\right) - c(e^*(\theta))\right) = \bar{u}F\left(\frac{\hat{q} - \theta - e^*(\theta)}{\alpha}\right) \in [0,1).$$

The derivative is equal to zero if and only if $\bar{u} = 0$.

Lower effort implies lower chances to publish immediately.

The paper gets submitted if

$$1 - [1-\delta\bar{u}]F\left(\frac{\hat{q} - \theta - e^*(\theta)}{\alpha}\right) - c(e^*(\theta)) \geq \bar{u}.$$

Notice that the right-hand side increases one-to-one with $\bar{u}$, and does not change with δ. Since the left-hand side increases more slowly than one-to-one, the result follows. $\square$

Proposition 3. **Efforts** The increase in α "flattens" the distribution (see Figure 2a) just as an increase in δ lowered efforts, but it also "stretches" the pdf. Let $t = \frac{\hat{q}-\theta-e^*(\theta)}{\alpha}$. Differentiate completely (1) to obtain:

$$\frac{1-\delta\bar{u}}{\alpha^2}\left(-f'(t)\frac{\partial e^*(\theta)}{\partial \alpha} - f(t) - f'(t)t\right) = c''(e^*(\theta))\frac{\partial e^*(\theta)}{\partial \alpha} \Rightarrow$$

$$\frac{\partial e^*(\theta)}{\partial \alpha} = -\frac{1-\delta\bar{u}}{\alpha^2}\frac{f(\frac{\hat{q}-\theta-e^*(\theta)}{\alpha}) + f'(\frac{\hat{q}-\theta-e^*(\theta)}{\alpha})\frac{\hat{q}-\theta-e^*(\theta)}{\alpha}}{\underbrace{c''(e^*(\theta)) + \frac{1-\delta\bar{u}}{\alpha^2} f'(\frac{\hat{q} - \theta - e^*(\theta)}{\alpha})}_{\text{positive because it's SOC (2)}}}.$$

Thus, the sign of $\frac{\partial e^*(\theta)}{\partial \alpha}$ opposes the sign of $(tf(t))'_t$. This transformation from θ to t is monotone because of Lemma 2. Since $f(\cdot)$ is differentiable, and has a maximum at 0, $f'(0) = 0$. Effort thus decreases when $\theta = \theta_0$, and, by the differentiability of $tf(t)$, in the neighborhood of θ_0 as well. It is easy to see that there is at least one intersection to the left and to the right of the center: increasing α does not change the probability of publication at $\tilde{q} = \hat{q}$ (that is, for θ_0 type). Therefore, the stretched and non-stretched distributions should integrate to the same value at $\hat{q} - \theta_0 - e^*(\theta_0) = 0$, and therefore it must be the case that they intersect at least once to the left and at least once to the right from $\tilde{q} = \hat{q}$. This means that there are sets of positive measure in both $(-\infty, \theta_0]$ and $[\theta_0, +\infty)$ where the stretched density is above the original density.

If ε has a mean, $tf(t)$ should converge to zero from above when approaching infinity, and from below when approaching minus infinity, to integrate to something finite. This implies that $(tf(t))' < 0$ for both very high and very low t values, and thus effort increases for the "too high" and "too low" values of θ.

Finally, consider $tf(t)$ at $t > 0$. Observe that $tf(t)$ is strictly log-concave whenever $f(t)$ is strictly log-concave; thus, there is a unique argmaximum. Denote this argmaximum by t_1. Then $tf(t)$ is increasing from 0 to t_1, and decreasing afterwards. Define $\check{\theta}_1$ as follows:

$$\frac{\hat{q} - \check{\theta}_1 - e^*(\check{\theta}_1)}{\alpha} = t_1.$$

For all $\theta \in [\check{\theta}_1, \theta_0)$, the corresponding value of $\frac{\hat{q} - \theta - e^*(\theta)}{\alpha} \in [0, t_1]$, and therefore for these θ, effort choice declines. Similarly, for all θ below $\check{\theta}$, effort choice increases.

Analogously, consider $-tf(t)$ at $t < 0$. Observe that $tf(t)$ is strictly log-concave whenever $f(t)$ is strictly log-concave, and obtain t_2 as the argmaximum of $-tf(t)$. Solve for $\hat{\theta}_1$:

$$\frac{\hat{q} - \hat{\theta}_1 - e^*(\hat{\theta}_1)}{\alpha} = t_2.$$

Therefore, effort increases for types $\theta \in (-\infty, \check{\theta}_1) \cup (\hat{\theta}_1, +\infty)$, declines for $\theta \in (\check{\theta}_1, \hat{\theta}_1)$, and remains the same for $\theta \in \{\check{\theta}_1, \hat{\theta}_1\}$.

Utility The Envelope theorem provides

$$\frac{\partial}{\partial \alpha}\left(1 - [1 - \delta\bar{u}]F\left(\frac{\hat{q} - \theta - e^*(\theta)}{\alpha}\right) - c(e^*(\theta))\right) = \frac{1 - \delta\bar{u}}{\alpha^2}\left(\hat{q} - \theta - e^*(\theta)\right) f\left(\frac{\hat{q} - \theta - e^*(\theta)}{\alpha}\right).$$

The sign of the derivative coincides with the sign of $\hat{q} - \theta - e^*(\theta)$. When $\theta > \theta_0$, the derivative is negative, and it is positive otherwise.

