Market for Talent under Asymmetric Information*

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Abstract

This study considers markets where one side "sells her talent" to the other side, but neither side can precisely quantify this talent. How to submit a paper to a journal, for instance, becomes a strategic task for authors, and whether to accept a seemingly good paper is also difficult for editors. In equilibrium, the seller adjusts her strategy by learning (rejection). Realizing that the "talent" could have been previously rejected by others, the buyer corrects his selection bias by raising the threshold of acceptance. Furthermore, in the induced dynamic game with incumbent and entrant buyers, the competition is unfair for the latter because at the time of entry, the latter will also receive the "talent" previously rejected by the former. This finding brings a new insight into the formation of entry barriers in such markets.

JEL classification: C72, D83, L13

Keywords: information asymmetry, learning, entry barriers, selection bias.

*I am indebted to Philippe Jehiel and Olivier Compte for their guidance. Thanks to Frédéric Koessler, Régis Renault, Huiyun Ding, Jean-Marc Tallon, Herbert Dawid, Francis Bloch, Andriy Zapechelnyuk, Francisco Poggi, Andrea Galeotti, Roland Strausz, Kevin He, Jan Knoepfle, Vincenzo Denicolo, Mira Frick, Goncalves Duarte, Tangren Feng and seminar participants at PSE, Sciences Po and ADRES doctoral conference. Thanks to the Ecoles Universitaires de Recherche - Paris Graduate School of Economics for funding grant ANR-17-EURE-0001.

1. Introduction

In labor markets, some employees do routine jobs like truck driving, accounting or programming. Meanwhile, more and more people with various talents present their abilities such as playing football, writing a film script, and conducting a prospective research project. However, "talent" is difficult to be quantified precisely by anyone. It is feasible to achieve certificates for accounting or driving a truck, but it is not for playing football or writing novels. Therefore, ***one key feature*** of the market for talent is there is a lot of noise in assessing one's talent, which is the major difference from traditional labor markets. This "seller-talent-buyer" market is illustrated with an example of "author-paper-journal" throughout this article. With many journals in the field, authors face a trade-off between the quality of journals and the possibility of acceptance. Journals want to publish papers of good quality but they know nothing about one paper's submission history. Once an editor receives a seemingly good one (after observing some good but noisy signals from the referees' reports), he worries about overvaluing it since the paper might have been rejected by other journals before. This unknown failure history only to the journals' side is ***the second key feature*** of this market, the information asymmetry. Due to it, for one journal, "receiving a paper" or "being selected" indicates that the paper in hand may not be as good as it seems. This selection bias effect is the main topic of this article. It discovers how journals take it into account when making optimal choices.

The author-paper-journal market is composed of several journals and an author who writes a paper of unknown quality. The quality depends on her type, which is her private information. The higher the type, the more likely the paper is of good quality. She submits her paper to a journal at some cost. If rejected, she tries another one. Journals publish a paper only when the quality is higher than some standard. The editor can not precisely know the quality but can observe a noisy signal. A high-quality paper is more likely to generate a good signal.

If journals are homogeneous, a low-type author knows that her paper is unlikely to be accepted. Therefore, only when the author's type is high enough will she submit her paper to a randomly selected journal. Being rejected indicates that her paper may not be of high quality and it might not be worthwhile to try again. Only those with relatively higher types continue. The process goes on until either the author finds it better to stop or she tries all journals.

To publish qualified papers, the editor needs to avoid any cognitive errors. First, he should realize that receiving a paper itself is an extra signal. The paper might have been rejected, and he should correct this selection bias effect by only accepting the papers with better signals. Otherwise, he overestimates the quality of the paper in his hand and sets a lower threshold of the signal than the rational editor. Secondly, the editor should know that the author decides to (re)submit or to quit based on her type rather than randomizing. If the editor is unaware of the fact that the paper in hand comes from a high-type author probably, he tends to set a higher threshold.

Counter-intuitively, as the market size gets larger with more journals, authors' welfare does not necessarily increase though they have more places to try. This is because once an editor receives a paper, it could have been rejected many times before. In other words, the selection bias effect is more significant. To correct it, the journals should raise their threshold, which makes it harder for the author to get a publication.

If journals are heterogeneous, the market splits. A high-type author targets top-class journals publishing good-quality papers because it brings a high payoff. A low-type author has an alternative, the ordinary journals with lower standards, because they have lower thresholds of signals and bring a higher probability of acceptance. Due to this separation, top-class journals receive papers of higher average quality. Thus, compared to the homogeneous case, they set a lower threshold of signals. It lets them publish more good-quality papers. Diversity is beneficial to efficiency.

However, if the difference (the standards of the quality, the payoffs from publication) between a top-class journal and an ordinary one is not that significant, a counterintuitive equilibrium could also exist. The ordinary journal with a lower standard of quality sets a higher threshold than the top-class one. More precisely, in this case, the top-class journal is the author's first option. The ordinary journal receives only the papers having been rejected and perceives that the quality is more likely to be bad, which causes the inverted thresholds of acceptance. The major finding of this article is, with multiple equilibria, which one is selected depends largely on which journal exists at first due to the two features discussed initially. This finding brings insights into the formation of entry barriers in such markets, even without the cost of entry.

If the top-class journal (incumbent) exists before the ordinary journal (entrant), the entrant is not able to challenge the incumbent by publishing papers of similar quality. Because when entering, it receives papers rejected by the incumbent previously and it can not distinguish between them, it must set an unfairly high threshold to select the good-quality papers mixed with bad-quality ones. As a result, both journals publish papers with similar quality but the entrant has a lower possibility of acceptance, which generates the convention among the authors that they should submit to the incumbent first. This convention leads the entrant to receive rejected papers again in the next period and all following periods. Then, competing with the incumbent leads to either the amount of publications being so small or many bad-quality papers being published. The better choice is to avoid competition and to be the authors' second option.

The key factor to generate this vicious cycle is the selection bias effect in the market. It stems from their noisy perceptions of quality and journals' ignorance about authors' submission histories. On the one hand, the entry barrier disappears when journals know the quality perfectly because now authors' histories are irrelevant and thus the information asymmetry does not exist. On the other hand, it becomes weaker when authors know the quality perfectly. For instance, by setting a high threshold, the entrant becomes the first option for authors with good-quality papers because they want to find a place where only good papers are published and this journal will bring a higher payoff. Moreover, if the incumbents deviate from setting optimal thresholds due to some cognitive errors, it reduces the level of selection bias effect in the market because either the papers rejected are too bad to pass another refereeing or they are worthy of being published as being not that bad. Thus, the entrant finds the chance to challenge the incumbents' status.

The analysis in this study have broader applications, like the formation of oligopolies in markets for talent: top clubs in a sports league (seller: juvenile players, buyer: sports club, oligopoly: Real Madrid and Barcelona), school admissions (seller: students, buyer: universities, oligopoly: Ivy league), or even the market of artists like record labels' oligopoly (seller: musicians, buyer: record label, oligopoly: Universal, Sony, and Warner).

The rest of the article is organized as follows: Section 2 presents the model. Section 3 characterizes the equilibrium. Section 4 analyzes the case with heterogeneous journals and shows the possibility of multiple equilibria. Section 5 discusses the existence of entry barriers. Section 6 concludes the study and provides scope for further discussion. All proofs are in Appendix D.

1.1. Related Literature

This study contributes to the literature of the market with noisy perception and information asymmetry: i) the analysis of the agents' learning process under noisy environment, and ii) the existence of an entry barrier in such markets.

Several existing studies of academic publishing have a similar model structure, Cotton [2013], Leslie [2005], Muller-Itten [2017], Ellison [2002] and Azar [2015]. Among them, Cotton [2013], Leslie [2005] and Ellison [2002] focus on the necessity of the submission fee and the lengthy refereeing. A similar result is found in this study that journals have the incentive to set some cost to screen those high-type authors. Muller-Itten [2017] puts more emphasis on the author's behavior. She defines a score system where the author's ranking of submission is based on a score including some factors like the quality of the paper, the difficulty of publication, etc. This idea could be traced back to Oster [1980]. Heintzelman and Nocetti [2009] use the score system to analyze the case that the journal could precisely perceive the quality. Azar [2015] presents a simple model with one author and one journal. He characterizes the agents' behavior and analyzes how it changes with submission cost, journals' standards, and the noise in the editor's signal. The information structure used in the model is similar to the one in Zhu [2012] and Lauermann and Wolinsky [2016]. They present the search model where the side with information disadvantage is sampled and receives noisy signals about the state. Different from the previous studies, this study focuses on how the agents learn about the state through each interaction, and how different mistakes they could have in this process bias their behaviors.

In regard to the equilibrium multiplicity, many studies (Cooper and John [1988] and Milgrom and Roberts [1990]) attribute it to strategic complementarities. Brock and Durlauf [2001] present a random field model where the agents are influenced by their neighbors' behavior, which follows the same intuition as the above two. In this study, the equilibrium multiplicity comes from the journals' ignorance of the authors' submission order and their noisy perception of quality. Moreover, it shows that in the induced dynamic game, an equilibrium that favors the incumbent will be selected, which provides a cornerstone for the existence of entry barriers. The mutation method introduced in Kandori et al. [1993] and Young [1993] is also used to see which equilibrium is selected in the long run.

There is little literature discussing the formation of entry barriers under information asymmetry. Some discuss the asymmetry between the incumbent and the entrant. Dell'Ariccia et al. [1999], Dell'Ariccia [2001] and Marquez [2002] present a model of the banking industry where the entrants face the adverse selection problem because they can not know whether the borrower has been rejected by the incumbent. Bofondi and Gobbi [2006] find evidence in Italian local markets. Seamans [2013] studies the U.S. cable TV industry and verifies the incumbent's limit pricing behavior. Langinier [2004] studies how the asymmetry influences the frequency of patent renewal which further changes the likelihood of entry. Some (Aghion and Bolton [1987], Martimort et al. [2021]) consider the asymmetry between the buyer and the seller where the information advantage side gains by contracting. Different from the previous studies, this study gives a simpler insight where the entrant suffers immediately once it enters the market due to the information asymmetry.

2. The Model

An author writes a paper of an unknown quality $q \in \mathbb{R}$. The quality q is contingent on her type $\theta \in \mathbb{R}$, which is her private information. The probability distribution of the quality conditional on the type follows a continuous density function $f(q|\theta)$, and f satisfies the monotone likelihood ratio property (MLRP). It means that a high-type author is more likely to write a paper of higher quality. Let the continuous function $\mu(\theta)$ be the prior distribution of the author's type.

Assume that there are m class-A journals. A publication in one of them yields a payoff $v > 1$ to the author. In each round, the author submits her paper to a journal with a submission cost $c < 1$. Getting rejected, she chooses another journal in the next round, or stop trying.

The journals only want to publish a paper of sufficiently high quality. Specifically, the journal's payoff of publishing a paper with quality q is $q - q_A$. They publish a paper if and only if the quality is higher than q_A. The journal can not precisely know the quality but can observe a noisy signal $s = q + \epsilon$, $\epsilon \sim \mathcal{N}(0, \sigma_s^2)$.

Importantly, the author keeps a record of historical submission failure but the selected journal does not know. Let $h \in H = \{\emptyset, (A), (A, A), ...\}$ be the set of all possible history. For example, $h = (A, A)$ means that the author submitted her paper to two journals of class-A in the first and second rounds and got rejected. For simplification, denote A^i as the history where the author tries i times but all fail ($A^0 = \emptyset$).

Strategy

The strategy of the author is a mapping from her type θ and her history h to either submitting her paper to a class-A journal or stopping, $\tau : \mathbb{R} \times H \to \{A, stop\}$. The strategy of the journal is a mapping from the signal s to either accepting or rejecting, $\eta_A : s \to \{Accept, Reject\}$.

Belief

The author, given the history h, updates a posterior distribution of the quality $\gamma(q|\theta, h)$ by applying Bayes' rule. For instance, if $h = (A)$, then

$$\gamma(q|\theta, h) = \frac{f(q|\theta) \int \mathbb{1}_{\{\eta_A(s)=Re\}} \phi(s, q, \sigma_s) ds}{\int dq f(q|\theta) \int \mathbb{1}_{\{\eta_A(s)=Re\}} \phi(s, q, \sigma_s) ds}$$

where ϕ is the probability density function of a normal distribution.

Receiving a paper, the editor of a class-A journal forms a belief β_A of the quality q.

Equilibrium

The perfect Bayesian equilibrium of this game is studied. A tuple $(\gamma, \tau, \eta_A, \beta_A)$ is a perfect Bayesian equilibrium if

1. Given signal s and belief β_A, class-A journals accept a paper ($\eta_A(s) = Ac$) if and only if the expected quality is higher than q_A,

$$\mathbb{E}_{\beta_A}[q|s] \geq q_A \tag{1}$$

2. Given her history h, the author calculates the expected payoff of submitting her paper to a class-A journal. That is,

$$\pi_A(\theta, h) = v \int \gamma(q|\theta, h) \int \mathbb{1}_{\{\eta_A(s)=Ac\}} \phi(s, q, \sigma_s) ds dq - c \tag{2}$$

   If $\pi_A(\theta, h) \geq 0$ and the author has not tried all journals, she submits her paper to a journal of class-A she has not tried before ($\tau(\theta, h) = A$). Otherwise, she stops ($\tau(\theta, h) = stop$).
3. Given τ and η_A, $\gamma(q|\theta, h)$ and $\beta_A(q)$ are derived by Bayes' rule.

2.1. *Preliminary Observation*

Journal's problem. Receiving a paper, the editor worries that it has been rejected by other journals before. In other words, receiving a paper is not good news. This selection bias effect should be considered when he forms the belief of the quality. The symmetric equilibrium, in which the author sets the submission order randomly, is considered first. A journal's position in the order is uniformly distributed. Then, the likelihood of the event that the editor receives a paper of quality q from the author with type θ and history h is

$$L(q, \theta, h = A^i) = \frac{1}{m} \cdot \mu(\theta) \cdot f(q|\theta) \cdot \left(\prod_{j=0}^{i} \mathbb{1}_{\{\tau(\theta, A^j)=A\}} \right) \cdot \left(\int \mathbb{1}_{\{\eta_A(s)=Re\}} \phi(s, q, \sigma_s) ds \right)^i \tag{3}$$

It is the probability that the journal is ranked in the $(i+1)^{th}$ position of the author's submission order, times the prior of θ, times the distribution of the quality conditional on type under the condition that the author submits and resubmits before and all get rejected. ϕ is the probability density function of a normal distribution.

The editor forms a belief of the quality

$$\beta_A(q) = \sum_{i=0}^{m-1} \int L(q, \theta, h = A^i) d\theta \Bigg/ \sum_{i=0}^{m-1} \iint L(q, \theta, h = A^i) d\theta dq \tag{4}$$

Given his belief, the editor uses a cutoff strategy because the distribution of signal s satisfies MLRP.

Lemma 1. *Given the editor's belief β_A, there exists a threshold s_A such that the journal accepts a paper if it observes a signal $s \geq s_A$, and otherwise, it rejects.*

Author's problem. Before deciding to submit, the author first forms a belief of the quality based on her type and her submission history h, $\gamma(q|\theta, h)$. Given lemma 1, it can be rewritten as follow

$$\gamma(q|\theta, h) = \frac{f(q|\theta)\Phi^i(s_A, q, \sigma_s)}{\int f(q|\theta)\Phi^i(s_A, q, \sigma_s)dq}, \ if \ h = A^i$$

where Φ is the cumulative distribution function of a normal distribution. Note that $\gamma(q|\theta, h)$ also satisfies the MLRP.

