Congestion in academic journals under an impartial selection process

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Résumé : Cet article le jeu qui oppose chercheurs et éditeurs lorsque les éditeurs adoptent un processus de sélection impartial des articles. Il considère les possibilités de congestion dans le processus éditorial et montre que, suivant le type d’équilibre qui apparaît, la hausse des coûts de rejet peut s’avérer inefficace pour éliminer les risques de congestion.

Abstract : This paper studies the publishing game played by researchers and editors when the editors adopt an impartial selection process. It analyzes the possibility of congestion in the editorial process and shows that, depending on the nature of the equilibrium, the rise of the rejection costs could be an inappropriate solution to avoid the congestion effect.

Keywords : Publication market, Academic journals, Editors, Congestion.

JEL Classification: A11; M21; D83
Congestion in academic journals
under an impartial selection process

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Abstract

This paper studies the publishing game played by researchers and editors when the editors adopt an impartial selection process. It analyzes the possibility of congestion in the editorial process and shows that, depending on the nature of the equilibrium, the rise of the rejection costs could be an inappropriate solution to avoid the congestion effect.

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Section 1: Introduction

Following the trend set by the US many years ago, European and Asian governments are undertaking an institutional transformation of their research environment. The reforms aim at increasing the quantity and quality of research through performance-based reward schemes and enhancement of the role of research in the public evaluation process. In this process, academic publications tend to become the major indicator of research performance. As a result, competition for inclusion in the high impact peer-review academic journals becomes more intense. Highly-cited journals attract more submissions and quality journals’ refereeing process generates higher rejection rates (Donovan 1998).

In answer to what could be considered as a congestion of the editorial process (Goel and Faria 2007), editors of top-tier journals start to implement defence strategies, some of them running against the transparency of the publication process (Bence and Oppenheim 2004a, 2004b). The usual way to prevent submission of low quality papers to top journals generally consists in an increase of the costs paid by the authors in case of rejection. For instance, a long time between the submission and the first answer, as it postpones the possibility of publication in other reviews and the reward that could come with the publication, may deter low quality articles of being submitted (Elisson 2002, Azar 2005). The increase in submission fees appears to be an alternative efficient device to reduce the flow of submissions (Wang 1997, Leslie 2005, Azar 2006). While these measures do oppose the congestion effect, they also clearly convey an image of unfairness and lack of transparency\(^4\).

This paper studies the publishing game played by researchers and editors when the editors

\(^4\) Editorial favoritism is arguably the worst case of unfairness and lack of transparency. Laband and Piette (1994) point out that editorial favoritism generates sizeable wealth redistributions among members of the scientific community, providing incentives for authors to attempt to influence the chances of publication and citation. On editorial favoritism, see, among others, Graves et al. (1982), Blank (1991), Medoff (2003), and Berg and Faria (2008).
implement an *impartial selection process*.\(^5\) It analyzes the conditions for some congestion to appear in the editorial process and shows that, depending on the nature of the equilibrium, the rise of the rejection costs could be an inappropriate solution to avoid the congestion effect.

This paper follows an idea close to McCabe and Snyder (2004) and Besancenot and Vranceanu (2008b) in which the editors can only imperfectly determine an article's quality\(^6\). It considers researchers who may publish their paper either in a book or in a refereed journal. Publishing an article in an academic journal has greater value, however the selection process is risky and a rejection is costly for a researcher.

In this paper, the quality of the refereeing process relies on the number of submission received by the editor. The editor who receives a paper ignores the quality of the paper and, in order to make her decision, she sends the paper to a referee in charge of the paper's evaluation. The editor has at her disposal a pool of referees that splits into two groups. A first group of referees have a perfect judgement. They can identify a paper's quality without error, rejecting poor papers and accepting good ones. These referees are perfectly known by the editor: they may be close colleagues from the same university or institution, regular authors of a journal or identified specialists of the field, in sum, they are members of the same academic network (van Dalen 1999, Faria, 2002). However, the set of academic fellows in which an editor can have an absolute trust is bounded and, even in asking more than one report to each of these referees, the maximum number of trustable referee reports that an editor can ask for is limited. When only a few papers are submitted to the review, they will be evaluated by efficient referees and the selection process is perfect. Unfortunately, when the number of submissions exceeds the maximum number of good referee reports that the editor can ask for, she will have difficulties to

\(^5\)The game between editors and researchers has already been studied by Frey (2005) and Faria (2005) under alternative settings.