When $\theta_0 > \hat{\theta}$, the author type who swung indifferently between submission to the good journal and sending his papers directly to the bad journal, encounters an increase in α, he starts strictly preferring to submit his paper to the good journal. By continuity of the maximized utility, the author types in the left neighborhood of this type start submitting, too, which leads to more submissions than before. The case for $\hat{\theta} > \theta_0$ is proven similarly. $\square$

Proposition 4. Compare Equations (1) and (1′). Their difference is in the marginal benefit component, in the square bracket part left of $f(\cdot)$. Since $F(\hat{q} - \theta - e^*(\theta))$ decreases in θ, $1 - \delta + 2\delta F(\hat{q} - \theta - e^*(\theta))[1 - \delta\bar{u}]$ decreases in θ too. Consider the limits:

$$\lim_{\theta \to -\infty} 1 - \delta + 2\delta F(\hat{q} - \theta - e^*(\theta))[1 - \delta\bar{u}] = 1 + \delta - 2\delta^2\bar{u} > 1 - \delta\bar{u},$$

$$\lim_{\theta \to +\infty} 1 - \delta + 2\delta F(\hat{q} - \theta - e^*(\theta))[1 - \delta\bar{u}] = 1 - \delta < 1 - \delta\bar{u}.$$

Ignoring jumps in $e^*(\theta)$, by the intermediate value theorem, there is θ_1 where

$$1 - \delta + 2\delta F(\hat{q} - \theta_1 - e^*(\theta_1))[1 - \delta\bar{u}] = 1 - \delta\bar{u},$$

and by the monotonicity of the left-hand side, it is unique. The agent of this type will choose the same effort level in both worlds, one journal or two journals. Therefore, θ_1 is such that

$$\theta_1 : F(\hat{q} - \theta_1 - e^*(\theta_1)) = \frac{1}{2}\frac{1 - \bar{u}}{1 - \delta\bar{u}}.$$

For all $\theta < \theta_1$, the marginal benefit of effort in the scenario with two journals is *higher* than the marginal benefit in the scenario with only one journal: even though getting published in one place is unlikely, with two journals, the chances of getting accepted *somewhere* improve. At the same time, for $\theta > \theta_1$, the insurance motive for exercising effort is weaker, and these authors spend less effort in the scenario with two journals.

Since $F(\hat{q} - \theta_1 - e^*(\theta_1)) = \frac{1}{2}\frac{1-\bar{u}}{1-\delta\bar{u}}$, the author whose chance of publication is $1/2$ will reduce his effort, as will all authors of higher ability, and some authors whose ability is lower than this. $\square$

Proposition 5. Assume submitting to Journal 2 is better than abstaining:

$$\gamma(1 - F) + F\delta\bar{u} - c(e) \geq \bar{u},$$

where $F = F(\hat{q} - \theta - e) \in (0, 1)$ for any e. Then using the same effort provides a higher utility, if one attempts resubmission to Journal 1:

$$\gamma(1 - F) + F\delta\overbrace{(1 - F + F\delta\bar{u})}^{>\bar{u}+c(e)} - c(e) = \gamma(1 - F) + F\bar{u} - c(e) \geq \gamma(1 - F) + F\delta\bar{u} - c(e)\bar{u}.$$

Finally, observe that sending first to Journal 1 is strictly better:

$$1-F+F\delta\left(\gamma(1-F)+F\delta\bar{u}\right)-c(e)=\overbrace{\gamma(1-F)+F\delta\left(1-F+F\delta u\right)-c(e)}^{\text{Utility of submitting to 2 first}}+\gamma(1-F)(1-F\delta).$$

However, some authors may find it optimal to not resubmit if they get a rejection after submission to Journal 1. Let $e^{**}(\theta)$ solve

$$\max_e 1-F(\hat{q}-\theta-e)+F(\hat{q}-\theta-e)\delta\max\left\{\bar{u},\gamma(1-F(\hat{q}-\theta-e)+F(\hat{q}-\theta-e)\delta\bar{u}\right\}-c(e).$$

For simplicity, let us agree that when the author type swings indifferently between (re)submitting and sending the paper to a bad journal, the author chooses $\bar{u}$. $e^{**}(\theta)$ is positive and well-defined because the payoff is continuous in e and bounded, c is convex and $c'(0)=0$. The first-order condition of this problem is (omitting $\hat{q}-\theta-e^{**}(\theta)$ for brevity):

$$c'(e)=f(\cdot)[1-\delta\bar{u}\max\left\{\bar{u},\gamma(1-F(\cdot)+F(\cdot)\delta\bar{u}\right\}]+F(\cdot)\overbrace{\left[\begin{array}{r}0,\bar{u}\geq\gamma(1-F(\cdot)+F(\cdot)\delta\bar{u},\\(\gamma-\delta\bar{u})f(\cdot),\bar{u}<\gamma(1-F(\cdot)+F(\cdot)\delta\bar{u}.\end{array}\right.}^{Q(\theta+e^{**}(\theta))}$$

Besides jumps due to multiple solutions of the FOC as discussed in Lemma 1 (and handled similarly), there may be jumps due to a discontinuity in the right part of the marginal benefit function $Q(\cdot)$. Consider

$$\theta_0^{**}:\begin{cases}\bar{u}\geq\lim\limits_{\theta\to\theta_0^{**}-}\gamma(1-F(\hat{q}-\theta-e^{**}(\theta))+F(\hat{q}-\theta-e^{**}(\theta))\delta\bar{u},\\ \bar{u}\leq\lim\limits_{\theta\to\theta_0^{**}+}\gamma(1-F(\hat{q}-\theta-e^{**}(\theta))+F(\hat{q}-\theta-e^{**}(\theta))\delta\bar{u}.\end{cases}$$

$Q(\theta+e^{**}(\theta))$ is continuous and equal to zero to the left from θ_0^{**}. For every point in the right neighborhood of θ_0^{**}, the marginal benefit function jumps *up* due to a discontinuity in $Q(\cdot)$; therefore, every point in the right neighborhood of θ_0^{**} has $e^{**}(\theta)>e^{**}(\theta_0^{**})$.