Then, the author faces a trade-off between the gain from publication and the submission cost. She finds it optimal to submit if

$$v \int \gamma(q|\theta, h)[1 - \Phi(s_A, q, \sigma_s)]dq \geq c$$

Obviously, as the author receives more rejections, she should know her paper is less likely to be of high quality. Thus, the gain (left hand side) will finally be lower than the cost. She should stop submitting. Moreover, the gain is increasing with the type because of MLRP. Thus, there is a sequence of types, $\theta_0 < \theta_1 < \theta_2 < ... < \theta_{m-1}$ where the authors with type $\theta < \theta_0$ never submits; those with type $\theta \in (\theta_0, \theta_1)$ submits only once; those with type $\theta \in (\theta_1, \theta_2)$ submits twice; so on and so forth.

Lemma 2. *Given s_A, for any history h, there exists a unique $\theta^*_A(h) \in (-\infty, +\infty)$ such that $\pi_A(\theta^*_A(h), h) = 0$. Not having tried all class-A journals, the author with history h submits her paper to a class-A journal if her type $\theta \geq \theta^*_A(h)$. She stops if her type $\theta < \theta^*_A(h)$ or $h = A^m$. Moreover, $\theta^*_A(A^{m-1}) > ... > \theta^*_A(A) > \theta^*_A(\emptyset)$.*

3. Equilibrium Characterization

This section characterizes the equilibrium of this model. First, I find that a unique symmetric equilibrium exists. I analyze how the agents' behavior changes with the number of journals, the author's benefit-cost ratio, and the diminishing noise in agents' perception. Then, I consider the possible mistakes the agents could make, and find that different mistakes lead the editor to set either higher or lower thresholds.

Proposition 1. *A unique symmetric equilibrium exists. The journals' threshold is s_A^*. The author with history A^i ($i = 0, 1, ..., m-1$) submits her paper to a journal randomly selected from those she has not tried yet if and only if her type $\theta > \theta_A^*(A^i)$.*

3.1. Comparative Statics

3.1.1. The Number of Journals

As the number of journals increases, two effects influence the agents' behavior. First, it decreases the probability that one journal is on the top positions of the author's submission order. Thus, the submitted paper could have been rejected many times before. That is to say, the quality is less likely to be high. To correct this selection bias, journals should raise their threshold.

Secondly, only the author with a relatively higher type is willing to resubmit after getting rejected. It increases the average quality of the paper submitted and makes journals set a lower threshold. However, this effect dominates only when submission cost is extremely high.

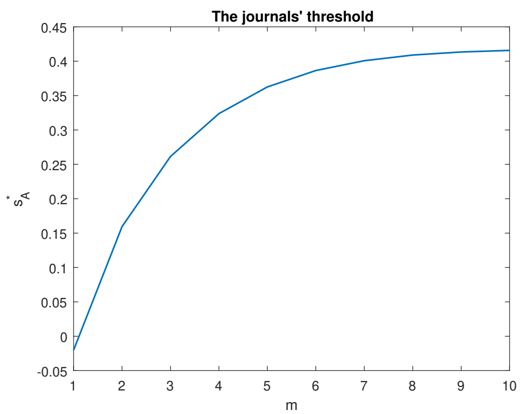
Proposition 2. *There is $\underline{c} \in (0, v]$ such that if $c < \underline{c}$, s_A^* is increasing in m, and $\theta_A^*(h)$ is increasing in m for any $h \in H$.*

Example 1. *The author's type θ follows a normal distribution: $\mu(\theta) = \phi(\theta, 0, \sigma_\theta)$. The quality conditional on the type follows a normal distribution: $f(q|\theta) = \phi(q, \theta, \sigma_q)$.*

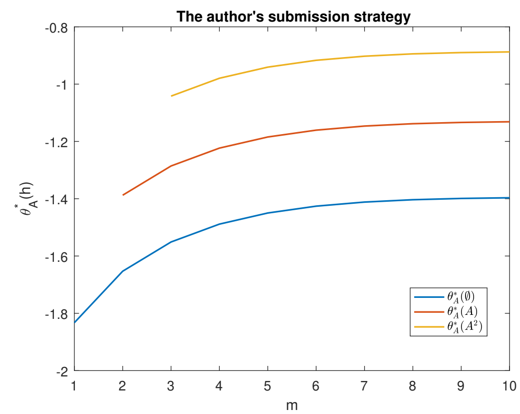
In Figure 1, Panel (a) and (b) show that both s_A^* and θ_A^* increase as the number of journals increases. Moreover, they converge to some value. It is somewhat counterintuitive because as the number of journals becomes extremely big, the probability that one journal is selected is very small. Therefore, being selected is very bad news: the author should have tried and failed many times before. It should make journals set an infinitely high threshold.

For most authors, after getting rejected for several rounds, their beliefs of the quality have been passive enough. They find that the payoff from resubmitting is lower than submission cost. Therefore, once the journal receives a paper, it knows the author could not have been rejected for infinite times. That is the reason for convergence. In contrast, if one lets submission cost approach 0, s_A^* and θ_A^* do not have any convergence, which is shown in Panel (c) and (d) in Figure 1. □

With more journals in the market, authors have more places to try but the welfare does not necessarily increase because the selection bias effect raises the threshold of acceptance. When this effect is significant in the market, it becomes harder for the author to get a publication even if the submission cost is negligible (in which case authors try until there is



((a))



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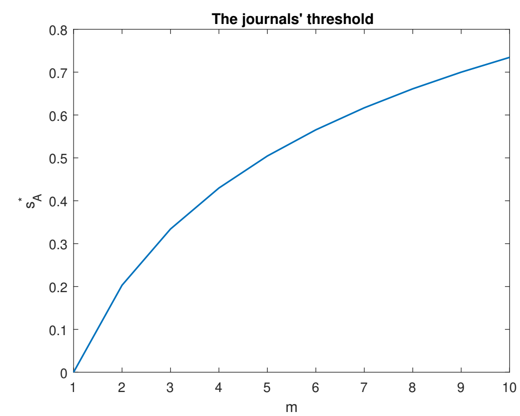

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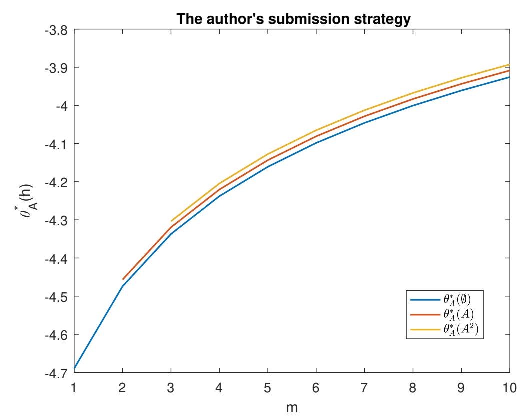


((d))

Fig. 1. The upper-left graph is journals' strategy s_A^* under different numbers of journals. The upper-right graph is the author's strategy $\theta_A^*(h)$. The parameters are: $\sigma_\theta = \sigma_q = \sigma_s = 1$; $q_A = 0$; $v = 2$ and $c = 0.2$. The bottom two graphs assume $c = 0.001$.

no chance left whatever their type). We define the welfare of the market by $TQ(m)$,

$$\begin{aligned} TQ(m) &= \mathbb{E}[q - q_A|Accepted] \cdot Pr[Accepted] \\ &= \iint (q - q_A)\mu(\theta) f(q|\theta) \sum_{i=0}^{m-1} \Phi^i(s_A, q, \sigma_s)[1 - \Phi(s_A, q, \sigma_s)] d\theta dq \end{aligned}$$

It means the quality increments based on the minimum standard q_A from those papers being published finally. Then, we compare $TQ(1)$ and $TQ(2)$ under different minimum standards, as shown in figure 2. The welfare is higher when q_A is low. This is because when the minimum standard is low, the journal tends to set a lower threshold of acceptance. Then, being rejected implies that the paper is quite bad, which makes the selection bias effect more significant. In this situation, adding another journal raises the threshold further and makes the acceptance harder not only for rejected papers but also for unrejected ones.

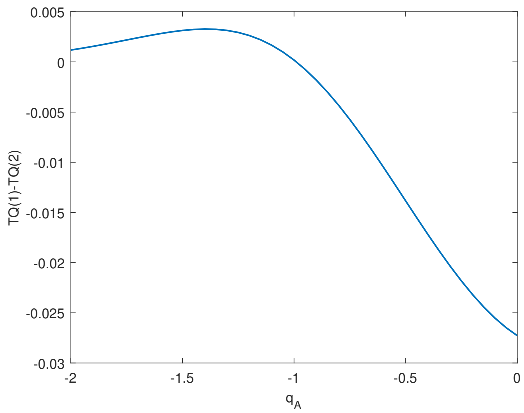


Fig. 2. Keep the settings of Example 1. The parameters are: $\sigma_\theta = \sigma_q = 1$, $\sigma_s = 2$ and $c = 0$.

3.1.2. *The Ratio v/c*

As the value from publication increases compared to the cost, it leads the author with lower type to try or try again. Under this case, journals receive low-quality papers more often. Thus, they will increase their thresholds.

Proposition 3. *$\theta_A^*(h)$ is decreasing in v/c for any $h \in H$. s_A^* is increasing in v/c.*

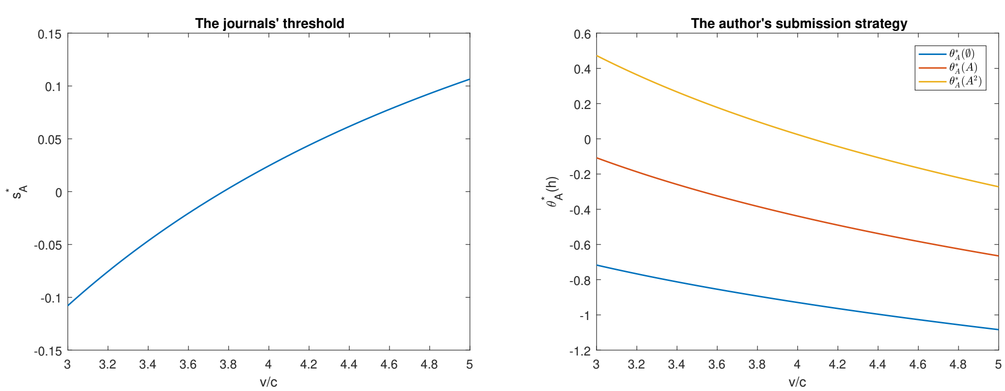


Fig. 3. The left graph is journals' strategy s_A^* under different v/c ratios. The right graph is the author's strategy θ_A^*. The parameters are: $\sigma_\theta = \sigma_q = \sigma_s = 1$; $q_A = 0$ and $m = 3$.

Keeping the setting of example 1, Figure 3 shows the trends of s_A^* and θ_A^* changing with different v/c. A higher submission cost discourages submission from low-type authors. It can be used as a tool to filter them. If journals form a coalition and set a positive submission cost cooperatively, they should let the expected quality of the marginal author's paper equal q_A.

3.1.3. Author Knows the Quality

If the author knows the quality before submission ($f(q|\theta)$ is a delta function), then her problem reduces to whether

$$\pi_A(q,h) = v[1-\Phi(s_A,q,\sigma_s)] - c > 0$$

She does not learn anything from rejection, and her payoff function does not depend on her history. If the quality is higher than some q^* making $v[1-\Phi(s_A,q^*,\sigma_s)] = c$, then she always submits her paper until she gets a publication or there is no chance left. This feature is different from the finding in the previous case where the author has only a rough perception of quality. In Appendix A, I analyze how the degree of this ignorance affects the agents' behavior in more detail.

Although the journals know the quality is at least q^*, it could be rejected before. In other words, selection bias still exists.

A preliminary result is q^* must be lower than q_A in the equilibrium. If it is not the case, the editor accepts the paper regardless of the signal it receives, knowing its quality is higher than the standard. Then, the author also submits the paper when the quality is lower than q^*.

Proposition 4. *A unique symmetric equilibrium exists, in which the threshold of the journal is s_A^*, and the author submits her paper to a journal randomly selected from those she has not tried yet if and only if its quality $q > q^*$, where $q^* < q_A$.*

3.1.4. Journal Observes the Quality Perfectly

Observing the quality perfectly ($s = q$ or $\sigma_s = 0$), the editor accepts a paper if $q > q_A$. In this case, there is no information asymmetry. Thus, after receiving the rejection, the author learns that her paper will not be accepted by another journal. Her problem reduces to

$$\pi_A(\theta) = v[1 - F(q_A|\theta)] - c > 0$$

θ' is the type that makes $\pi_A(\theta)$ equal 0. Then, only the author with the type $\theta > \theta'$ submits her paper. Once she gets rejected, she never submits again.

3.2. *Bounded Rational Editor*

This section discusses the possible mistakes the editor could make depending on his bounded rationality. The first kinds of naive editors do not realize that "being sampled" contains some information. The second kinds of bounded rational editors do not know that the author has private information (her type) and takes action based on it, but believe that she submits with some probability given each history.

3.2.1. *Editor with "Sampling Curse"*

The following simplified case is illustrated: the type of the author θ is either high (H) or low (L). There are two journals. Table 1 lists the likelihood $l(\theta, h)$ of the combination of the author's type θ and his history h, where μ_θ is the prior distribution of type and P_θ^R is probability that the paper of the type-θ author is reject. $P_H^R < P_L^R$, which means that the high-type author is less likely to get rejection. It is assumed that the submission costs are negligible so that the author will try again regardless of his type.

$\theta \backslash h$	$\emptyset$	(A)
H	μ_H	$\mu_H \cdot P_H^R$
L	μ_L	$\mu_L \cdot P_L^R$

Table 1: Likelihood of the combination of the author's type θ and his history h.

The naive editor knows the prior distribution of the authors' type and the conditional probability of the author's history given her type,[1] but does not realize that "receiving a paper" itself is an extra signal. He computes the probability,

$$Pr\left[\theta = H, h = \emptyset\right] = Pr\left[\theta = H\right] Pr\left[h = \emptyset \middle| \theta = H\right] = \frac{\mu_H}{1 + P_H^R}$$

and

$$Pr\left[\theta = L, h = \emptyset\right] = Pr\left[\theta = L\right] Pr\left[h = \emptyset \middle| \theta = L\right] = \frac{\mu_L}{1 + P_L^R}$$

However, for the sophisticated editor being aware of "sampling curse", he computes the conditional probability

$$\begin{aligned} Pr\left[\theta = H, h = \emptyset \middle| sampled\right] &= \frac{\frac{1}{2} l(H, \emptyset)}{\frac{1}{2} l(H, \emptyset) + \frac{1}{2} l(L, \emptyset) + \frac{1}{2} l(H, (A)) + \frac{1}{2} l(L, (A))} \\ &= \frac{\mu_H}{1 + \mu_H P_H^R + \mu_L P_L^R} \end{aligned}$$

[1]In a real situation, the naive editor perceives that from asking his colleagues how many times their papers have been rejected and whether they will submit again.

and

$$\begin{aligned} Pr\left[\theta = L, h = \emptyset \middle| sampled\right] &= \frac{\frac{1}{2}l(L,\emptyset)}{\frac{1}{2}l(H,\emptyset) + \frac{1}{2}l(L,\emptyset) + \frac{1}{2}l(H,(A)) + \frac{1}{2}l(L,(A))} \\ &= \frac{\mu_L}{1 + \mu_H P_H^R + \mu_L P_L^R} \end{aligned}$$

It is easy to verify that $Pr[\theta = H, h = \emptyset] > Pr[\theta = H, h = \emptyset | sampled]$ and $Pr[\theta = L, h = \emptyset] < Pr[\theta = L, h = \emptyset | sampled]$ and it is also true for history $h = (A)$. The naive editor overestimates the author's type, and furthermore, the paper's quality. Thus, compared to the sophisticated editor, he tends to set a lower threshold of the signal.