\(^6\) This assumption is empirically verified by Oswald (2007) who demonstrates that the best article in a medium quality journal can be more influential than the worst articles in an issue of an elite journal.
obtain reviews from individuals with appropriate expertise (Hochberg et alii. 2009). In this case, the editor is forced to rely upon referees of the second group. However, these referees are less reliable: some of them will accept any kind of paper (since they are afraid of rejecting a good paper) while others will reject every paper (in order to avoid the risk of accepting a bad paper).

In this framework, when no good referee is available, the editor may wish to correct some of the bad referees’ decisions. As a gap between the frequencies of accepted papers by the two groups of referees would reveal a bias in favour of either rejection or acceptance, an impartial editor will correct the bad referees’ decisions in order to match the frequency of their accepted papers with the frequency of acceptation by good referees. Hereafter, this correction will be referred to as the impartial selection process⁷:

The basic result of this game is twofold. The first point is that when the editor can call for a sufficient (but reasonably low) number of good referee reports, a separating equilibrium always exists whatever the values of other parameters. In this equilibrium, good researchers and only good researchers submit their paper to the journal and each paper is accepted. As a result, the quality of the journal is the highest possible. The second result is that when the reward of refereed publications exceeds a given threshold, two hybrid equilibria are feasible in which the selection process is subject to congestion. In these equilibria bad researchers submit their papers to the journal hopping to get published and, as the flow of papers exceeds the availability of good referees, the refereeing process becomes imperfect. This gives a chance to low-quality papers to get published by the journal.

As usual in case of multiple equilibria, expectations are self-fulfilling. The researchers' beliefs concerning the quality of the editorial process determines the effective quality of the review. An interesting point in the model is that the properties of the two hybrid equilibria are asymmetric.

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⁷ The assumption of impartiality in decision making has been introduced by Besancenot and Vranceanu (2008a) in the description of a judge behaviour seeking for impartial justice under congestion of the court.
The optimal reaction of the editor to reduce the adverse effects of congestion in one equilibrium would have counterproductive effects in the other one. More specifically, an increase of the submission fees or in the mean time before first answer could paradoxically raise the propensity for authors to submit their papers to the refereed journals.

The paper is organized as follows. Section 2 introduces the main assumptions and analyzes researchers payoffs. Section 3 presents the typology of equilibria and comments on their basic features. Section 4 provides a discussion of the results and a last section summarizes our conclusions.

Section 2 : The model

We consider a population of researchers of dimension one. Each researcher is endowed with a paper and has to choose a publication strategy.

There are two types of papers, the \textit{g-type} (for "good"), which are high quality papers, and the \textit{b-type} (for bad), which are low-quality papers that do not satisfy the quality standards for publication in a refereed journal. In order to simplify the presentation, hereafter we will refer to \textit{g-type} researcher (resp. \textit{b-type}) for an academic fellow endowed with a good (resp. bad) paper. The frequency of \textit{g-type} papers (resp. \textit{b-type}) in the total set of papers is denoted by \( \alpha \) (resp. \( 1 - \alpha \)), with \( 0 < \alpha < 1 \).

A researcher perfectly knows the quality of his paper. He can either submit this paper to an academic journal (J-strategy) or publish it in a book (B-strategy). Whatever its type, a paper's quality is sufficient to guarantee a publication in a book. Thus the B-strategy leads to the certain reward \( W^b \). A researcher playing the J-strategy sends his paper to the editor of an academic journal. If the paper is accepted for publication, the reward is \( W^j \), with \( W^j > W^b \). However, the paper may be rejected and the author has no alternative other than to publish the paper in a
book. In this case, the reward will be $W^b - c$ where $c$ denotes the cost for the researcher of an unsuccessful submission (i.e. the sunk submission fee, the frustration of being rejected or the financial consequences of a delayed publication).

Good referees come from a pool of high-skilled researchers (a small subset of authors). Let us denote by $\theta$ the maximum number of reports that the editor can ask from these referees. In the following we will restrict our arguments to the non trivial case where $\alpha < \theta < 1/2$. There is at least as much good referee reports as good papers and the editor cannot affect a good referee to more than half of the total number of papers.