Similarly to Lemma 2, we can take the second-order condition of the optimization problem which defines $e^{**}(\theta)$, and observe that everywhere where there are no jumps in $e^{**}(\theta)$, $1+\frac{de^{**}(\theta)}{d\theta}=\frac{c''(e^{**}(\theta)}{SOC}>0$. Therefore, the total quality of the submitted paper in this framework, $\theta+e^{**}(\theta)$, is increasing in θ.

It is trivial to establish that $\gamma(1-F(-z)+F(-z)\delta\bar{u}$ is increasing in z, and thus the monotonicity of $\theta+e^{**}(\theta)$ implies that θ_0^{**} is single-valued for $\gamma>\bar{u}$, and not present if $\gamma<\bar{u}$. Similarly, define

$$\theta_1^{**}:\begin{cases}\bar{u}\geq\lim\limits_{\theta\to\theta_1^{**}-}1-F(\hat{q}-\theta-e^{**}(\theta)+F(\hat{q}-\theta-e^{**}(\theta))\delta\bar{u}-c(e^{**}(\theta)),\\ \bar{u}\leq\lim\limits_{\theta\to\theta_1^{**}+}1-F(\hat{q}-\theta-e^{**}(\theta)+F(\hat{q}-\theta-e^{**}(\theta))\delta\bar{u}-c(e^{**}(\theta)).\end{cases}$$

Without the $c(e^{**}(\theta))$ part, because $\gamma < 1$, we would have $\theta_1^{**} \leq \theta_0^{**}$. Because we have the $c()$ part, θ_1^{**} becomes larger, and, depending upon the shapes of $f(\cdot)$ and $c(\cdot)$, might become larger than θ_0^{**}. If this is the case, all authors below θ_1^{**} submit to Journal 1, and resubmit to Journal 2 if they were rejected, and all authors below θ_1^{**} submit to the bad journal immediately. If $\theta_1^{**} < \theta_0^{**}$, all agents to the right of θ_0^{**} would attempt to resubmit their papers to Journal 2 if they don't get accepted in Journal 1. All agents to the left of θ_1^{**} would not even attempt to submit to Journal 1. Finally, all agents in $(\theta_1^{**}, \theta_0^{**})$ will submit to Journal 1, but will not try to resubmit to Journal 2.

To establish whether θ_1^{**} is smaller than θ_0^{**}, observe that in this case, for θ_1^{**}

$$1 - F_1 + F_1\delta\bar{u} - c_1 = \bar{u},$$

where $c_1 = c(e^*(\check{\theta}))$, $e^*(\cdot)$ solves (1), and $F_1 = F(\hat{q} - \theta_1^{**} - e^*(\theta_1^{**}))$. If this author gets a rejection from Journal 1, he finds it optimal to resubmit to the second journal if

$$\gamma(1 - F_1) + F_1\delta\bar{u} \geq \bar{u}.$$

Obviously, if $\gamma < \bar{u}$, this never holds. When $\gamma > \bar{u}$, this inequality, after substitution of the indifference condition to remove F_1, produces

$$\frac{\gamma - \bar{u}}{\gamma - \delta\bar{u}} \leq \frac{1 - \bar{u} - c_1}{1 - \delta\bar{u}},$$

which holds if $\gamma \geq \frac{1-\delta+\delta c_1}{\bar{u}(1-\delta)+c_1}\bar{u} \in (\bar{u}, 1)$.[20] If γ is not high enough, θ_1^{**} type will have some agents in the right neighborhood of θ_1^{**} who submit to Journal 1, but do not resubmit to Journal 2 afterwards, which implies that θ_0^{**} is far enough to the right of θ_1^{**}. □

Proposition 6. **Local case** Consider the choice between submitting first to Journal 1, then to Journal 2 (strategy 1), and submitting first to Journal 2, then to Journal 1 (strategy 2). Consider the effort choice problem when choosing strategy i; let $e_i^*(\theta)$ denote the effort chosen by the author of type θ.

The utility from submitting to Journal 1 first is $U_1 =$

$$1-F(\hat{q}_1-\theta-e_1^*(\theta))+F(\hat{q}_1-\theta-e_1^*(\theta))\delta\left(\gamma(1 - F(\hat{q}_2 - \theta - e_1^*(\theta))) + F(\hat{q}_2 - \theta - e_1^*(\theta))\delta\bar{u}\right)-c(e_1^*(\theta)).$$

The utility from submitting to Journal 2 first is $U_2 =$

$$\gamma(1-F(\hat{q}_2-\theta-e_2^*(\theta)))+F(\hat{q}_2-\theta-e_2^*(\theta))\delta\left(1 - F(\hat{q}_1 - \theta - e_2^*(\theta)) + F(\hat{q}_1 - \theta - e_2^*(\theta))\delta\bar{u}\right)-c(e_2^*(\theta)).$$

[20]The fraction is decreasing in c_1, the smallest possible c_1 is 0, and the largest possible c_1 is $1 - \bar{u}$.