Proposition 5. *When search costs are negligible $c \to 0$, the naive editor sets a threshold $\tilde{s}_A < s_A^*$.*

3.2.2. Editor with Analogy-based Expectation

Another kind of bounded rational editor who does not know that the author has private information (her type) is considered. He only observes that a proportion of the authors quit after being rejected, without realizing that the author takes action according to her type (the high-type author resubmits but the low-type quits). Then, he believes that the author rejected mixes between resubmitting and stopping. The analogy-based approach (Jehiel [2005]) is used to characterize the solution concept.

Analogy-based Expectation Equilibrium (ABEE)

A tuple $(\gamma, \hat{\tau}, \hat{\eta}_A, \hat{\beta}_A, \xi, \alpha)$ is an ABEE if

1. Bounded rational editors put the authors with the same history h but different types into the same analogy class $\alpha(h)$, and form an analogy-based expectation that the author (re)submits with Probability $\xi(h)$, and stops with Probability $1 - \xi(h)$.

$$\xi(h) = \int \mu(\theta|h) \mathbb{1}_{\{\hat{\tau}(\theta,h)=A\}} d\theta$$

$\mu(\theta|h)$ is the distribution of authors' type conditional on their history h.

2. Given signal s and belief $\hat{\beta}_A$, class-A journals accept a paper ($\hat{\eta}_A(s) = Ac$) if and only if the expected quality is higher than q_A,

$$\mathbb{E}_{\hat{\beta}_A}[q|s] \geq q_A$$

3. Given her history h, the author calculates the expected payoff of submitting her paper

to a class-A journal. That is,

$$\hat{\pi}_A(\theta,h) = v\int \gamma(q|\theta,h)\int \mathbb{1}_{\{\hat{\eta}_A(s)=Ac\}}\phi(s,q,\sigma_s)dsdq - c$$

If $\hat{\pi}_A(\theta,h) \geq 0$ and the author has not tried all journals, she submits her paper to a journal of class-A she has not tried before ($\hat{\tau}(\theta,h) = A$). Otherwise, she stops ($\hat{\tau}(\theta,h) = stop$).

4. Given $\hat{\tau}$ and $\hat{\eta}_A$, $\gamma(q|\theta,h)$ and $\hat{\beta}_A(q)$ are derived by Bayes' rule.

$$\hat{\beta}_A(q) = \sum_{i=0}^{m-1}\hat{f}(q,h=A^i)\Bigg/\sum_{i=0}^{m-1}\int \hat{f}(q,h=A^i)dq$$

$$\hat{f}(q,h=A^i) = \frac{1}{m}\cdot\int \mu(\theta)\cdot f(q|\theta)d\theta\cdot\left(\prod_{j=0}^{i}\xi(A^j)\right)\cdot\left(\int \mathbb{1}_{\{\hat{\eta}_A(s)=Re\}}\phi(s,q,\sigma_s)ds\right)^i$$

In this case, the bounded rational editor is unaware of the fact that the paper in hand probably comes from a high-type author. Thus, compared to the sophisticated editor, he tends to set a higher threshold of the signal.

Proposition 6. *The bounded rational editor with analogy-based expectation sets a threshold $\hat{s}_A > s_A^*$.*

3.3. Asymmetric Equilibrium and Stability

In the previous analysis, I consider the symmetric equilibrium in which the author randomly chooses a journal. If she has a specific submission order, it may lead to an asymmetric equilibrium. The existence is not guaranteed, however.

For instance, there are two class-A journals: A1 and A2. The author always tries A1 first, and then A2 after getting rejected. Importantly, in equilibrium, A2 should set a higher threshold than A1. If it is not the case, the author finds it better to submit to A2 first. A2 has an incentive to do so because it receives papers rejected by A1. On the other hand, it has less incentive to do so because those low-type authors getting rejected stop trying. If the second effect dominates, the asymmetric equilibrium does not exist.

Example 2. *There are two class-A journals: A1 and A2. The author's type θ follows a normal distribution: $\mu(\theta) = \phi(\theta, 0, \sigma_\theta)$. The quality conditional on the type follows a normal distribution: $f(q|\theta) = \phi(q,\theta,\sigma_q)$. The parameters are: $\sigma_\theta = 0.5$, $\sigma_q = \sigma_s = 1$; $q_A = 3$; $v = 2$ and $c = 1.2$.*

We try to find the asymmetric equilibrium where the author does not randomly select the journal. If the author has a specific submission order: 'first A1 then A2', A1 sets a threshold of signal $s_1 = 2.78$*, and the author with a type* $\theta > 3.14$ *submits to A1. Getting rejected, she submits to A2 when her type* $\theta > 4.08$*, and A2 sets a threshold* $s_2 = 2.73$*.*

A2's threshold is lower than A1. The author has no incentive to submit A1 first. Similarly, 'first A2 then A1' can not be an equilibrium. $\square$

Note that when submission cost approaches 0, the second effect diminishes. Multiple equilibria exist. Section 4.2 and Section 5 discuss the general situation in more detail. Moreover, if asymmetric equilibria exist, the symmetric one is not stable. This is because if there is little difference between journals' thresholds, the journal with a low one becomes the first option for the author. In other words, there is a specific order of submission, which is the asymmetric equilibrium. However, it seems counterfactual because, in reality, not every author has the same order of submission.

One way to explain this paradox is to assume that the authors' payoffs are heterogeneous. Author i's payoff is v plus some subjective preference ϵ_i^j to journal j.

$$v_i^j = v + \epsilon_i^j,\ \epsilon_i^j \sim \mathcal{N}(0, \sigma_\epsilon^2)$$

Then, if we consider two journals A and B and their approximately close threshold s_A and s_B, author i submits to A first if

$$(v + \epsilon_i^A) Pr[Accepted\ by\ A|s_A] > (v + \epsilon_i^B) Pr[Accepted\ by\ B|s_B]$$

$$\epsilon_i^A - \epsilon_i^B > \frac{v\big(Pr[Accepted\ by\ A|s_A] - Pr[Accepted\ by\ B|s_B]\big)}{Pr[Accepted\ by\ A|s_A]} =: k$$

The approximate probability that author i submits to A first is $1 - \Phi(k, 0, 2\sigma_\epsilon^2)$. As long as the variance is sufficiently large to resist the perturbation of thresholds, the symmetric equilibrium is stable.

4. Competition

This section introduces another class of journals having a lower standard compared to class-A journals. I characterize the agents' behavior and compare it with the previous case. Then, I find that there could be multiple equilibria. It triggers the idea of entry barriers in such markets.

4.1. *Class-B Journals Exist*

Now suppose there are infinitely many class-B journals besides class-A journals. The payoff from publication on a class-B journal is normalized to 1, and the submission cost is c. The other settings are similar as in the previous case. The payoff of publishing a paper with quality q for a class-B journals is $q - q_B$, $q_B < q_A$. Like class-A journals, they can not precisely know the quality but can observe a noisy signal $s = q + \epsilon$, $\epsilon \sim \mathcal{N}(0, \sigma^2)$.

In each round, the author can submit her paper to a journal of either class. If her paper is accepted and published, she receives the corresponding payoff. Otherwise, she can choose another journal to submit in the next round. It is assumed that the author wants to publish her paper as quickly as possible, which means that her preference ranks as follow: publish in a class-A journal $\succ$ publish in a class-B journal $\succ$ rejected in this round and publish in a class-A journal in the next round $\succ$ rejected in this round and publish in a class-B journal in the next round $\succ$ ...

Let $\tilde{h} \in \tilde{H} = \{\emptyset, (A), (B), (A, A), (A, B), (B, B), ...\}$ be the set of possible history of the author's submission. For example, $\tilde{h} = (A, A, B)$ means that the author submitted her paper to two class-A journals in the first and second rounds and got rejected. In the third round, she submitted it to a class-B journal and got rejected. For simplification, denote $A^i B^j$ as the history that the author tries class-A journals i times and class-B journals j times but fails all.

Strategy

The strategy of the author is a mapping from her type θ and her history $\tilde{h}$ to either submitting her paper to A, to B, or stopping, $\tilde{\tau} : \mathbb{R} \times \tilde{H} \rightarrow \{A, B, stop\}$. The strategy of class-A journal is a mapping from the signal s it receives to either accepting or rejecting, $\tilde{\eta}_A : s \rightarrow \{Accept, Reject\}$. Similarly, $\tilde{\eta}_B : s \rightarrow \{Accept, Reject\}$.

Belief

Given the history $\tilde{h}$, the author forms a posterior distribution of the quality $\gamma(q|\theta, \tilde{h})$ by applying Bayes' rule. Receiving a paper, the editor of a class-A journal forms a belief of the quality $\tilde{\beta}_A$. Similarly, denote $\tilde{\beta}_B$ as class-B journal's belief after receiving a paper.

Equilibrium

I use the perfect Bayesian equilibrium concept. A tuple $(\gamma, \tilde{\tau}, \tilde{\eta}_A, \tilde{\eta}_B, \tilde{\beta}_A, \tilde{\beta}_B)$ is a perfect Bayesian equilibrium if

1. Given signal s and belief $\tilde{\beta}_A$, class-A journals accept the paper ($\tilde{\eta}_A(s) = Ac$) if and

only if its expected quality is higher than q_A,

$$\mathbb{E}_{\tilde{\beta}_A}[q|s] \geq q_A \tag{5}$$

Given signal s and belief $\tilde{\beta}_B$, class-B journals accept the paper ($\tilde{\eta}_B(s) = Ac$) if and only if

$$\mathbb{E}_{\tilde{\beta}_B}[q|s] \geq q_B \tag{6}$$

2. Given her history $\tilde{h}$, the author compares the expected payoff from submitting her paper to a journal of either class. That is,

$$\pi_A(\theta, \tilde{h}) = v \int \gamma(q|\theta, \tilde{h}) \int \mathbb{1}_{\{\tilde{\eta}_A(s)=Ac\}} \phi(s, q, \sigma_s) ds dq - c \tag{7}$$

and

$$\pi_B(\theta, \tilde{h}) = \int \gamma(q|\theta, \tilde{h}) \int \mathbb{1}_{\{\tilde{\eta}_B(s)=Ac\}} \phi(s, q, \sigma_s) ds dq - c \tag{8}$$

If $\pi_A(\theta, \tilde{h}) \geq \max\{0, \pi_B(\theta, \tilde{h})\}$, then she submits her paper to a journal of class-A: $\tilde{\tau}(\theta, \tilde{h}) = A$. If $\pi_B(\theta, \tilde{h}) \geq \max\{0, \pi_A(\theta, \tilde{h})\}$, she submits it to one of class-B: $\tilde{\tau}(\theta, \tilde{h}) = B$. Otherwise, she stops: $\tilde{\tau}(\theta, \tilde{h}) = \textit{stop}$.

3. Given $\tilde{\tau}$, $\tilde{\eta}_A$ and $\tilde{\eta}_B$, γ, $\tilde{\beta}_A$ and $\tilde{\beta}_B$ are derived by Bayes' rule.

Journal's problem. Journals have the same problem as the previous case. Given their belief, class-A journals set a threshold of the signal s_A, and class-B journals set s_B.

Lemma 3. *There exists a s_A (s_B) such that the journal in class-A (B) accepts the paper if it observes a signal $s > s_A$ ($s > s_B$), and otherwise, it rejects.*

Author's problem. First, the author's posterior belief can be rewritten as

$$\gamma(q|\theta, \tilde{h}) = \frac{f(q|\theta)\Phi(s_A, q, \sigma_s)\Phi(s_B, q, \sigma_s)}{\int dq f(q|\theta)\Phi(s_A, q, \sigma_s)\Phi(s_B, q, \sigma_s)}, \; if \; \tilde{h} = (A, B)$$

Then, the author faces three choices, submitting her paper to a class-A journal, to a class-B journal, or stopping. The expected payoff from submitting her paper to class-A (B) journals can be rewritten as

$$\pi_A(\theta, \tilde{h}) = v \int \gamma(q|\theta, \tilde{h})[1 - \Phi(s_A, q, \sigma_s)] dq - c$$

and

$$\pi_B(\theta, \tilde{h}) = \int \gamma(q|\theta, \tilde{h})[1 - \Phi(s_B, q, \sigma_s)] dq - c$$

The author compares the payoffs if they are positive. For a high-type author, she finds it optimal to submit her paper to a class-A journal because it could bring a higher payoff from publication. After getting several rejections, she perceives that the quality is less likely to be high. Thus, she either turns to a class-B journal if $\pi_B > 0$, or stops if $\pi_B < 0$. For a medium-type author, a class-B journal is the optimal choice, guaranteeing a relatively higher probability of acceptance. She continues until $\pi_B < 0$. For a low-type author, she finds it not optimal to try either class of journals.

Lemma 4. *Given s_A and s_B, for any history $\tilde{h}$, there exists a unique $\theta_A^*(\tilde{h}) \in (-\infty, +\infty)$ such that $\pi_A(\theta_A^*(\tilde{h}), \tilde{h}) = 0$; there exists a unique $\theta_B^*(\tilde{h}) \in (-\infty, +\infty)$ such that $\pi_B(\theta_B^*(\tilde{h}), \tilde{h}) = 0$; there exists a unique $\theta^*(\tilde{h}) \in [-\infty, +\infty)$ such that $\pi_A(\theta^*(\tilde{h}), \tilde{h}) = \pi_B(\theta^*(\tilde{h}), \tilde{h})$.*

If the author has not tried all class-A journals, then

- *if $\theta^*(\tilde{h}) > \theta_A^*(\tilde{h}) > \theta_B^*(\tilde{h})$, the author with history $\tilde{h}$ submits her paper to a class-A journal if her type $\theta \geq \theta^*(\tilde{h})$. She submits it to a class-B journal if her type $\theta \in [\theta_B^*(\tilde{h}), \theta^*(\tilde{h}))$. She stops if her type $\theta < \theta_B^*(\tilde{h})$.*
- *if $\theta^*(\tilde{h}) \leq \theta_A^*(\tilde{h}) \leq \theta_B^*(\tilde{h})$, the author with history $\tilde{h}$ submits her paper to a class-A journal if her type $\theta \geq \theta_A^*(\tilde{h})$. She stops if her type $\theta < \theta_A^*(\tilde{h})$.*

Otherwise, the author submits her paper to a class-B journal if her type $\theta \geq \theta_B^*(\tilde{h})$. She stops if her type $\theta < \theta_B^*(\tilde{h})$.