The model can be cast as a sequential game featuring two rational players: the researcher, who chooses his publication strategy, and the journal’s editor who decides to publish or not the submitted papers. The typical sequence of decisions is the following:
Time $t = 0,$ nature chooses the type of paper that the researcher will have to manage.

Time $t = 1,$ the researcher decides which of the two publication strategies he will implement. He can publish his paper in a book and receive $W^b$ (in this case, the game is over) or send it to the editor and wait for her decision.

Time $t = 2,$ the editor who receives a paper sends it to a referee. With a probability $P,$ the paper will be evaluated by a good referee, and with a probability $(1 - P)$ the paper is evaluated by a bad one. Hereafter, $P$ will be endogenously defined according to the relative number of submissions and good referees.

Time $t = 3,$ when the referee is good, the editorial decision perfectly reflects the quality of the paper. A $b$-type's paper will be rejected (its author will receive $W^b - c$), and a $g$-type paper will be accepted (its author will receive $W^j$). If the referee is a bad one, the paper will be accepted, whatever its quality, with a probability $\pi$ equal to the frequency of $g$-type in the set of submitted papers. Remark that this frequency is known by the editor who observes the rate of rejection by good referees. Figure 1 presents the decision tree of the game.

Let us denote by $l$ (resp. $\lambda$) the probability that a researcher endowed with a $g$-type paper (resp. a $b$-type) plays the J-strategy and by $(1 - l)$ (resp. $1 - \lambda$) the probability of the B-strategy. According to these probabilities, the number of journal submissions is given by $\alpha l + (1 - \alpha)\lambda,$ and the probability $P$ for a submitted paper to be evaluated by a good referee is:

$$P = \min\{1, \frac{\theta}{\alpha l + (1 - \alpha)\lambda}\}$$  \hspace{1cm} (1)

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8 Under $\theta < \alpha,$ the separating equilibrium would not exist.

9 By assumption, the choice of the referee is random; the editor cannot assign good referees to good authors
According to the *impartial selection assumption*, the frequency $\pi$ of papers accepted by the review matches the frequency of $g$-type papers in the set of submitted papers, so:

$$\pi = P[g \mid s = J] = \frac{\alpha d}{\alpha d + (1 - \alpha) \lambda},$$

(2)

Thus, the expected payoffs $E[U^g|s]$ for a $g$-type researcher playing strategy $s$ are:

$$E[U^g \mid s = B] = W^b$$

$$E[U^g \mid s = J] = P[C]W^j + (1 - P[C])\left[\pi W^j + (1 - \pi)(W^b - c)\right]$$

$$= W^j - \frac{(1 - \alpha) \lambda}{\alpha d + (1 - \alpha) \lambda} \left(1 - \min\{1, \frac{\theta}{\alpha d + (1 - \alpha) \lambda}\}\right)[W^j - W^b + c],$$

(3)

and the expected payoffs $E[U^b|s]$ for a $b$-type researcher are given by:

$$E[U^b \mid s = B] = W^b$$

$$E[U^b \mid s = J] = P[C](W^b - c) + (1 - P[C])\left[\pi W^j + (1 - \pi)(W^b - c)\right]$$

$$= (W^b - c) + \frac{\alpha d}{\alpha d + (1 - \alpha) \lambda} \left(1 - \min\{1, \frac{\theta}{\alpha d + (1 - \alpha) \lambda}\}\right)[W^j - W^b + c],$$

(4)

**Section 3 : Equilibria:**

We can study now the Nash equilibria of the game. A Nash equilibrium is defined here as a situation where a researcher, expecting his colleagues to play a given strategy, carries out an optimal strategy coherent with his expectations. In this game we can check the existence of a separating, a pooling, and two hybrid equilibria. As the pooling equilibrium appears to be the limiting case of one of the two hybrids, this equilibrium will be presented in annexe 1.

**Separating equilibrium**

In this first equilibrium, only the $g$-type researcher submits to the review, the $b$-type publishes

(Cf. Hamermesh 1994).
in books. In such equilibrium, researchers' beliefs are: $\lambda = 0, \ l = 1$.

For a $g$-type researcher, these beliefs imply $E[U^g | s = B] = W^b$ and $E[U^g | s = J] = W^j$. As $W^b < W^j$, we get $E[U^g | s = B] < E[U^g | s = J]$. In this equilibrium, the good researcher is sure to publish in the review and find optimal to submit his paper to the journal.