When $\gamma = 1$ and $\hat{q}_2 = \hat{q}_1$, $e_1^*(\theta) = e_2^*(\theta) = e^*(\theta)$, and $U_1(\theta) = U_2(\theta)$. Consider a small change in γ at $\gamma = 1$ and $\hat{q}_1 = \hat{q}_2 = \hat{q}$:

$$\frac{dU_1}{d\gamma} = \delta F(\hat{q} - \theta - e^*(\theta))(1 - F(\hat{q} - \theta - e^*(\theta))) > 0.$$

$$\frac{dU_2}{d\gamma} = 1 - F(\hat{q} - \theta - e^*(\theta)) > 0.$$

As in Proposition 5, lowering γ makes submitting to Journal 2 first a strictly dominated strategy for every ability level:

$$\frac{d(U_1 - U_2)}{d\gamma} = (1 - F(\hat{q} - \theta - e^*(\theta)))\left(\delta F(\hat{q} - \theta - e^*(\theta)) - 1\right) < 0.$$

Consider a small change in $\hat{q}_2$, the admission standard of Journal 2:

$$\frac{dU_1}{d\hat{q}_2} = \delta F(\hat{q} - \theta - e^*(\theta))(\delta \bar{u} - 1) f(\hat{q} - \theta - e^*(\theta)) < 0.$$

$$\frac{dU_2}{d\hat{q}_2} = (\delta\left[1 - F(\hat{q} - \theta - e^*(\theta)) + F(\hat{q} - \theta - e^*(\theta))\delta \bar{u}\right] - 1) f(\hat{q} - \theta - e^*(\theta)) < 0.$$

Lowering $\hat{q}_2$ makes submitting to Journal 1 first a strictly dominated strategy:

$$\frac{d(U_1 - U_2)}{d\hat{q}_2} = f(\hat{q} - \theta - e^*(\theta))[1 - \delta] > 0.$$

To model a simultaneous decrease in $\hat{q}_2$ and γ, express the relative change in $\hat{q}_2$ with $\lambda > 0$, and consider

$$\frac{-d(U_1 - U_2)}{d\gamma} + \lambda \frac{-d(U_1 - U_2)}{d\hat{q}_2} = (1 - F(\cdot))(1 - \delta F(\cdot)) - \lambda f(\cdot)[1 - \delta].$$

Strategy 1 is better than strategy 2 if this derivative is positive:

$$[1 - \delta]\lambda < \frac{1 - F(\hat{q} - \theta - e^*(\theta))}{f(\hat{q} - \theta - e^*(\theta))}[1 - \delta F(\hat{q} - \theta - e^*(\theta))].$$

By the log-concavity of $f(\cdot)$, $[1 - F(\cdot)]/f(\cdot)$ is decreasing. The product of two decreasing positive functions is decreasing, and therefore the inequality above holds for a small enough $q - \theta - e^*(\theta)$. By the monotonicity of $\theta + e^*(\theta)$, there will be a threshold level of θ such that all authors of ability higher than this will submit to Journal 1 first, and the rest will submit to Journal 2 first.

Non-local case Consider a family of journals parameterized by t such that the successful publication pays off t utility, and the signal threshold enforced by the editor of Journal

t is $\hat{q}(t)$. Consider the problem of choice between submitting to the *stronger* Journal t and the *weaker* Journal t' that has a marginally smaller payoff and marginally lower threshold. Let $e_i^*(\theta)$ denote the solution to the effort choice problem for author θ that submits first to the Journal $i \in \{s, w\}$, and then to the journal $\{s, w\} \setminus \{i\}$. The utility that the author of type θ derived from submitting to the stronger journal first is

$$\begin{aligned} U_s = {} & t(1 - F(\hat{q}(t) - \theta - e_s^*(\theta)))+ \\ & + F(\hat{q}(t) - \theta - e_s^*(\theta))\delta\left(t'(1 - F(\hat{q}(t') - \theta - e_s^*(\theta)))F(\hat{q}(t') - \theta - e_s^*(\theta))\delta\bar{u}\right) - c(e_s^*(\theta)). \end{aligned}$$

The utility for the author of type θ derived from submitting to the weaker journal first is

$$\begin{aligned} U_w = {} & t'(1 - F(\hat{q}(t') - \theta - e_w^*(\theta)))+ \\ & + F(\hat{q}(t') - \theta - e_w^*(\theta))\delta\left(t(1 - F(\hat{q}(t) - \theta - e_w^*(\theta)))F(\hat{q}(t) - \theta - e_w^*(\theta))\delta\bar{u}\right) - c(e_w^*(\theta)). \end{aligned}$$

When $t = t'$, $e_w^*(\theta) = e_s^*(\theta) = e^*(t, \hat{q}(t) - \theta)$, and all authors are indifferent over submitting first to Journal s or Journal w, the local case argument above suggests that there is a type $\bar{\theta}$ who is indifferent as to journals s and w when

$$\hat{q}'(t) = \frac{1 - F(\hat{q}(t) - \bar{\theta} - e^*(t, \hat{q}(t) - \bar{\theta}))}{f(\hat{q}(t) - \bar{\theta} - e^*(t, \hat{q}(t) - \bar{\theta}))} \frac{1 - \delta F(\hat{q}(t) - \bar{\theta} - e^*(t, q(t) - \bar{\theta}))}{t(1 - \delta)} = Q(t, \hat{q} - \bar{\theta} | e^*).$$

Pick an author type $\bar{\theta}$. Can we "guide" $q(t)$ from $t = \gamma$ to $t = 1$ so that type $\bar{\theta}$ is indifferent to all journals along this path? This would make that type indifferent to both our original Journals 1 and 2. To locate this type, we solve a parameterized initial value problem:

$$\hat{q}'(t) = Q(t, \hat{q}(t) - \bar{\theta} | e^*), \hat{q}(\gamma) = \hat{q}_2. \tag{6}$$