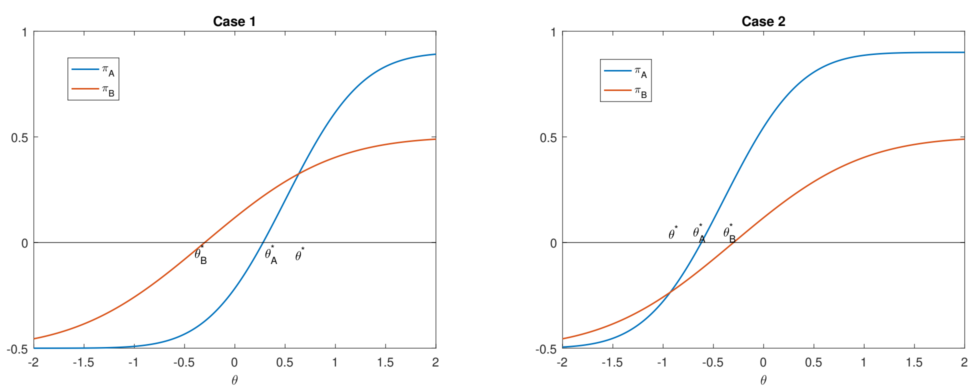


Fig. 4. Two cases of the order of $\theta^*(\tilde{h})$, $\theta_A^*(\tilde{h})$ and $\theta_B^*(\tilde{h})$.

These two lemmas characterize the agents' best responses. Moreover, one could find that $\theta^*(\tilde{h})$, $\theta_A^*(\tilde{h})$ and $\theta_B^*(\tilde{h})$ are continuous in s_A and s_B, and the best responses of journals s_A^* and s_B^* should be bounded. Therefore, an equilibrium exists.

Proposition 7. *An equilibrium exists where class-A (B) journals' threshold is s_A^* (s_B^*), and the author behaves in the way described in lemma 4.*

Remark 1: class-A journals' threshold

Compared to the case in the previous section, class-A journals receive papers from the higher-type author because now the low-type author has an alternative, class-B journals. Therefore, class-A journals set a lower threshold because the quality is more likely to be high ex ante.

Example 3. *Consider there is one class-A journal and other settings keep the same as in the example 1. In the left graph of Figure 5, the blue curve represents the threshold of the journal s_A^* under different standards q_A. In the right graph, the blue curve represents the author's strategy θ^*. She submits her paper to class-A journal if and only if her type $\theta > \theta^*$. Then, if we introduce class-B journals, the red curve in the left graph represents s_A^*. In the right graph, if the author's type is above the red curve, she submits her paper to class-A journal. Otherwise, she either chooses a class-B journal, or she stops.*

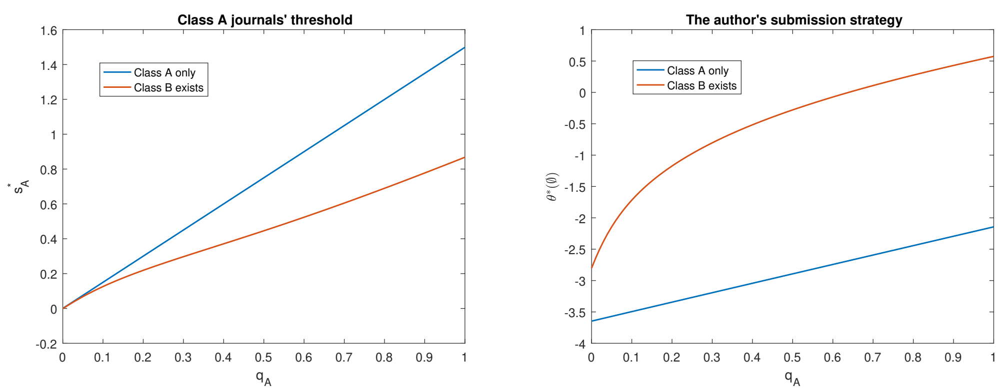


Fig. 5. The left graph is journals' strategy s_A^*. The right graph is the author's strategy $\theta^*(\emptyset)$. If her type θ is higher than $\theta^*(\emptyset)$, she submits her paper to class-A journal. The parameters are: $\sigma_\theta = \sigma_q = \sigma_s = 1$; $q_B = -1$; $v = 2$ and $c = 0.01$.

In the right graph, the red curve is above the blue one. It means that with the existence of class-B journals, the author with a lower type will submit her paper to them instead of class-A journal. The left graph shows that class-A journal's threshold s_A^* is lower because the author's type is higher. $\square$

Introducing class-B journals makes high-type author's paper easier to be accepted by class-A journals. In Appendix B, I analyze how this diversity affects market efficiency in more detail. I find that journals publish more papers, and good-quality papers are easier to be published.

Remark 2: Author's patience

In the above analysis, it is assumed that the author wants to publish her paper as quickly as possible. In contrast, not hurrying to publish her paper, she will try more class-A journals before switching to class-B journals. Let δ be the discount factor. An author with type θ and history $\tilde{h}$ finds it optimal to submit her paper to a class-A journal instead of a class-B one if

$$vPr[s > s_A|\theta, \tilde{h}]+\delta u(\tilde{h}A)(1-Pr[s > s_A|\theta, \tilde{h}]) > Pr[s > s_B|\theta, \tilde{h}]+\delta u(\tilde{h}B)(1-Pr[s > s_B|\theta, \tilde{h}])$$

where $u(\tilde{h}A)$ is the valuation function if the author's history becomes $\tilde{h}A$. Obviously, $u(\tilde{h}A) > u(\tilde{h}B)$ and $Pr[s > s_A|\theta, \tilde{h}] < Pr[s > s_B|\theta, \tilde{h}]$. Therefore, if an extremely impatient author with type θ and history $\tilde{h}$ is indifferent between A and B ($vPr[s > s_A|\theta, \tilde{h}] = Pr[s > s_B|\theta, \tilde{h}]$), then for a patient author, submitting to a class-A journal yields a higher payoff than to a class-B one. Under such situation, class-A journals will raise their thresholds because they receive a paper having been probably rejected more times.

4.2. Equilibrium Multiplicity

There could be multiple equilibria when the number of journals is finite. To better illustrate the intuition, I use the simplified case. Consider two journals A and B with different standards of qualities $q_A > q_B$. There is no submission fee ($c \to 0$), and a publication in either journal yields the same payoff to the author ($v \to 1$). Under this setting, one need not compute the author's cutoff strategy θ^* but consider her submission order. This simplified case could be extended generally, which is discussed in Section 5.

One apparent equilibrium is that journal A sets a higher threshold than journal B ($s_A > s_B$) because the former has a higher standard. Then, the author submits her paper to journal B first regardless of her type, because it is more likely to be accepted with a lower threshold. After getting rejected, she submits it to journal A.

When q_B is close to q_A, however, an opposite equilibrium also exists. The author submits her paper to journal A first regardless of her type. Getting rejected, she submits it to journal B. In this case, journal B's threshold s_B is higher than s_A because it receives papers that have been rejected by A and are possibly of bad quality. The second equilibrium seems counterintuitive because the lower-standard journal sets a higher threshold of acceptance.

Proposition 8. *There exists Δ such that when $q_B \in (q_A - \Delta, q_A)$, two equilibria exist:*

1. *the author submits her paper to journal B first, and $s_A^* > s_B^*$;*
2. *the author submits her paper to journal A first, and $s_A^* < s_B^*$.*

Which equilibrium is selected depends on which journal exists at first. If journal B exists at first, the author submits her paper to it. Then, journal A is established and receives the rejected paper. It sets a higher threshold not only because of its higher standard but also because it receives papers of bad quality. In contrast, if journal A exists at first, and then journal B is established. The latter sets a higher threshold even though its standard is lower. This reasoning provides an innovative insight for the entry barrier in such markets, where the entrant should set an unfairly high threshold to compete with the incumbent.

5. Entry Barrier

This section uses a dynamic model to give some qualitative results of the entry barrier. I find that the entrant is not able to compete head-on with the incumbent if it can not bring a much higher value without mutation of authors' submission order. Then, I analyze how authors' and journals' noisy perception of quality strengthens the entry barrier, and the barrier still exists if journals set the capacity instead of the standard of quality. Finally, I analyze the robustness and find the condition such that the entry barrier exists in the long run (in Appendix C).

Consider there are N (large) authors, and in each period $t = 0, 1, 2, ...$, each author writes one new paper and tries to find a place to publish it. To simplify the model, it is assumed that there is no submission cost and the authors wish to get published as soon as possible. I also assume that they know nothing but the prior distribution $f(q)$ about the quality.

Suppose an incumbent journal exists initially. Its objective is to maximize the sum-up of the quality of the papers published. (In other words, the editor should publish any paper with positive quality if he knows it perfectly.) The incumbent sets the threshold s_I^0 and publishes papers of which signals $s \sim \mathcal{N}(q, \sigma_s^2)$ are higher than the threshold.[2] Denote Q_I^t as the average of the papers published in the incumbent's journal in period t. s_I and Q_I^t are public information. In period 0, the incumbent should publish any paper with the expected quality higher than 0. Thus, it sets s_I^0 such that

$$\mathbb{E}[q|s_I^0] = \frac{\int qf(q)\phi(s_I^0, q, \sigma_s)dq}{\int f(q)\phi(s_I^0, q, \sigma_s)dq} = 0$$

and the corresponding average quality Q_I^0 is

$$Q_I^0 = \frac{\int qf(q)[1 - \Phi(s_I^0, q, \sigma_s)]dq}{\int f(q)[1 - \Phi(s_I^0, q, \sigma_s)]dq}$$

[2]Sometimes journals do not have this choice but publish the best ones among what they receive under a fixed capacity. However, intuitively, choosing a small capacity is equivalent to setting a high threshold, and vice versa.

Then, in period t' (without loss of generality, we can say $t' = 1$), an entrant who has the same objective as the incumbent issues a new journal. It needs to set its threshold s_E to compete with the incumbent. Denote Q_E^t as the average of the papers published in the entrant's journal in period t. In this period, the authors with new papers simultaneously decide to which journal they should submit. Importantly, the entrant also receives papers rejected by the incumbent previously. In each of the following periods $t \geq t' + 1$, the authors with new papers simultaneously decide to which journal they should submit. The journal also receives the papers rejected by the other in the previous period.

Let continuous function $v(Q)$ be the authors' payoff of a publication in a journal with the average quality of their papers published being Q. $v(Q)$ is assumed to be increasing in Q. Without loss of generality, we normalize $v(Q_I^0)$ to be 1.

The next question is under which condition, the incumbent is still the first option of the authors even after the entrant comes. To find the answer, we consider the worst (best) case for the former (latter): in period t', almost all the authors with new papers submit to the entrant so that the average quality Q_E and the value $v(Q_E)$ reach the highest. Note that the entrant also receives papers rejected by the incumbent in the previous period $t' - 1$. Thus,

$$Q_E(s_E) = \frac{\int q f(q)[1 + \Phi(s_I^0, q, \sigma_s)][1 - \Phi(s_E, q, \sigma_s)]dq}{\int f(q)[1 + \Phi(s_I^0, q, \sigma_s)][1 - \Phi(s_E, q, \sigma_s)]dq}$$

The expected payoff of submitting to the incumbent is

$$v(Q_I^0) \cdot \int f(q)[1 - \Phi(s_I^0, q, \sigma_s)]dq = \int f(q)[1 - \Phi(s_I^0, q, \sigma_s)]dq$$

and to the entrant

$$v(Q_E) \cdot \int f(q)[1 - \Phi(s_E, q, \sigma_s)]dq$$

Then, we define

$$\tilde{v}(Q_E) := \frac{\int f(q)[1 - \Phi(s_I^0, q, \sigma_s)]dq}{\int f(q)[1 - \Phi(s_E, q, \sigma_s)]dq}$$

such that if $v < \tilde{v}$, even in the worst case for the incumbent, it is still better to choose it first and we can say the entrant will never become the authors' first option and always receive rejected papers by the incumbent.

Lemma 5. $\tilde{v}(Q_I^0) > v(Q_I^0) = 1$.

Mimicking the incumbent is not optimal

Lemma 5 shows that $v(Q_E)$ must be lower than $\tilde{v}(Q_E)$ locally around $Q_E = Q_I^0$. The left graph in Figure 6 illustrates this. The blue curve is the upper bound $\tilde{v}(Q_E)$. Specifically, even when Q_E is lower than Q_I^0, $\tilde{v}(Q_E)$ can be higher than 1. It indicates that the entrant is never the authors' first option if Q_E is close to Q_I^0, or it sets a threshold s_E which leads its average quality to be close to the incumbent's. The reason to cause that is similar to the formation of the counter-intuitive equilibrium in which the thresholds are inverted. Because the entrant receives rejected papers by the incumbent previously and it can not distinguish between them, it must set an unfairly high threshold to select the good-quality papers mixed with bad-quality ones (as shown in the right graph of Figure 6). As a result, the entrant brings a similar payoff but has a much higher threshold (lower possibility of acceptance), which generates the convention among the authors that they should submit to the incumbent first. This convention leads the entrant to receive rejected papers again in the next period and all following periods.

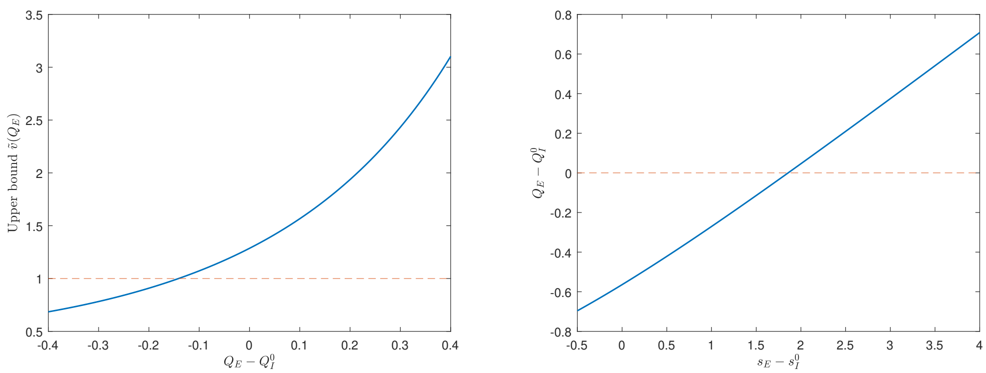


Fig. 6. The left graph is the upper bound $\tilde{v}$ of the entrant. The right graph is the entrant's average quality corresponding to its threshold. The quality follows a normal distribution: $f(q) = \phi(q, 0, \sigma_q)$. The parameters are: $\sigma_q = \sigma_s = 1$.

Corollary 1. *For any value function v, there exists $\bar{s}_E > s_I^0$ such that when $s_E \in (s_I^0, \bar{s}_E)$, authors always submit their papers to the incumbent first, where $\bar{s}_E$ induces $Q_E = Q_I^0$.*

Then, the only choice for the entrant is to be differentiated with the incumbent by setting a threshold leading its average quality either much higher or much lower than Q_I^0, in which cases $v(Q_E)$ can be above $\tilde{v}(Q_E)$and the entrant can receive not only rejected papers. However, in the former case ($Q_E > Q_I^0$), if v is not so steep that the entrant needs to set an extremely high threshold to have $v(Q_E) > \tilde{v}(Q_E)$, the amount of publication will be so small. On the other hand ($Q_E \ll Q_I^0$), if v is not so flat, the entrant needs to set an extremely low threshold and many of the papers published are of bad quality. In either case, though the entrant becomes the authors' first option, its utility (sum-up of the quality of the papers published) will be even worse than being the second option and publishing relatively good papers among those rejected by the incumbent.