For a $b$-type researcher, the same beliefs imply:

$$E[U^b | s = J] = (W^b - c) + \left(1 - \min\{1, \frac{\alpha}{\theta}\}\right)[W^j - W^b + c]$$

and as $\min\{1, \frac{\alpha}{\theta}\} = 1$, the expected reward of a submission to the review is $E[U^b | s = J] = (W^b - c)$. Obviously, the $b$-type researcher will prefer to publish his paper in books. For both types of researchers, optimal strategies are consistent with the equilibrium beliefs.

Remark that this equilibrium is always feasible under the sufficient condition: $\min\{1, \frac{\alpha}{\theta}\} = 1$, i.e. if $\theta \geq \alpha$. This condition states that as long as the number of good referees exceeds the number of submitted papers, any low quality paper will be rejected and there is no incitation for a bad researcher to submit a paper to the academic journal. The selection process of papers is thus perfectly efficient.

**Hybrid equilibria**

The model also allows equilibria in which a good researcher plays J-strategy, and a bad researcher, indifferent between the two strategies, randomly adopts the B- or the J-strategy. In this case, researchers' beliefs are given by: $\lambda \in [0, 1]$ and $l = 1$, and the expected payoffs of the J-strategy are:

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10Hybrid equilibria in which good researchers are indifferent between the two strategies or strictly prefer the B-strategy are impossible.
For the \textit{b-type} researcher the indifference between the two strategies implies

\[
E[U^b | s = B] = E[U^b | s = J], \quad \text{i.e.:}
\]

\[
W^b = (W^b - c) + \frac{\alpha}{\alpha + (1 - \alpha) \lambda} \left( 1 - \frac{\theta}{\alpha + (1 - \alpha) \lambda} \right) [W^j - W^b + c] \tag{7}
\]

After some manipulations, this equality can be stated as:

\[
0 = c(\alpha + (1 - \alpha) \lambda) \lambda - (\alpha + (1 - \alpha) \lambda) \alpha [W^j - W^b + c] + \theta \alpha [W^j - W^b + c] \tag{8}
\]

\[
\Leftrightarrow 0 = cx^2 - xy + \theta y \quad \text{with} \quad \begin{cases} 
  y = \alpha [W^j - W^b + c] > 0 \\
  x = (\alpha + (1 - \alpha) \lambda)
\end{cases}
\]

This equation presents two solutions for $x$ and implies two solutions for $\lambda$:

\[
x_{1,2} = \frac{y \pm \sqrt{y^2 - 4c \theta y}}{2c} \Rightarrow \lambda_{1,2} = \frac{y - 2c \alpha \pm \sqrt{y^2 - 4c \theta y}}{2c(1 - \alpha)}. \tag{9}
\]

Before studying the properties of these solutions, let us check that with any of these values of $\lambda$, the \textit{g-type} researcher strictly prefers the J-strategy. This will be the case if

\[
E[U^g | s = J] > E[U^g | s = B], \quad \text{or, in an equivalent way if:}
\]

\[
W^b < W^j - (1 - \alpha) \lambda \left\{ \frac{1}{\alpha + (1 - \alpha) \lambda} \left( \alpha + (1 - \alpha) \lambda - \theta \right) \left( \frac{\alpha + (1 - \alpha) \lambda - \theta}{\alpha + (1 - \alpha) \lambda} \right) [W^j - W^b + c] \right\}. \tag{10}
\]

Replacing the term in the brackets by its value in (7), this inequality becomes

\[
W^b < W^j - (1 - \alpha) \lambda \left\{ \frac{\alpha + (1 - \alpha) \lambda - \theta}{\alpha + (1 - \alpha) \lambda} \left( \frac{\alpha + (1 - \alpha) \lambda - \theta}{\alpha + (1 - \alpha) \lambda} \right) [W^j - W^b + c] \right\}. \tag{11}
\]

Replacing the term in brackets by its value in (9) we get:

\[
x_{1,2} = \frac{y \pm \sqrt{y^2 - 4c \theta y}}{2c} \Rightarrow y \pm \sqrt{y^2 - 4c \theta y} < 2\alpha (W^j - W^b + c)
\]

\[
\Leftrightarrow y > \pm \sqrt{y^2 - 4c \theta y},
\]

which is always true. When the \textit{b-type} researcher is indifferent between the two strategies,
the g-type researcher strictly prefers the J-strategy.