We want to pick $\bar{\theta}$ so that $\hat{q}(1|\bar{\theta}) = \hat{q}_1$. First, observe that

$$\frac{1 - F(\hat{q}(t) - \bar{\theta} - e^*(t, \hat{q}(t) - \bar{\theta}))}{f(\hat{q}(t) - \bar{\theta} - e^*(t, \hat{q}(t) - \bar{\theta}))} \frac{1 - \delta F(\hat{q}(t) - \bar{\theta})}{t(1 - \delta)} > \frac{1 - F(\hat{q}_1 - \bar{\theta})}{f(\hat{q}_1 - \bar{\theta})} \frac{1 - \delta F(\hat{q}_1 - \bar{\theta})}{1 - \delta},$$

and if one picks $\bar{\theta}$ low enough so that the right-hand side is equal to $\frac{\hat{q}_1 - \hat{q}_2}{1 - \gamma}$, the integral above is strictly above $\hat{q}_1 - \hat{q}_2$. Denote this $\bar{\theta}$ as $\bar{\theta}_l$. On the other hand,

$$\frac{1 - F(\hat{q}(t) - \bar{\theta} - e^*(t, \hat{q}(t) - \bar{\theta}))}{f(\hat{q}(t) - \bar{\theta} - e^*(t, \hat{q}(t) - \bar{\theta}))} \frac{1 - \delta F(\hat{q}(t) - \bar{\theta})}{t(1 - \delta)} < \frac{1 - F(\hat{q}_2 - \bar{\theta} - E)}{f(\hat{q}_2 - \bar{\theta} - E)} \frac{1 - \delta F(\hat{q}_2 - \bar{\theta} - E)}{\gamma(1 - \delta)},$$

where E solves $c(E) = 1$: this would be a natural cap to the level of effort. Therefore, there is a $\bar{\theta}$ high enough so that the right-hand side is equal to $\frac{\hat{q}_1 - \hat{q}_2}{1 - \gamma}$, and the integral above yields strictly less than $\hat{q}_1 - \hat{q}_2$. Denote this $\bar{\theta}$ as $\bar{\theta}_h$. These two values, $\bar{\theta}_l$ and $\bar{\theta}_h$, provide boundaries on potentially relevant values of $\bar{\theta}$.

If $e^*(\cdot)$ has jumps, $Q(\cdot|e^*)$ may have jumps, too. Observe that $P(t,x) = Q(t,x|e^*)$ is monotone and decreasing in x. Denote $p = \hat{q} - \bar{\theta}$, then ODE (6) changes to

$$p' = P(t,p), \quad p(\gamma) = \hat{q}_2 - \bar{\theta}.$$

Denote the solution of this ODE $p(t|\bar{\theta})$. If for some t', $P(t', p(t'|\bar{\theta})) = P(t', p(t'|\bar{\theta}'))$, by the monotonicity of $P(t,\cdot)$ this implies that $p(t'|\bar{\theta}) = p(t'|\bar{\theta}')$, which in turn implies that $p(t|\bar{\theta}) = p(t|\bar{\theta}')$ holds for all t, because they solve the same ODE with the same starting point. Because $P(t,p)$ is monotone in the second argument, $p'(t|\bar{\theta}) < p'(t|\bar{\theta}')$ for all t, which means that

$$p(1|\bar{\theta}') + \bar{\theta} = \hat{q}_2 + \int_\gamma^1 P(t, p(t|\bar{\theta}'))dt > \hat{q}_2 + \int_\gamma^1 P(t, p(t|\bar{\theta}))dt = p(1|\bar{\theta}) + \bar{\theta}.$$

Therefore, $\hat{q}(1|\bar{\theta})$ is increasing in $\bar{\theta}$, which means it has countably many discontinuities.

If for some $\bar{\theta}^*$, $\hat{q}(1|\bar{\theta}^*) = \hat{q}_1$, we have found our separation candidate type: this $\bar{\theta}^*$ type is indifferent to all the stronger and weaker journals along the path of $(t, q(t))$, and therefore this type is indifferent to both Strategies 1 and 2, while all types above strictly prefer submitting to stronger journals first, and all types below prefer submitting to weaker journals first. If there is no such $\bar{\theta}^*$, there must be a $\bar{\theta}^*$ for which $\hat{q}(1|\bar{\theta})$ is taking a jump, and $\lim_{\bar{\theta}\to\bar{\theta}^*-} \hat{q}(1|\bar{\theta}) < \hat{q}_1 < \lim_{\bar{\theta}\to\bar{\theta}^*+} \hat{q}(1|\bar{\theta})$. This $\bar{\theta}^*$ is the separation type we are looking for:

- all types below $\bar{\theta}^*$ would weakly prefer publishing in weaker journals to publishing in stronger journals, and therefore would prefer Strategy 2, if the publication cutoff in Journal 1 was $\lim_{\bar{\theta}\to\bar{\theta}^*-} q(1|\bar{\theta})$, somewhat lower than the one we are looking for;
- all types above $\bar{\theta}^*$ would weakly prefer Strategy 1 even if the publication cutoff in Journal 1 was $\lim_{\bar{\theta}\to\bar{\theta}^*+} q(1|\bar{\theta}) > \hat{q}_1$;
- since $\frac{d(U_1 - U_2)}{d\hat{q}_1} < 1$, preferences over strategies above hold *strictly* instead of *weakly* for the true level of $\hat{q}_1$:

$$U_1(\theta) > U_2(\theta) \Leftrightarrow \theta > \bar{\theta}, U_1(\theta) < U_2(\theta) \Leftrightarrow \theta < \bar{\theta}.$$

By the continuity of $U_1(\theta)$ and $U_2(\theta)$, $U_1(\bar{\theta}^*) = U_2(\bar{\theta}^*)$. □

Proposition 7. **Local case** Follow Figure 6 for illustration. Consider the choice between submitting first to a general interest journal, and then to field (strategy 1), versus submitting to a field journal, and then to general interest (strategy 2). Consider the effort choice problem when choosing strategy i; let $e_i^*(\theta)$ denote the effort chosen by the author of type θ.