Following that idea, I characterize the steepness of the value function v by one parameter $\alpha \geq 0$.

$$v(Q) = \frac{\max\{0, Q\}^\alpha}{(Q_I^0)^\alpha}$$

Then, if v is not so flat or not so steep (α not so low or not so high), the entrant would rather choose to be the authors' second option and set s_E^1 where

$$\mathbb{E}[q|s_1 < s_I^0, s_2 = s_E^1] = \frac{\int q f(q)\Phi(s_I^0, q, \sigma_s)\phi(s_E^1, q, \sigma_s)dq}{\int f(q)\Phi(s_I^0, q, \sigma_s)\phi(s_E^1, q, \sigma_s)dq} = 0$$

Proposition 9. *There exists $\underline{\alpha} \in [0, 1)$ and $\bar{\alpha} \in (1, +\infty)$ such that when $\alpha \in [\underline{\alpha}, \bar{\alpha}]$, in the equilibrium, the incumbent sets the threshold s_I^0 and the entrant sets s_E^1; in each period, the authors with new papers always submit to the incumbent first and then to the entrant after rejection.*

Remark: If v is steep or flat ($\alpha \notin [\underline{\alpha}, \bar{\alpha}]$), the result is unavailable because there could be multiple equilibria from the authors' side. To avoid the above problem, we assume that the equilibrium becomes the one that the last mover favors (All the authors with new papers submit to the entrant after it comes if multiple equilibria exist. After that, if the incumbent changes its threshold, all the authors with new papers submit to it if multiple equilibria exist...). Then, suppose v is steep, both journals want to be overhead of each other by setting a higher threshold. This process continues until one finds that the amount of publication is too low and it is better to set a low threshold. The other finds it better to also lower the threshold and the whole process begins again. Therefore, there is no pure-strategy equilibrium. Only mixed-strategy equilibrium exists.[3]

5.1. *Noisy Perception*

The key factors to generate entry barriers are noisy perceptions of quality and journals' ignorance about authors' submission histories. The following analysis shows how perfect perception of either side reduces the barrier.

5.1.1. *Impact of Journals' Perception of Quality*

When the signal of journals becomes less noisy, it is harder for the incumbent to sustain the advantage. From the left graph of Figure 7, the upper bound $\tilde{v}$ moves downward and becomes closer to point $(Q_I^0, 1)$. Moreover, if we simulate the range $[\underline{\alpha}, \bar{\alpha}]$, it shrinks as σ_s

[3] Similar result can be found in Varian [1980].

decreases but it does not converge to a singleton as $\sigma_s \to 0$. If $\sigma_s = 0$ which means that the signal is perfect, $\tilde{v}$ crosses $(Q_I^0, 1)$.

Lemma 6. *If $\sigma_s = 0$ and $s_E = s_I$, then $Q_E = Q_I$.*

Then, the entrant can always mimic the incumbent by setting the same threshold. In this case, though the entrant still receives rejected papers, it knows they will finally be eliminated because the signal is perfect and both journals have the same threshold. The average quality of these two will be the same, and the authors with new papers just randomly submit to either first.

Proposition 10. *Let $\underline{\alpha}^0 = \lim_{\sigma_s \to 0} \underline{\alpha}$ and $\bar{\alpha}^0 = \lim_{\sigma_s \to 0} \bar{\alpha}$. When $\sigma_s = 0$ and $\alpha \in [\underline{\alpha}^0, \bar{\alpha}^0]$, in the equilibrium, the incumbent and the entrant sets the same threshold $s_I = s_E = 0$; in each period, the authors with new papers always submit to either journal first with Probability $1/2$, and then to the other one after rejection.*

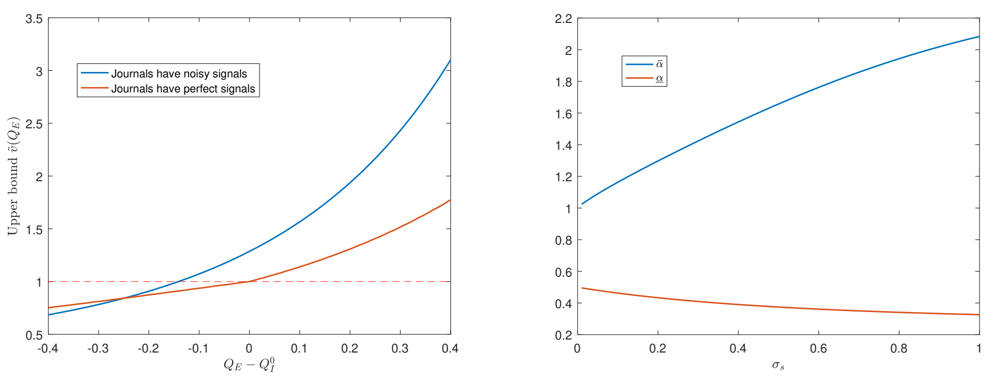


Fig. 7. The quality follows a normal distribution: $f(q) = \phi(q, 0, \sigma_q)$. The parameters are: $\sigma_q = 1$.

5.1.2. Impact of Author's Perception of Quality

In contrast to coarse authors discussed previously, it is now assumed that the author know her type as defined in Section 2. To characterize the author's perception of the quality, it is assumed that his type θ follows a normal distribution $\mathcal{N}(0, \sigma_\theta^2)$ and the quality conditional on the type $q|\theta$ follows $\mathcal{N}(\theta, \sigma_q^2)$. I let $\sigma_\theta^2 + \sigma_q^2 = 1$ so that when σ_θ approaches 1, the authors know the quality perfectly. When σ_θ approaches 0, we go back to the fully coarse case. Then, if the entrant sets a slightly higher threshold $s_E > s_I$ than the incumbent, the market splits and two equilibria can exist. One can find cutoffs $\bar{\theta}$ and $\underline{\theta}$, $\bar{\theta} > \underline{\theta}$. In one equilibrium, the author with type $\theta > \bar{\theta}$ chooses the entrant first and the rest chooses the incumbent. In the other one, the author with type $\theta > \underline{\theta}$ chooses the entrant first. The former one favors the incumbent and the latter one favors the entrant. To transit from one to the other, it requires those in the middle $\theta \in (\underline{\theta}, \bar{\theta})$ to change their strategy at the same time.

However, with partial information about the quality, it is hard to predict which equilibrium will be selected if multiple ones exist. For example, the entrant sets the same threshold as the incumbent, $s_E = s_I$. One equilibrium is that all authors choose the incumbent first regardless of their type and the entrant receives only the rejected papers. In this situation, the incumbent publishes papers with higher average quality. As the possibilities of acceptance are the same, the authors will indeed go to the incumbent first. However, suppose at some time, only the low-type authors choose the incumbent while the rest choose the entrant. Then, the average quality of the papers published in the entrant journal exceeds the incumbent journal's. The equilibrium transits to the one favoring the entrant, and the next transition can happen at any time.

To investigate the stability of the equilibrium in which the incumbent holds the advantage, I introduce the "inertia". It is assumed that in each period, only a certain proportion of the authors can change their strategies while the rest stick to their last choices. Then, I try to find the minimal level of "inertia" such that the incumbent can hold the advantage. If this value is high, it means that the entry barriers reduce for the entrant.

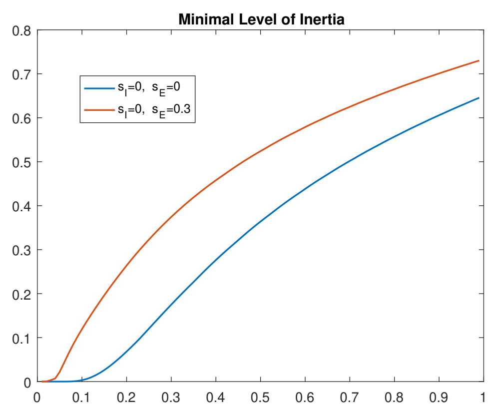


Fig. 8. The minimal level of inertia under different perfectness of the authors' perception about the quality. The value function is linear, $v(Q) = \max\{0, Q\}/Q_I^0$.

Figure 8 shows the minimal level of inertia required to establish the entry barriers to the entrant. When σ_θ approaches 0, the inertia required is negligible, which is coincident with the previous findings. As the authors become more sophisticated about the quality, the inertia required increases and it is harder for the incumbent to maintain the advantage.

The reason is when the authors get clear private information about the quality, those thinking they have high-quality papers will submit to the journal bringing higher value whether it is the incumbent or the entrant. As it becomes clearer, the proportion of the authors being willing to do so increases. Thus, a higher level of inertia is required to prevent the authors to do so in which case they know many authors will stick to their original choice. In conclusion, clearer private information raises the minimal level of inertia, which reduces the entry barriers for the entrant.

5.2. Bounded Rational Incumbents

In section 3.2, it shows that the editor's decision can be biased by different mistakes he makes. This section studies, if the incumbents are not rational, what's the impact of this bias on the entry barriers? I find that entry barriers reduce whatever the bias direction. The key reason is under both situations, the selection bias effect is less significant, then, receiving rejected papers becomes less bad.

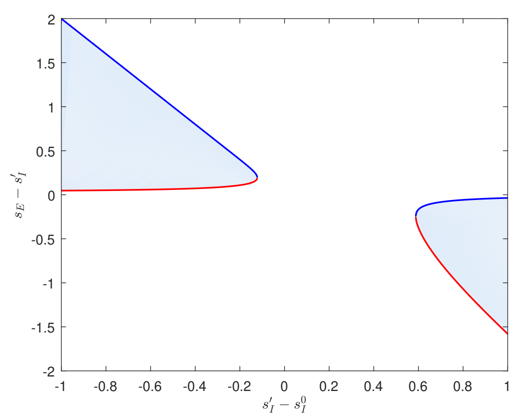


Fig. 9. The quality follows a normal distribution: $f(q) = \phi(q, 0, \sigma_q)$. The signal conditional on quality follows a normal distribution $\phi(s, q, \sigma_s)$. The value function is linear, $v(Q) = \max\{0, Q\}/Q^0_I$. The parameters are: $\sigma_q = 1$, $\sigma_s = 0.1$.

If the incumbents are of the first kind of naivety (neglecting the selection bias effect) by setting lower thresholds, those papers rejected are really bad and they are harder to be republished by the entrant. In figure 9, the shaded area is where the entrant's threshold lies which can make it become the first option of authors. If the incumbents set a threshold s'_I lower than the optimal one s^0_I, the entrant can challenge them by setting a slightly higher threshold, which guarantees that most of the papers published have not been rejected previously. Not only the average quality but also the acceptance rate are competitive with the incumbents.

If the incumbents are of the second kind of naivety (ignorance about the authors' private information) by setting higher thresholds, rejected papers are not that bad in quality and receiving them is also not unacceptable. In this situation, the entrant can challenge the incumbents by setting a slightly lower threshold which keeps the average quality similar to the incumbents but brings a higher acceptance rate.

6. Conclusion and Further Discussion

The model in this study investigates a noisy market with information asymmetry and dynamic learning. I find that: i) without knowing the quality of "talent" perfectly, high-type seller try to sell more times compared to low-type ones. In contrast, knowing it perfectly, they will always try; and ii) there can be multiple equilibria but the one favoring the incumbent will be selected, which triggers the existence of the entry barrier. It shows that the entrant can not compete with the incumbent for both the market share and the quality of "talent". Moreover, the noisy perception of quality will make the entry barrier higher.

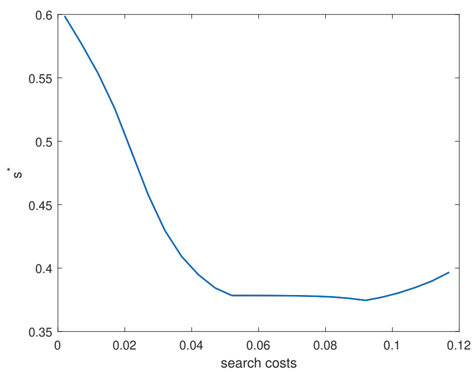
The existence of entry barriers found in this study has some inspiration in policymaking. The key factor to generate the barriers is the noisy perception. Therefore, one direction of reducing the barriers is to implement accurate perceiving technology. Another direction of breaking the vicious cycle is to change the convention radically. One example is the draft lottery system in the North American sports league. It leads high-potential rookies to go to weak teams so that the oligopoly becomes harder to form.

6.1. Directions for Further Research

In the current work, the journals' action is just accepting or rejecting. Other cases can more complex such as the football player and the club. The latter not only needs to decide whether to sign the former but also to give a specific offer conditional on the signal. Thus, one direction of extension is to enlarge the buyer's strategy space to be a mapping from signals to prices. The seller chooses whether to accept or reject the buyer's offer. If she rejects, she then chooses whether to continue searching or to stop.

However, this extension brings an incentive compatibility problem. All buyers want to offer only the least possible price. Then, the result is exactly the same as the current model. One way to solve this problem is to assume that the seller has an outside option (opportunity cost) conditional on her quality (a high-quality seller has a high outside option). Then, the high-type seller will continue searching until a good offer occurs, or even choose the outside option rather than searching the market. More precisely, given the buyer's strategy, the seller computes her continuation payoff and expected outside option, and compares them with the offer. If the continuation payoff is the highest, she rejects the offer and continues searching. If the outside option is the highest, she quits. Then, the buyer has an incentive to offer a good price if the signal is high enough because otherwise, the seller rejects probably.

Consider a toy model with the seller's discrete quality being either high (H) or low (L). The seller's outside options are: $u_H = 1$ and $u_L = 0$. Her values to the buyer are: $v_H = 1.5$ and $v_L = 0.5$. The signal structure: $g(s|H) = 2s$, $g(s|L) = 2(1-s)$, $s \in [0, 1]$. The seller's type θ is the probability that she believes her type is H. The buyer knows only the prior distribution $\mu(\theta)$, a truncated normal distribution with mean 0.8 and standard deviation 0.1. Assume that the seller can offer two prices $\underline{p} \in [u_L, v_L]$ and $\bar{p} \in [v_L, u_H]$.



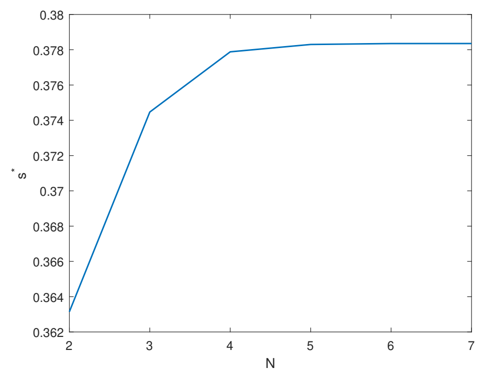


Fig. 10. The left graph is the threshold s^* under different search costs. The right graph is the threshold s^* under different size of market.