The utility from following strategy 1 is $U_1(\theta) = -c(e_1^*(\theta)) +$

$$+1 - F(\hat{q}-\theta-e_1^*(\theta)) + F(\hat{q}-\theta-e_1^*(\theta))\delta\left(\gamma\left(1 - F\left(\frac{\hat{q}-\theta-e_1^*(\theta)}{\alpha}\right)\right) + F\left(\frac{\hat{q}-\theta-e_1^*(\theta)}{\alpha}\right)\delta\bar{u}\right).$$

The utility from following strategy 2 is $U_2(\theta) = -c(e_2^*(\theta)) +$

$$+\gamma\left(1 - F\left(\frac{\hat{q}-\theta-e_2^*(\theta)}{\alpha}\right)\right) + F\left(\frac{\hat{q}-\theta-e_2^*(\theta)}{\alpha}\right)\delta\left(1 - F(\hat{q}-\theta-e_2^*(\theta)) + F(\hat{q}-\theta-e_2^*(\theta))\delta\bar{u}\right).$$

Assume $\gamma = 1$ and $\alpha = 1$, then $e_1^*(\theta) = e_2^*(\theta) = e^*(\theta)$, and both submission strategies are equally attractive. Consider the difference of the utility from the first submission strategy and the utility from the second submission strategy. Take a derivative with respect to α:

$$\frac{d}{d\alpha}(U_1 - U_2)|_{\alpha=1} = -(\gamma - \delta)\left[\hat{q} - \theta - e^*(\theta)\right] f(\hat{q} - \theta - e^*(\theta)).$$

Since $\theta + e^*(\theta)$ is increasing, the sign of $[\hat{q} - \theta - e^*(\theta)]$ determines the sign of the whole expression. When θ is high enough, the whole expression is negative: able authors prefer submitting to a field journal.

Consider now a change in γ:

$$\frac{d}{d\gamma}(U_1 - U_2)|_{\gamma=1} = -(1 - F(\hat{q} - \theta - e^*(\theta)))(1 - \delta F(\hat{q} - \theta - e^*(\theta))).$$

To model the simultaneous decrease in α and γ, express the relative change in α with $\lambda > 0$, and consider

$$\frac{-d}{d\gamma}(U_1 - U_2) + \lambda\frac{-d}{d\alpha}(U_1 - U_2)|_{\alpha=\gamma=1} = (1 - F(x))(1 - \delta F(x)) + \lambda[1 - \delta]xf(x),$$

where $x = \hat{q} - \theta - e(\theta)$. Authors of positive x (that is, with $\theta + e^*(\theta) < \hat{q}$) will prefer to pursue strategy 1 for every λ.

Take $\bar{x} < 0$, and pick $\lambda > \bar{\lambda}$, where

$$\bar{\lambda} = \frac{(1 - \delta F(x))(1 - F(x))}{xf(x)(1 - \delta)} > 0.$$

For this λ, agents in the neighborhood of $\bar{x}$ prefer strategy 2. Even so, as $x \to -\infty$ (that is, as $\theta \to +\infty$),

$$\frac{-d}{d\gamma}(U_1 - U_2) + \lambda\frac{-d}{d\alpha}(U_1 - U_2)|_{\alpha=\gamma=1} = \overbrace{(1 - F(x))}^{\to 1}\overbrace{[1 - \delta F(x)]}^{\to 1} + \lambda\overbrace{xf(x)}^{\to 0} > 0,$$

since $xf(x)$ has to converge to 0 so that ε has a mean. Therefore, for every λ, least- and most-able authors prefer submitting to the general interest journal first.

Non-local case For θ large enough, the probability of publishing in either journal is arbitrarily close to 1. This makes the payoff from submitting to the general interest journal approach 1, while the payoff from submitting to the field journal approaches to $\gamma < 1$. Therefore, by continuity authors of high enough ability prefer to submit to the general interest journal first.

From the local case proof, we know that type $\bar{\theta} = \hat{q} - E$, where E solves $c(E) = 1$, no matter what the chosen effort level, has $\hat{q} - \bar{\theta} + E - e^*(\bar{\theta}) = E - e^*(\bar{\theta}) > 0$, and therefore for every t, all authors of ability less than $\hat{q} - E$ prefer to submit to the general interest journal.

Under log-concavity of $f(\cdot)$, one can show that $-\frac{xf(x)}{(1-\delta F(x))(1-F(x))}$ has a unique extremum, and it is a maximum. Regardless of log-concavity, this fraction is positive at $(-\infty, 0)$; it is equal to 0 at $x = 0$; it converges to 0 as $x \to -\infty$ because ε has a finite mean, and therefore by the intermediate value theorem, there is an extremum in $(-\infty, 0)$, and there is at least one maximum. The derivative of this fraction provides a first-order condition:

$$\frac{-f(x) - xf'(x)}{(1-\delta F(x))(1-F(x))} - \frac{xf^2(x)(1+\delta-2\delta F(x)}{(1-\delta F(x))^2(1-F(x))^2} = 0 \Rightarrow$$

$$\Rightarrow 1 + x\frac{f'(x)}{f(x)} + \overbrace{\frac{xf(x)}{(1-\delta F(x))(1-F(x))}}^{\text{original fraction}}(1+\delta-2\delta F(x)) = 0.$$

Assume that there is more than one x that solves the equation above. Because $f'(0) = 0$, $f'(x)/f(x)$ is positive; because of log-concavity, $f'(x)/f(x)$ is decreasing; and therefore $xf'(x)/f(x)$ is increasing and negative[21] when $x < 0$, including the points that solve the FOC. Take a derivative with respect to x:

$$\overbrace{(1 + x\frac{f'(x)}{f(x)})'}^{>0} + \overbrace{\left(\frac{xf(x)}{(1-\delta F(x))(1-F(x))}\right)'}^{=0}(1+\delta-2\delta F(x)) + \overbrace{\underbrace{\frac{xf(x)}{(1-\delta F(x))(1-F(x))}}_{<0}\underbrace{(-2\delta f(x))}_{<0}}^{>0} > 0$$

The fraction $\frac{xf(x)}{(1-\delta F(x))(1-F(x))}$ has a slope of 0 at our chosen solutions of the FOC because of the way that we choose the points of evaluation: after all, these values are *exactly* the extrema of $\frac{xf(x)}{(1-\delta F(x))(1-F(x))}$! Therefore, our continuous FOC at all zeros has the same slope sign, which implies that there is exactly one FOC solution, which must be a maximum.

[21] The log-concavity is obviously beyond what is necessary to get this.

Because of the single-peakedness of $-\frac{xf(x)}{(1-F(x)(1-\delta F(x))}$, $\frac{-d}{d\gamma}(U_1-U_2)+\lambda\frac{-d}{d\alpha}(U_1-U_2)|_{\alpha=\gamma=1}=$

$$= \overbrace{(1-F(x))(1-\delta F(x))\lambda}^{>0}\left[\frac{1}{\lambda}+\frac{xf(x)}{(1-\delta F(x))(1-F(x))}\right],$$

where, as before, x is the shorthand notation for $\hat{q}-\theta-e^*(\theta))$. In order to obtain the existence of types that prefer submission to field journals first, one needs

$$\lambda > \min_x \frac{(1-\delta F(x))(1-F(x))}{-xf(x)}.$$

By the single-peakedness of $\frac{-xf(x)}{(1-\delta F(x))(1-F(x))}$, every large enough λ produces three intervals of x: one bounded, $(\underline{x},\bar{x})$, where $\lambda > \frac{(1-\delta F(x))(1-F(x))}{-xf(x)}$ for all $x \in (\underline{x},\bar{x})$, and two complementary unbounded ones. At $\bar{\theta}$ and $\underline{\theta}$, corresponding to $\underline{x}$ and $\bar{x}$, authors swing indifferently between two strategies. □

Proposition 8. Compare (1) and (4). Observe that $c'(2e) > c'(e)$, and therefore the per-paper effort has to be lower when two papers are written and submitted.

To calculate the total effort, denote $E=2e$. Rewrite (4) as

$$[1-\delta\bar{u}]f(\hat{q}-\theta-E/2)=c'(E). \tag{4'}$$

The right-hand sides of (1) and (4′) coincide. The left-hand sides are different only by the argument of $f(\cdot)$.

For single-peaked $f(\cdot)$, the nonzero intersection of $f(\hat{q}-\theta-e)$ and $f(\hat{q}-\theta-e/2)$ is unique; denote it $\bar{e}(\theta)$. It exists for small θ, where $f'(\hat{q}-\theta)>0$. If it does not exist, the marginal benefit of effort when writing two papers is always greater than the marginal benefit of effort when concentrating on one paper. Therefore, for author types of $\theta \geq \hat{q}$, the total effort of writing two papers is greater than the total effort from writing one paper.

Consider $\theta < \hat{q}$. When $\bar{e}(\theta)>0$, one can get it by solving:

$$f(\hat{q}-\theta-\bar{e}(\theta)) = f(\hat{q}-\theta-\frac{\bar{e}(\theta)}{2}).$$

Taking a derivative with respect to θ yields

$$\frac{\partial\bar{e}(\theta)}{\partial\theta} = -\frac{f'(\hat{q}-\theta-\bar{e}(\theta))-f'(\hat{q}-\theta-\frac{\bar{e}(\theta)}{2})}{f'(\hat{q}-\theta-\bar{e}(\theta))-\frac{1}{2}f'(\hat{q}-\theta-\frac{\bar{e}(\theta)}{2})} = -1-\frac{-\frac{1}{2}f'(\hat{q}-\theta-\frac{\bar{e}(\theta)}{2})}{f'(\hat{q}-\theta-\bar{e}(\theta))-\frac{1}{2}f'(\hat{q}-\theta-\frac{\bar{e}(\theta)}{2})}.$$

Since $f(\hat{q}-\theta-e)$ and $f(\hat{q}-\theta-e/2)$ are both single-peaked with respect to e with maxima at positive values, and the maximum of the latter is to the of from the maximum of the former, the intersection must have a $f'(\hat{q}-\theta-\frac{\bar{e}(\theta)}{2}) < 0$ and $f'(\hat{q}-\theta-\bar{e}(\theta)) > 0$. This makes the fraction above negative, and therefore a decrease in θ increases $\bar{e}(\theta)$. Therefore, there is at most unique point $\bar{\theta}$ such that $e^*(\bar{\theta}) = \bar{e}(\bar{\theta})$: total effort is the same for authors of ability $\theta = \bar{\theta}$, whether they write one or two papers. It exists because for $\theta_m = \arg\max_e e^*(\theta)$, $\bar{e}(\theta_m) > e^*(\theta_m)$, and $\bar{e}(\theta)$ is continuous.