Figure 10 illustrates the buyer's threshold of the signal of whether to propose a high or low offer. A similar result can be observed here. As search costs decrease or there are more buyers, buyers worry about meeting a seller having been offered lowly and rejected several times so they raise the threshold. However, the high-type seller has an incentive to choose the outside option at the very beginning. This effect becomes significant when search costs are large. Thus, threshold s^* first decreases and then increases as search costs get larger.

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Appendix A. Author's Noisy Perception

In Section 3.1.3, I find that knowing the quality perfectly, the author always submits her paper until she gets a publication or there is no chance left if the quality is sufficiently high. In contrast, she learns after each submission, and the high-type author tries more times and stops after several submissions. This section analyzes how this ignorance affects the agents' behavior.

Consider a case where the author's type θ follows a normal distribution: $\mu(\theta) = \phi(\theta, 0, \sigma_\theta)$. The quality follows a normal distribution conditional on θ: $f(q|\theta) = \phi(q, \theta, \sigma_q)$. σ_q is a measure of the author's ignorance level. There are two homogeneous journals A in the field, which yields v to the author for the publication. The submission cost is c. Their standard of quality q_A is 0. The journal observes a noisy signal conditional on the quality $s = q + \epsilon$, $\epsilon \sim \mathcal{N}(0, \sigma_s)$.

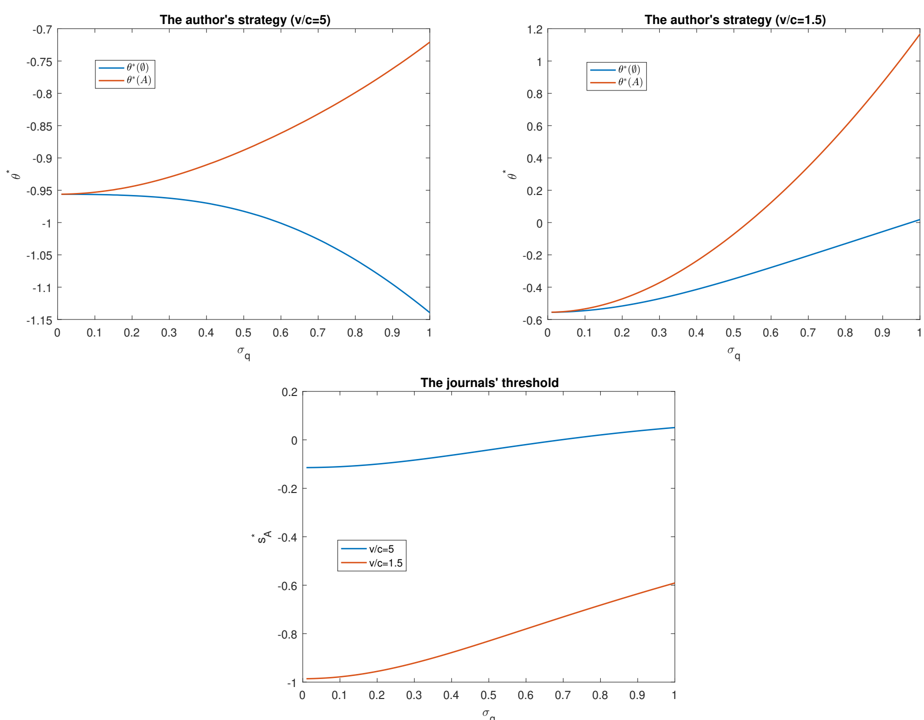

Fig. 11. The left graph is the acceptance rate of a paper with quality q. The right graph is the author's payoff if the quality is q.

When σ_q is close to 0, the author has a precise perception of quality. The finding in Section 3.1.3 indicates that $\theta^*(\emptyset)$ are close to $\theta^*(A)$. As σ_q increases, the author with a relatively lower type stops after getting a rejection. As shown in Figure 11, the difference between $\theta^*(A)$ and $\theta^*(\emptyset)$ becomes larger. Another finding is the trend of $\theta^*(\emptyset)$ depends on the benefit-cost ratio (v/c). When the author is extremely ignorant, her type implies little information. If v/c is high, the ignorant author without getting rejected wants to try regardless of her type. Thus, $\theta^*(\emptyset)$ decreases as σ_q increases. In contrast, if v/c is low, the ignorant author has less willing to have a try.

The journals are more likely to receive papers of low quality as the author becomes ignorant. Thus, they raise their thresholds.

Appendix B. Market Differentiation

In Section 4, I present the idea that introducing an ordinary class of journals splits the market of authors, makes the top-class journals easy to select those papers with high quality, and thus is beneficial to efficiency. This section further discusses it by analyzing the situation of two journals with three cases: 1. both set a low standard of quality; 2. both set a high standard of quality; 3. one set a high standard, and the other set a low one.

More specifically, consider a case where the author's type θ follows a normal distribution: $\mu(\theta) = \phi(\theta, 0, 1)$. The quality follows a normal distribution conditional on θ: $f(q|\theta) = \phi(q, \theta, 1)$. Assume that the paper with a quality $q > 0$ is valuable and should be published. A paper with higher quality is more valuable. There are two journals A and B in the field. The submission cost is $c = 0.1$. The journal observes a noisy signal conditional on the quality $s = q + \epsilon$, $\epsilon \sim \mathcal{N}(0, 1)$. In case 1, both set a baseline standard of quality $q_A = q_B = 0$. A publication on either of them yields 1 to the author. In case 2, both set an aggressive standard $q_A = q_B = 1$. A publication on either of them yields 2. In case 3, journal A sets $q_A = 1$ while journal B sets $q_A = 0$. A publication on journal A yields 2, and 1 on journal B.

I define efficiency in two aspects: i) whether the paper published is worthwhile. I use the following W_1 to measure the global quality of the papers in the market.

$$W_1 = \mathbb{E}[q|Accepted] \cdot Pr[Accepted] = \int_{-\infty}^{+\infty} q\phi(q, 0, 2)Pr[Accepted|q]dq$$

A higher W_1 means that the market generates more valuable knowledge, and ii) whether a high-quality paper is easier to be published in a journal bringing higher payoff, and a relatively low-quality paper is easier to be published in a journal bringing lower payoff.

First, I solve the equilibrium in these 3 cases.

Case 1

The author with a type $\theta > -1.65$ submits her paper to either journal first. If she gets rejected, she submits to the other journal if her type $\theta > -1.39$. Both journals set the threshold $s_A = s_B = 0.16$.

Case 2

The author with a type $\theta > -0.75$ submits her paper to either journal first. If she gets rejected, she submits to the other journal if her type $\theta > -0.58$. Both journals set the threshold $s_A = s_B = 1.58$.

<u>*Case 3*</u>

The author with a type $\theta > 0.71$ submits her paper to journal A first. If she gets rejected, she submits to journal B. The author with a type $\theta \in (-1.73, 0.71)$ submits her paper to journal B first. If she gets rejected, she submits to journal A if her type $\theta > -0.42$. Journal A sets the threshold $s_A = 1.31$ while journal B sets $s_B = 0.08$.

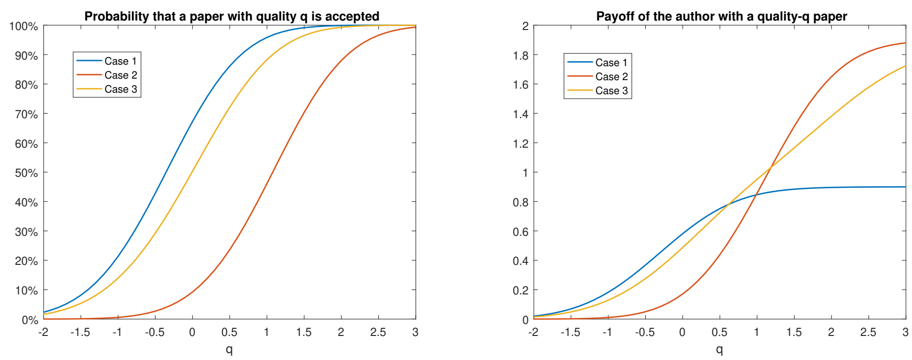

Fig. 12. The left graph is the acceptance rate of a paper with quality q. The right graph is the author's payoff if the quality is q.

Secondly, I analyze market efficiency in two aspects mentioned. From the first aspect, I compute the value of W_1 under three cases: 0.4788, 0.3948, and 0.4786. The first and third cases generate a similar amount of knowledge. In the first case, more papers are published and some of them are of low quality, compared to the second case. This is because journal A has a higher standard of quality in case 3. The left graph in Figure 12 also shows that the yellow curve is slightly below the blue one because journal A accepts fewer papers but with higher quality. In case 2, W_1 is lower because of the fact that far fewer papers are published. This is not only because journal B has a high standard but also because journals should set higher thresholds to correct selection bias. The right graph shows the author's payoff if the quality is q. In case 1, the author with a high-quality paper does not get rewarded while in case 2, only the substantial-high-quality paper brings a reward. In case 3, the extreme situation is improved by splitting the authors.

From the second aspect, in case 3, journal A's threshold s_A is lower compared to case 2, and journal B's threshold s_B is lower compared to case 1. The authors find it easier to publish either a high-quality or a relatively low-quality paper in the corresponding journal. Still, it is because of the splitting which weakens selection bias.

Appendix C. Entry Barrier in the Long Run

In Section 5, I find the existence of entry barriers. The next question is "Is it robust?" In other words, if we tremble authors' behavior, will the barriers still exist? This section introduces "mutation". It is assumed that there is some probability that the old authors pass away. Not being familiar with the payoffs from submitting, the new coming authors just randomly choose one journal. The answer to the question is the barriers reduce compared to the case without mutation, but when the number of authors is large, it takes an extremely long time for the entrant to transcend it.

First, instead of using the absolute value function $v(Q)$, I define the continuous function $R(Q_I^t, Q_E^t)$ to be the authors' relative payoff of a publication in the entrant's journal compared to the incumbent's given the average quality of their papers published respectively. More precisely, given Q_I^t and Q_E^t, if the authors' payoff of a publication in the incumbent's journal is 1, the payoff from the entrant is $R(Q_I^t, Q_E^t)$. $R(Q_I^t, Q_E^t)$ is assumed to be increasing in Q_E^t, but decreasing or Q_I^t. Note that the absolute value function is just a special case of the generalized relative value function.

Next, I define the deterministic dynamic[4] for the authors. Specifically, they compute the expected payoffs from submitting to the incumbent or the entrant based on the previous period. In each period t, they submit to the entrant if doing so yields a higher expected payoff than submitting to the entrant,

$$z_t = b(z_{t-1}) = \begin{cases} N & if\ \pi_I(t) \geq \pi_E(t), \\ 0 & otherwise \end{cases}$$

where z_t is the number of authors who choose to submit to the incumbent first in period t, and $\pi_I(t)$ ($\pi_E(t)$) is the expected payoff from submitting to the incumbent (the entrant),

$$\pi_I(t) = \int f(q)\big[1 - \Phi\big(s_I, q, \sigma_s\big)\big]dq$$

$$\pi_E(t) = R(Q_I^{t-1}, Q_E^{t-1}) \int f(q)\big[1 - \Phi\big(s_E, q, \sigma_s\big)\big]dq$$

Finally, assume that in each period, with Probability ϵ, each author changes her submission order, which is the mutation. Then, I define the long run equilibrium according to

[4] This deterministic dynamic can be generalized to any one satisfying: $sign\{b(z_{t-1}) - z_{t-1}\} = sign\{\pi_I(t) - \pi_E(t)\}$

definitions 1 and 2 in Kandori et al. [1993]. First, one has a stochastic process of z_t,

$$z_t = b(z_{t-1}) + x_t - y_t$$

where x_t and y_t are binomial distributions,

$$x_t \sim Bin(N - b(z_{t-1}), \epsilon),\ y_t \sim Bin(b(z_{t-1}), \epsilon)$$

Then, one gets a Markov chain of z_t. Let P be the Markov matrix, in which the element

$$p_{ij} = Pr[z_{t+1} = j | z_t = i]$$

Let $\mu_\epsilon = \big(\mu_\epsilon(1), \mu_\epsilon(2), ..., \mu_\epsilon(N)\big)$ be the stationary distribution of z_t, which is $\mu_\epsilon P = \mu_\epsilon$.

Definition 1. *Denote the limit distribution*

$$\mu^* = \lim_{\epsilon \to 0} \mu_\epsilon.$$

Always submitting to the incumbent (entrant) first is the long run equilibrium if $\mu^*(N) = 1$ ($\mu^*(0) = 1$).

I look for the knife-edge situation in which if multiple pure-strategy equilibria exist (authors always submitting to the incumbent or to the entrant), both can be stable against mutations in the long run. To induce the corresponding relative value function $\hat{R}$, we consider the mixed-strategy equilibrium: for any thresholds s_I and s_E set by the journals, half of the authors with new papers choosing the incumbent first and the other half choosing the entrant first. Then, their average quality of the papers published are

$$Q_I = \frac{\int q f(q)[1/2 + \Phi(s_E, q, \sigma_s)/2][1 - \Phi(s_I, q, \sigma_s)]dq}{\int f(q)[1/2 + \Phi(s_E, q, \sigma_s)/2][1 - \Phi(s_I, q, \sigma_s)]dq}$$

$$Q_E = \frac{\int q f(q)[1/2 + \Phi(s_I, q, \sigma_s)/2][1 - \Phi(s_E, q, \sigma_s)]dq}{\int f(q)[1/2 + \Phi(s_I, q, \sigma_s)/2][1 - \Phi(s_E, q, \sigma_s)]dq}$$

The authors' indifference condition indicates that the expected payoffs of submitting to either journal are the same. Therefore, $\hat{R}$ is defined as

$$\hat{R}(Q_I, Q_E) := \frac{\int f(q)[1 - \Phi(s_I, q, \sigma_s)]dq}{\int f(q)[1 - \Phi(s_E, q, \sigma_s)]dq}$$

By Kandori et al. [1993] Theorem 3, *if $R < \hat{R}$, always submitting to the incumbent first* *is the long run equilibrium regardless of the thresholds the journals set. Otherwise, always submitting to the entrant is.*

Similarly to $\tilde{v}$, $\tilde{R}(Q_I, Q_E)$ can be defined as the upper bound in the relative value form:

$$\tilde{R}(Q_E, Q_I) := \frac{\int f(q)[1 - \Phi(s_I, q, \sigma_s)]dq}{\int f(q)[1 - \Phi(s_E, q, \sigma_s)]dq}$$

where

$$Q_I = \frac{\int qf(q)[1 - \Phi(s_I, q, \sigma_s)]dq}{\int f(q)[1 - \Phi(s_I, q, \sigma_s)]dq}$$

$$Q_E = \frac{\int qf(q)[1 + \Phi(s_I, q, \sigma_s)][1 - \Phi(s_E, q, \sigma_s)]dq}{\int f(q)[1 + \Phi(s_I, q, \sigma_s)][1 - \Phi(s_E, q, \sigma_s)]dq}$$

Under the relative value $\hat{R}$, regardless of the thresholds the journals set, neither will definitely be the disadvantaged side by receiving only the rejected papers in the long run. However, the following proposition shows that without mutation, the latecomer is always the disadvantage side in a market potentially allowing two journals to compete fairly.