$\bar{\theta}$ makes it possible to compare the size of the total effort required for concentrating on one paper with the required effort for working on two papers. If $\theta < \bar{\theta}$, the intersection of the marginal benefit curves is to the right of the $c'(e)$ curve, as on Figure 7b, which makes $f(\hat{q}-\theta-e^*(\theta)) > f(\hat{q}-\theta-e^*(\theta)/2)$, and therefore the effort from concentrating on one paper is greater than the total effort from working on two papers. Otherwise, the intersection of the marginal benefit curves is to the left of the $c'(e)$ curve, as in Figure 7a, $f(\hat{q}-\theta-e^*(\theta)) < f(\hat{q}-\theta-e^*(\theta)/2)$, and therefore the effort from concentrating on one paper is less than the total effort from working on two papers. $\square$

Proposition 9. It is trivial to establish that every author prefers working *solo* if γ is close to 0. For $\gamma = 1$, all authors strictly prefer publishing in collaboration: the coauthor's effort in this case is a free increase of θ. By continuity, when $\gamma < 1$, but close to 1, there are authors who would prefer to coauthor papers. For every $\gamma < 1$, there is an author with θ so high that their expected utility when publishing *solo* is at least γ. These authors would prefer publishing *solo*. By the continuity of the utility functions with respect to θ, there must be an author type who swings indifferently between submitting *solo*-written paper and coauthoring. Obviously, the higher is γ, the higher should be θ of the indifferent author:[22] The utility of coauthorship is monotone with respect to γ, and the utility of *solo* authorship is not dependent upon γ.

Take γ high enough (but still below 1), so that the θ of the indifferent author is above $\arg\max_\theta e^*(\theta)$. The marginal utility of an increase in θ for the strategy of *solo* publication of this indifferent author is

$$\frac{d}{d\theta}\underbrace{(1-[1-\delta\bar{u}])F(\hat{q}-\theta-e^*(\theta))-c(e^*(\theta))}_{U_1(\theta)} = [1-\delta\bar{u}]f(\hat{q}-\theta-e^*(\theta) = c'(e^*(\theta)),$$

where the first equality is from the Envelope theorem, and the second one is from the first-order condition (we cannot hit a place where the jump happens because the marginal benefit is locally declining). The marginal utility of coauthored publication is

$$\frac{d}{d\theta}\underbrace{(1-[1-\delta\bar{u}])F(\hat{q}-\theta-2e_2^*(\theta))-c(e_2^*(\theta))}_{U_2(\theta)} = [1-\delta\bar{u}]f(\hat{q}-\theta-2e_2^*(\theta)[1+\underbrace{\frac{de_2^*}{d\theta}}_{<0}] < c'(e_2^*(\theta)).$$

[22]If there is more than one indifferent author types, here we mean the one with the largest θ.

$\frac{de_2^*}{d\theta} < 0$ by the single-peakedness of the effort, and because the per-person effort peak for collaboration happens for a lower θ than for solo attempts, which is lower than the θ for the indifferent highly-able author. Since θ is high enough, $e^*(\theta) > e_2^*(\theta)$, which by the monotonicity of $c'()$ implies that $c'(e^*(\theta)) > c'(e_2^*(\theta))$, and therefore the author with somewhat higher θ will strictly prefer *solo* publication to coauthorship, and the reverse will hold for θ that is somewhat smaller than the indifferent agent. By the continuity of U_1 and U_2, there is an open interval to the left of the indifferent author where collaboration yields higher utility than solo authoring.

We have established the existence of authors who prefer to collaborate when $\gamma < 1$, but still large. To finish the proof, we will show that for every $\gamma < 1$ there is a small enough θ such that for all smaller ability levels, $e^*(\theta) > e_2^*(\theta)$. Take $\check{\theta}$ such that $e^*(\hat{\theta}) = e_2^*(\hat{\theta})$. There are at least two of such points: one is between the peaks of $e^*(\cdot)$ and $e_2^*(\cdot)$, and another one appears when $\gamma < 1$, when θ is small enough so that $f(\hat{q}-\theta-e)$ is increasing in e at $e = e^*(\theta)$ (such as the one plotted at Figure 8d). Let $\check{\theta}$ be the smaller one. For every θ smaller than $\check{\theta}$, $e^*(\theta) > e_2^*(\theta)$; the only caveat remaining to handle is the case of multiple intersections of the MB and MC functions, in the spirit of Figure 1d. If multiple intersections are an issue, observe that for a small enough θ, the lower intersection becomes the relevant one. Therefore, instead of using $\check{\theta}$ as the relevant threshold, one should use the minimum of $\check{\theta}$ and the value of θ for which the lower local maximum becomes the global maximum for both effort choice problems.

Since both U_1 and U_2 converge to 0 as $\theta \to -\infty$, $e^*(\theta) > e_2^*(\theta)$ for a small enough θ implies that $U_1(\theta) > U_2(\theta)$ for all these θ, too. Since we've established that small enough and large enough θ authors prefer to work *solo* for $\gamma < 1$, and we've shown that there is a positive mass of authors with interim abilities who prefer collaboration when γ is large enough (but still less than 1), there must be at least one bounded interval of abilities that contains collaborating authors. $\square$