Proposition 11. $\hat{R}(Q_I, Q_E) < \tilde{R}(Q_I, Q_E)$ *for any* Q_I *and* Q_E*.*

How "long" does it need to transit to the long run equilibrium?

Even if the relative value is above $\hat{R}$, it takes time to have enough proportion of authors to mutate and to transit from the status quo to another equilibrium. First, a higher relative value requires fewer mutations. Thus, the time needed to change the status quo is shorter. Another factor is the number of authors. With more authors, it asks for more mutations to reach the turning proportion. Therefore, it becomes longer to transit from the status quo.

Consider an example with $s_I = s_E = 0$ and $\epsilon = 0.1$. Table 2 shows the expected periods for transition to the equilibrium favoring the entrant under some bundles of parameters. It shows that when the number of authors is large, the entrant needs to wait billions of periods to become their first option.

Appendix D. Proofs

Proof of lemma 1:

The left hand side of (1) is increasing and continuous in s. Moreover,

$$\lim_{s \to +\infty} \mathbb{E}_{\beta_A}[q|s] = +\infty, \quad \lim_{s \to -\infty} \mathbb{E}_{\beta_A}[q|s] = -\infty$$

N	$R/\hat{R}$	T		N	$R/\hat{R}$	T
20	1.1	3.7×10^8		2	1.5	2
20	1.2	1.8×10^7		4	1.5	6
20	1.3	1.2×10^6		6	1.5	15
20	1.4	8.9×10^4		10	1.5	89
20	1.5	7.8×10^3		20	1.4	7.8×10^3
20	1.6	770		30	1.5	6.9×10^5
20	1.7	80		50	1.5	5.4×10^9
20	1.8	8		100	1.5	3.0×10^{19}

Table 2: N: number of authors, $R/\hat{R}$: the ratio of the relative value compare to the fair one, T: expected periods for transition to the equilibrium favoring the entrant.

Therefore, there exists a s_A such that

$$\mathbb{E}_{\beta_A}[q|s_A] = q_A. \quad \blacksquare$$

Proof of lemma 2:

Because $\gamma(q|\theta, h)$ satisfies the MLRP, $\pi_A(\theta, h)$ is monotonically increasing. Along with

$$\lim_{\theta \to +\infty} \pi_A(\theta, h) = v - c > 0, \ \lim_{\theta \to -\infty} \pi_A(\theta, h) = -c < 0, \forall h \in H$$

there exists a unique $\theta_A^*(h)$ such that $\pi_A(\theta_A^*(h), h) = 0$. Additionally, $\pi_A(\theta_A^*(h), h) \geq 0$ if $\theta \geq \theta_A^*(h)$.

$\frac{\gamma(q|\theta, A^{i+1})}{\gamma(q|\theta, A^i)} \propto \Phi(s_A, q, \sigma_s)$ is decreasing in q. As a result, either $\gamma(q|\theta, A^{i+1})$ is always lower than $\gamma(q|\theta, A^i)$, or they are single crossing. Under both cases, $\pi_A(\theta, A^{i+1}) \geq \pi_A(\theta, A^i)$. Therefore, $\theta_A^*(A^{m-1}) > ... > \theta_A^*(A) > \theta_A^*(\emptyset)$. $\blacksquare$

Proof of proposition 1:

According to lemma 2, given s_A, $\theta_A^*(h)$ are well-defined and continuous in s_A because π_A is continuous in s_A. Then, the journal receiving a paper forms a belief β_A based on (3) and (4). According to lemma 1, the journal could find the optimal threshold noted as $\omega(s_A)$. The left hand side of (1) and β_A are continuous in $\theta_A^*(h)$. Therefore, $\omega(s_A)$ is continuous in s_A. Obviously, $\omega(s_A)$ is bounded. As a result, there exists a fixed point $\omega(s_A^*) = s_A^*$ according to Brouwer fixed-point theorem.

Secondly, as s_A increases, $\pi_A^*(\theta, h)$ decreases, which follows the fact that as the threshold becomes higher, the paper is harder to be accepted and the expected payoff from submission is lower. Then. $\theta_A^*(h)$ increases, meaning that only high-type authors find it optimal to submit. Therefore, $\omega(s_A)$ decreases because the journal is more likely to receive a high-quality paper from high-type author. Thus, the equilibrium is unique because $\omega(s_A)$ is a decreasing function. ■

Proof of proposition 2:

If $m = 1$, one can find s_A^* and $\theta_A^*(\emptyset)$. Then, if $m = 2$, one consider the expected quality if journals keep the standard at s_A^*.

$$\frac{\int_{-\infty}^{+\infty} q \int_{\theta_A^*(A)}^{+\infty} \gamma(q|\theta, A) d\theta dq}{\int_{-\infty}^{+\infty} \int_{\theta_A^*(A)}^{+\infty} \gamma(q|\theta, A) d\theta dq}, \textit{ where } \gamma(q|\theta, A) \propto f(q|\theta)\Phi(s_A^*, q, \sigma_s)$$

If $c \to 0$, $\theta_A^*(A) \to -\infty$. Along with $\gamma(q|\theta, \emptyset)$ first-order stochastic dominating $\gamma(q|\theta, A)$, the expected quality must be lower than q_A if $c \to 0$. Thus, one can find $\underline{c}_1 \in (0, v]$ such that the expected quality is higher than q_A.

Then, for $m > 2$, one repeats above process to find $\underline{c}_{m-1}$. $\underline{c} = \inf_{1 \le i \le m-1} \underline{c}_i$. ■

Proof of proposition 3:

$\int_{-\infty}^{+\infty} f(q|\theta_A^*(h), h)[1 - \Phi(s_A, q, \sigma_s)]dq = c/v$ and the left hand side is increasing in $\theta_A^*(h)$. Therefore, as v/c increases, $\theta_A^*(h)$ decreases. It lowers the paper's expected quality. Thus, to make it equal to q_A, journals raise the threshold. ■

Proof of proposition 4: According to lemma 2, given s_A, q^* is well-defined by

$$v[1 - \Phi(s_A, q^*, \sigma_s)] = c,$$

and continuous in s_A. Then, the journal receiving a paper forms a belief β_A based on (3). According to lemma 1, the journal could find the optimal threshold noted as $\omega(s_A)$. The left hand side of (1) and β_A are continuous in q^*. Therefore, $\omega(s_A)$ is continuous in s_A. Obviously, $\omega(s_A)$ is bounded. As a result, there exists a fixed point $\omega(s_A^*) = s_A^*$ according to Brouwer fixed-point theorem.

If $q^* > q_A$, the journal will accept the paper regardless of the signal it receives because the editor knows its quality is higher than the standard. Then, the author with a paper of which the quality is lower than q^* will also submit it. Therefore, $q^* < q_A$. ■

Proof of proposition 5:

Given s_A, the naive editor computes the probability,

$$\begin{aligned} Pr\left[\theta, h = A^i\right] &= Pr\left[\theta\right] Pr\left[h = A^i \middle| \theta\right] \\ &= \mu(\theta) \cdot \int f(q|\theta)\Phi^i(s_A, q, \sigma_s)dq \Bigg/ \sum_{j=0}^{m-1} \int f(q|\theta)\Phi^j(s_A, q, \sigma_s)dq \end{aligned}$$

The sophisticated editor computes the probability,

$$Pr\left[\theta, h = A^i \left| sampled\right.\right] = \int \mu(\theta) f(q|\theta)\Phi^i(s_A, q, \sigma_s)dq \Bigg/ \sum_{j=0}^{m-1} \iint \mu(\theta') f(q|\theta')\Phi^j(s_A, q, \sigma_s)dqd\theta'$$

We have

$$\frac{Pr\left[\theta, h = A^i \left| sampled\right.\right]}{Pr\left[\theta, h = A^i\right]} = Y \sum_{j=0}^{m-1} \int f(q|\theta)\Phi^j(s_A, q, \sigma_s)dq, \ \forall i$$

Y is a constant. Since $f(q|\theta)$ satisfies MLRP and $\Phi^j(s_A, q, \sigma_s)$ is decreasing in q, the right hand side is decreasing in θ. Since

$$1 = \sum_{j=0}^{m-1} \int Pr\left[\theta, h = A^i \left| sampled\right.\right] d\theta = \sum_{j=0}^{m-1} \int Pr\left[\theta, h = A^i\right] d\theta,$$

$Pr\left[\theta, h = A^i \left| sampled\right.\right]$ and $Pr\left[\theta, h = A^i\right]$ are single-crossing in θ.

The naive editor forms a belief on the quality $\tilde{\beta}_A(q)$,

$$\tilde{\beta}_A(q) = \sum_{i=0}^{m-1} \int \gamma(q|\theta, h = A^i) Pr\left[\theta, h = A^i\right] d\theta \Bigg/ \sum_{i=0}^{m-1} \iint \gamma(q|\theta, h = A^i) Pr\left[\theta, h = A^i\right] d\theta dq,$$

while the sophisticated editor forms the unbiased belief $\beta_A(q)$,

$$\beta_A(q) = \frac{\sum_{i=0}^{m-1} \int \gamma(q|\theta, h = A^i) Pr\left[\theta, h = A^i | sampled\right] d\theta}{\sum_{i=0}^{m-1} \iint \gamma(q|\theta, h = A^i) Pr\left[\theta, h = A^i | sampled\right] d\theta dq},$$

which is equivalent to (4). Since $Pr\left[\theta, h = A^i \left| sampled\right.\right]$ and $Pr\left[\theta, h = A^i\right]$ are single-crossing in θ, $\tilde{\beta}_A(q)$ FOSDs $\beta_A(q)$. The naive editor's optimal threshold is lower than the sophisticated's, $\tilde{\omega}(s_A) < \omega(s_A)$ ($\tilde{\omega}$ and ω are defined in the same way as in the proof of proposition 1). Thus, in equilibrium, the naive editor sets a lower threshold $\tilde{s}_A < s_A^*$. ■

Proof of proposition 6:

$$\hat{\beta}_A(q|h=A^i) = f(q|h=A^i) \propto \int_{-\infty}^{+\infty} \mu(\theta) f(q|\theta) d\theta \cdot \Phi^i(s_A, q, \sigma_s)$$

while

$$\beta_A(q|h=A^i) = f(q|h=A^i, \theta > \theta_A^*(h)) \propto \int_{\theta_A^*(A^i)}^{+\infty} \mu(\theta) f(q|\theta) d\theta \cdot \Phi^i(s_A, q, \sigma_s)$$

Thus, $\beta_A(q|h=A^i)$ FOSDs $\hat{\beta}_A(q|h=A^i)$ for any i.

Secondly,

$$Pr[h=A^i] \propto \iint_{\theta_A^*(A^i)}^{+\infty} \mu(\theta) f(q|\theta) d\theta \cdot \Phi^i(s_A, q, \sigma_s) dq$$

$$\hat{Pr}[h=A^i] \propto \left(\prod_{j=0}^{i} \xi(A^j) \right) \iint_{-\infty}^{+\infty} \mu(\theta) f(q|\theta) d\theta \cdot \Phi^i(s_A, q, \sigma_s) dq$$

$$\xi(A^j) = \iint_{\theta_A^*(A^j)}^{+\infty} \mu(\theta) f(q|\theta) d\theta \cdot \Phi^j(s_A, q, \sigma_s) dq \Bigg/ \iint_{\theta_A^*(A^{j-1})}^{+\infty} \mu(\theta) f(q|\theta) d\theta \cdot \Phi^{j-1}(s_A, q, \sigma_s) dq$$

Then,

$$\begin{aligned}
& \frac{\hat{Pr}[h=A^{i+1}]}{Pr[h=A^{i+1}]} \Bigg/ \frac{\hat{Pr}[h=A^i]}{Pr[h=A^i]} \\
= \; & \frac{\iint_{\theta_A^*(A^i)}^{+\infty} \mu(\theta) f(q|\theta) d\theta \cdot \Phi^{i-1}(s_A, q, \sigma_s) dq}{\iint_{-\infty}^{+\infty} \mu(\theta) f(q|\theta) d\theta \cdot \Phi^{i-1}(s_A, q, \sigma_s) dq} \frac{\iint_{-\infty}^{+\infty} \mu(\theta) f(q|\theta) d\theta \cdot \Phi^{i}(s_A, q, \sigma_s) dq}{\iint_{\theta_A^*(A^i)}^{+\infty} \mu(\theta) f(q|\theta) d\theta \cdot \Phi^{i}(s_A, q, \sigma_s) dq} \\
= \; & \frac{Pr[\theta > \theta_A^*(A^i) | h = A^{i-1}]}{Pr[\theta > \theta_A^*(A^i) | h = A^i]} > 1
\end{aligned}$$

Therefore, $\frac{\hat{Pr}[h=A^i]}{Pr[h=A^i]}$ is increasing in i. In other words, $\hat{Pr}[h=A^i]$ and $Pr[h=A^i]$ are single-crossing.

Since

$$\hat{\beta}_A(q) = \sum_{i=0}^{m-1} \hat{\beta}_A(q|h=A^i) Pr[h=A^i], \;\; \beta_A(q) = \sum_{i=0}^{m-1} \beta_A(q|h=A^i) \hat{Pr}[h=A^i],$$

$\beta_A(q)$ FOSDs $\tilde{\beta}_A(q)$. the naive editor's optimal threshold is lower than the sophisticated's, $\tilde{\omega}(s_A) > \omega(s_A)$ ($\tilde{\omega}$ and ω are defined in the same way as in the proof of proposition 1). Thus, in equilibrium, the naive editor sets a higher threshold $\hat{s}_A > s_A^*$. ■

Proof of lemma 3:

The left hand side of (5) is increasing and continuous in s. Moreover,

$$\lim_{s\to+\infty}\mathbb{E}_{\tilde{\beta}_A}[q|s]=+\infty,\ \lim_{s\to-\infty}\mathbb{E}_{\tilde{\beta}_A}[q|s]=-\infty,\ \forall f\in\mathcal{F}$$

Therefore, there exists a s_A (s_B) such that

$$\mathbb{E}_{\tilde{\beta}_A}[q|s_A]=q_A,\ \mathbb{E}_{\tilde{\beta}_B}[q|s_B]=q_B.\ \blacksquare$$

Proof of lemma 4:

Because $\gamma(q|\theta,\tilde{h})$ satisfies the MLRP, $\pi_A(\theta,\tilde{h})$ is monotonically increasing. Along with

$$\lim_{\theta\to+\infty}\pi_A(\theta,\tilde{h})=v-c>0,\ \lim_{\theta\to-\infty}\pi_A(\theta,\tilde{h})=-c<0,$$

there exists a unique $\theta^*_A(\tilde{h})$ such that $\pi_A(\theta^*_A(\tilde{h}),\tilde{h})=0$. Similarly, a unique $\theta^*_B(\tilde{h})$ exists such that $\pi_B(\theta^*_B(\tilde{h}),\tilde{h})=0$.

$\frac{v\phi(s_A,q,\sigma_s)}{\phi(s_B,q,\sigma_s)}$ is monotone in q. Then, the functions $v[1-\Phi(s_A,q,\sigma_s)]$ and $[1-\Phi(s_B,q,\sigma_s)]$ are single crossing. As a result, either $\pi_A(\theta,\tilde{h})$ is always higher than $\pi_B(\theta,\tilde{h})$, which corresponds to $\theta^*(\tilde{h})=-\infty$, or $\pi_A(\theta,\tilde{h})$ and $\pi_B(\theta,\tilde{h})$ crosses at a $\theta^*(\tilde{h})\in(-\infty,+\infty)$.

Finally, based on the definition of $\theta^*(\tilde{h})$, $\theta^*_A(\tilde{h})$ and $\theta^*_B(\tilde{h})$, there could be only two cases: 1. $\theta^*(\tilde{h})>\theta^*_A(\tilde{h})>\theta^*_B(\tilde{h})$; 2. $\theta^*(\tilde{h})\le\theta^*_A(\tilde{h})\le\theta^*_B(\tilde{h})$. In the first case, when $\theta\ge\theta^*(\tilde{h})$, $\pi_A(\theta,\tilde{h})>0$ and $\pi_A(\theta,\tilde{h})\ge\pi_B(\theta,\tilde{h})$. When $\theta\in[\theta^*_B(\tilde{h}),\theta^*(\tilde{h}))$, $\pi_B(\theta,\tilde{h})\ge 0$ and $\pi_B(\theta,\tilde{h})>\pi_A(\theta,\tilde{h})$. When $\theta<\theta^*_B(\tilde{h})$, $\pi_A(\theta,\tilde{h})<0$ and $\pi_B(\theta,\tilde{h})<0$. In the second case, when $\theta\ge\theta^*_A(\tilde{h})$, $\pi_A(\theta,\tilde{h})\ge 0$ and $\pi_A(\theta,\tilde{h})>\pi_B(\theta,\tilde{h})$. When $\theta<\theta^*_A(\tilde{h})$, $\pi_A(\theta,\tilde{h})<0$ and $\pi_B(\theta,\tilde{h})<0$. $\blacksquare$

Proof of proposition 7:

Proof: According to lemma 2, given s_A and s_B, $\theta^*_A(\tilde{h})$, $\theta^*_B(\tilde{h})$ and $\theta^*(\tilde{h})$ are well-defined and continuous in s_A and s_B because π_A and π_B are continuous in s_A and s_B respectively. Then, the journal receiving a paper forms the believes $\tilde{\beta}_A$ and $\tilde{\beta}_B$ based on Bayes' rule. According to lemma 3, journals could find the optimal threshold noted as $\omega(s_A,s_B)=(s'_A,s'_B)$. The left hand side of (5) and $\tilde{\beta}_A$ are continuous in $\theta^*_A(\tilde{h})$. Therefore, $\omega(s_A,s_B)$ is continuous in s_A. Similarly, $\omega(s_A,s_B)$ is continuous in s_B. Obviously, $\omega(s_A,s_B)$ is bounded. As a result, there exists a fixed point $\omega(s^*_A,s^*_B)=(s^*_A,s^*_B)$ according to Brouwer fixed-point theorem. $\blacksquare$

Proof of proposition 8:

Proof: The first case is obvious where

$$s_B^* = \arg_{s_B}\left\{\mathbb{E}_{\beta_B}[q|s_B] = \frac{\int q\beta_B(q)\phi(s_B,q,\sigma_s)dq}{\int \beta_B(q)\phi(s_B,q,\sigma_s)dq} = q_B\right\},\ \beta_B(q) = \int \mu(\theta)f(q|\theta)d\theta$$

$$s_A^* = \arg_{s_A}\left\{\mathbb{E}_{\beta_A}[q|s_A] = \frac{\int q\beta_A(q)\phi(s_A,q,\sigma_s)dq}{\int \beta_A(q)\phi(s_A,q,\sigma_s)dq} = q_A\right\} > s_B^*,\ \beta_A(q) = \frac{\Phi(s_B^*,q,\sigma_s)\int \mu(\theta)f(q|\theta)d\theta}{\int \Phi(s_B^*,q,\sigma_s)\int \mu(\theta)f(q|\theta)d\theta dq}$$

Then, $\pi_B(\theta,\emptyset) > \pi_A(\theta,\emptyset)$ which means that the author will submit her paper to B first.

For the second case,

$$s_A^* = \arg_{s_A}\left\{\mathbb{E}_{\beta_A}[q|s_A] = \frac{\int q\beta_A(q)\phi(s_A,q,\sigma_s)dq}{\int \beta_A(q)\phi(s_A,q,\sigma_s)dq} = q_A\right\},\ \beta_A(q) = \int \mu(\theta)f(q|\theta)d\theta$$

$$s_B^* = \arg_{s_B}\left\{\mathbb{E}_{\beta_B}[q|s_B] = \frac{\int q\beta_B(q)\phi(s_B,q,\sigma_s)dq}{\int \beta_B(q)\phi(s_B,q,\sigma_s)dq} = q_B\right\},\ \beta_B(q) = \frac{\Phi(s_A^*,q,\sigma_s)\int \mu(\theta)f(q|\theta)d\theta}{\int \Phi(s_A^*,q,\sigma_s)\int \mu(\theta)f(q|\theta)d\theta dq}$$

To ensure that $s_A^* < s_B^*$ ($\pi_B(\theta,\emptyset) < \pi_A(\theta,\emptyset)$), q_B should not be too low. s_B^* is increasing in q_B. Therefore, there is a Δ such that $s_A^* = s_B^*$ when $q_B = q_A - \Delta$. ■

Proof of lemma 5:

$$Q_I^0 = \frac{\int qf(q)[1-\Phi(s_I^0,q,\sigma_s)]dq}{\int f(q)[1-\Phi(s_I^0,q,\sigma_s)]dq}$$

To have

$$Q_I^0 = Q_E = \frac{\int qf(q)[1+\Phi(s_I^0,q,\sigma_s)][1-\Phi(s_E,q,\sigma_s)]dq}{\int f(q)[1+\Phi(s_I^0,q,\sigma_s)][1-\Phi(s_E,q,\sigma_s)]dq},$$

$s_I^0 < s_E$ because $f(q)$ first-order stochastic dominates $\frac{f(q)[1+\Phi(s_I^0,q,\sigma_s)]}{\int f(q)[1+\Phi(s_I^0,q,\sigma_s)]dq}$. Then,

$$\tilde{v}(Q_I^0) = \frac{\int f(q)[1-\Phi(s_I^0,q,\sigma_s)]dq}{\int f(q)[1-\Phi(s_E,q,\sigma_s)]dq} > 1$$

■

Proof of proposition 9:

If the incumbent sets the threshold s_I^0, the entrant sets s_E^1 and all the authors submit to the former first, the latter's utility is

$$u_E^0 = \int qf(q)\Phi(s_I^0,q,\sigma_s)[1-\Phi(s_E^1,q,\sigma_s)]dq$$

If the authors submit to the entrant first, its utility under different threshold s_E is

$$u_E^1(s_E) = \int qf(q)[1 - \Phi(s_E, q, \sigma_s)]dq$$

Define

$$s_E^l := \inf\{s_E | u_E^1(s_E) > u_E^0\}$$

and

$$s_E^h := \sup\{s_E | u_E^1(s_E) > u_E^0\}$$

We need to find the value of α such that when $s_E \in [s_E^l, s_E^h]$, $v(Q_E) < \tilde{v}(Q_E)$.

We first prove that $v(Q_E) < \tilde{v}(Q_E)$ for any Q_E if $\alpha = 1$.

$$\frac{\tilde{v}(Q_E)}{v(Q_E)} = \frac{\frac{\int f(q)[1-\Phi(s_I^0,q,\sigma_s)]dq}{\int f(q)[1-\Phi(s_E,q,\sigma_s)]dq}}{\frac{\int qf(q)[1+\Phi(s_I^0,q,\sigma_s)][1-\Phi(s_E,q,\sigma_s)]dq}{\int f(q)[1+\Phi(s_I^0,q,\sigma_s)][1-\Phi(s_E,q,\sigma_s)]dq} \Big/ \frac{\int qf(q)[1-\Phi(s_I^0,q,\sigma_s)]dq}{\int f(q)[1-\Phi(s_I^0,q,\sigma_s)]dq}}$$

$$= \frac{\int qf(q)[1 - \Phi(s_I^0, q, \sigma_s)]dq}{\int qf(q)[1 - \Phi(s_E, q, \sigma_s)]dq} \cdot \frac{\frac{\int qf(q)[1-\Phi(s_E,q,\sigma_s)]dq}{\int f(q)[1-\Phi(s_E,q,\sigma_s)]dq}}{\frac{\int qf(q)[1+\Phi(s_I^0,q,\sigma_s)][1-\Phi(s_E,q,\sigma_s)]dq}{\int f(q)[1+\Phi(s_I^0,q,\sigma_s)][1-\Phi(s_E,q,\sigma_s)]dq}}$$

The first item in the right hand side is higher than 1 because $s = s_I^0$ maximizes $\int qf(q)[1 - \Phi(s, q, \sigma_s)]dq$ according to the definition of s_I^0. The second item is also higher than 1 because $f(q)$ first-order stochastic dominates $\frac{f(q)[1+\Phi(s_I^0,q,\sigma_s)]}{\int f(q)[1+\Phi(s_I^0,q,\sigma_s)]dq}$.

Then $v(Q_E)$ is increasing in α if $Q_E > Q_I^0$ and decreasing if $Q_E < Q_I^0$. Then $\bar{\alpha}$ and $\underline{\alpha}$ are defined as

$$\bar{\alpha} = \inf\left\{\alpha > 1 \middle| v(Q_E) > \tilde{v}(Q_E), \exists s_E \in [s_E^l, s_E^h]\right\}$$

$$\underline{\alpha} = \sup\left\{\alpha \in [0, 1) \middle| v(Q_E) > \tilde{v}(Q_E), \exists s_E \in [s_E^l, s_E^h]\right\}$$

Finally, the authors with new papers submit to the incumbent first because $v(Q_E) < \tilde{v}(Q_E)$ under thresholds s_I^0 and s_E^1. If $\alpha \in [\underline{\alpha}, \bar{\alpha}]$, the entrant finds it optimal to set threshold s_E^1 and to be the second option of the authors because even if it can be the first option by setting a threshold outside $[s_E^l, s_E^h]$, the payoff will be lower. The incumbent finds it optimal to set threshold s_I^0 because it maximizes its payoff if it is always the authors' first option. ■

Proof of lemma 6: For any threshold s_I set by the incumbent

$$Q_I = \frac{\int qf(q)\mathbb{1}\{q \geq s_I\}dq}{\int f(q)\mathbb{1}\{q \geq s_I\}dq}$$

If the entrant sets the same threshold $s_E = s_I$,

$$Q_E = \frac{\int qf(q)[1 + \mathbb{1}\{q < s_I\}]\mathbb{1}\{q \geq s_E\}dq}{\int f(q)[1 + \mathbb{1}\{q < s_I\}]\mathbb{1}\{q \geq s_E\}dq} = \frac{\int qf(q)\mathbb{1}\{q \geq s_I\}dq}{\int f(q)\mathbb{1}\{q \geq s_I\}dq} = Q_I \quad \blacksquare$$

Proof of proposition 10:

First, if both journals set the same threshold, the authors with new papers are indifferent between them. Therefore, they randomly decide the submission order.

Then, if the incumbent sets $s_I = 0$ and $\alpha \in [\underline{\alpha}^0, \bar{\alpha}^0]$, the entrant finds it optimal to set the same threshold $s_E = 0$ because even if it can be the authors' first option by setting a threshold outside $[s_E^l, s_E^h]$, the payoff will be lower.

Finally, the total utility of these two journals gets maximum when the incumbent set threshold $s_I = 0$. According to lemma 6, the entrant can always guarantee the situation in which it sets the same threshold as the incumbent, and vice versa. Thus, in the equilibrium, both journals should have the same payoff, because otherwise the lower-utility journal can always deviate by choosing the same threshold as the other. Then, in the next period, both journals go back to situation maximizing their utility where $s_I = s_E = 0$. $\blacksquare$

Proof of proposition 11:

Given any Q_I and Q_E,

$$\hat{R}(Q_I, Q_E) := \frac{\int f(q)[1 - \Phi(\hat{s}_I, q, \sigma_s)]dq}{\int f(q)[1 - \Phi(\hat{s}_E, q, \sigma_s)]dq}$$

where $\hat{s}_I$ and $\hat{s}_E$ are determined according to

$$Q_I = \frac{\int qf(q)[1/2 + \Phi(\hat{s}_E, q, \sigma_s)/2][1 - \Phi(\hat{s}_I, q, \sigma_s)]dq}{\int f(q)[1/2 + \Phi(\hat{s}_E, q, \sigma_s)/2][1 - \Phi(\hat{s}_I, q, \sigma_s)]dq}$$

$$Q_E = \frac{\int qf(q)[1/2 + \Phi(\hat{s}_I, q, \sigma_s)/2][1 - \Phi(\hat{s}_E, q, \sigma_s)]dq}{\int f(q)[1/2 + \Phi(\hat{s}_I, q, \sigma_s)/2][1 - \Phi(\hat{s}_E, q, \sigma_s)]dq}$$

Then, consider

$$\tilde{R}(Q_I, Q_E) = \frac{\int f(q)[1 - \Phi(s'_I, q, \sigma_s)]dq}{\int f(q)[1 - \Phi(s'_E, q, \sigma_s)]dq}$$

where s'_I and s'_E are determined according to

$$Q_I = \frac{\int qf(q)[1 - \Phi(s'_I, q, \sigma_s)]dq}{\int f(q)[1 - \Phi(s'_I, q, \sigma_s)]dq}$$

$$Q_E = \frac{\int q f(q)[1+\Phi(s'_I, q, \sigma_s)][1-\Phi(s'_E, q, \sigma_s)]dq}{\int f(q)[1+\Phi(s'_I, q, \sigma_s)][1-\Phi(s'_E, q, \sigma_s)]dq}$$

Because $f(q)$ first-order stochastic dominates $\frac{f(q)[1+\Phi(\hat{s}_E,q,\sigma_s)]}{\int f(q)[1+\Phi(\hat{s}_E,q,\sigma_s)]dq}$, $s'_I < \hat{s}_I$. Then, $\frac{f(q)[1+\Phi(\hat{s}_I,q,\sigma_s)]}{\int f(q)[1+\Phi(\hat{s}_I,q,\sigma_s)]dq}$ first-order stochastic dominates $\frac{f(q)[1+\Phi(s'_I,q,\sigma_s)]}{\int f(q)[1+\Phi(s'_I,q,\sigma_s)]dq}$, $s'_E > \hat{s}_E$. Therefore,

$$\int f(q)[1-\Phi(s'_I, q, \sigma_s)]dq > \int f(q)[1-\Phi(\hat{s}_I, q, \sigma_s)]dq$$

and

$$\int f(q)[1-\Phi(s'_E, q, \sigma_s)]dq < \int f(q)[1-\Phi(\hat{s}_E, q, \sigma_s)]dq$$

Then,

$$\tilde{R}(Q_I, Q_E) = \frac{\int f(q)[1-\Phi(s'_I, q, \sigma_s)]dq}{\int f(q)[1-\Phi(s'_E, q, \sigma_s)]dq} > \frac{\int f(q)[1-\Phi(\hat{s}_I, q, \sigma_s)]dq}{\int f(q)[1-\Phi(\hat{s}_E, q, \sigma_s)]dq} = \hat{R}(Q_I, Q_E)$$

■