Remark now that the two roots \( \lambda_1 = \frac{y - 2c\alpha - \sqrt{y^2 - 4c\theta y}}{2c(1 - \alpha)} \) and \( \lambda_2 = \frac{y - 2c\alpha + \sqrt{y^2 - 4c\theta y}}{2c(1 - \alpha)} \) exist if and only if \( y > 4c\theta \). Moreover, in this model, the congestion of the refereeing process occurs if \( P < 1 \). From Eq. (1) this implies \( \lambda > \frac{(\theta - \alpha)(1 - \alpha)}{1 - \alpha} > 0 \), a condition that is satisfied with any of the two values of \( \lambda \):

\[
\lambda_1 > \frac{\theta - \alpha}{1 - \alpha} \\
\iff \frac{y - 2c\alpha - \sqrt{y^2 - 4c\theta y}}{2c(1 - \alpha)} > \frac{\theta - \alpha}{1 - \alpha} \\
\iff y - 2c\alpha - \sqrt{(y - 2\theta c)^2 - (2\theta c)^2} > 0
\]

(12)

Thus, if \( y > 4c\theta \), the two roots are positive, \( 0 < \lambda_1 < \lambda_2 \), the congestion of the editorial process is feasible. We now have to define the range of parameter under which, \( \lambda_1 < 1 \) or \( \lambda_2 < 1 \).

**Hybrid 1:** \( \lambda_1 \in [0, 1] \)

By definition: \( \lambda_1 < 1 \iff y - 2c\alpha - \sqrt{y^2 - 4c\theta y} < 0 \), two cases are possible.

- **Case 1:** \( y - 2c < 0 \). In this case, the inequality \( \lambda_1 < 1 \) is always true. As, \( y > 4c\theta \), this condition implies \( 4c\theta < y < 2c \), which is possible as \( \theta < 0.5 \). In this case, \( \lambda_1 \in [0, 1] \) is feasible under the necessary condition:

\[
4c\theta < y < 2c \iff c\left(\frac{4\theta - \alpha}{\alpha}\right) < \left[W_j - W^b\right] < c\left(\frac{2 - \alpha}{\alpha}\right)
\]

(13)

- **Case 2:** \( y - 2c > 0 \). Remark first that, in this case, the condition \( y > 4c\theta \) is always satisfied (by assumption \( \theta < 0.5 \)). Moreover, by definition of \( y \), the condition \( y - 2c > 0 \) is equivalent to
\[ c \left( \frac{2-\alpha}{\alpha} \right) < \left| W^j - W^b \right| \]  \hspace{1cm} (14) \]

but \( \lambda_1 < 1 \) implies \( y - 2c - \sqrt{y^2 - 4c\theta y} < 0 \), an inequality which can be written after simplification as \( c < y(1 - \theta) \), which in turn is equivalent to:

\[ c \frac{(1-\alpha(1-\theta))}{\alpha(1-\theta)} < \left| W^j - W^b \right| \]  \hspace{1cm} (15) \]

It is easy to check that, with \( \theta < 0.5 \), condition (15) is satisfied when (14) is true.

Finally, mixing conditions for \( \lambda_1 < 1 \) in Case 1 and Case 2, we get the the necessary and sufficient condition for \( 0 < \lambda_1 < 1 \):

\[ \left| W^j - W^b \right| > c \left( \frac{4\theta - \alpha}{\alpha} \right) \]  \hspace{1cm} (16) \]

In this range of parameters, differentiation of Eq. (8) allows to check that an increase of the cost \( c \) would induce a rise of the \( b \)-type submissions, \( d\lambda_1/dc > 0 \), and that a drop of the reward \( W^r \) would produce the same result: \( d\lambda_1/dW^r < 0 \).

\[
\begin{align*}
\frac{d\lambda_1}{dc} &= \frac{[(1-\alpha)\lambda_1(\alpha+(1-\alpha)\lambda_1)+\theta\alpha]}{(1-\alpha)\sqrt{y^2-4c\theta y}} > 0 \\
\frac{d\lambda_1}{dW^r} &= -\frac{\alpha}{(1-\alpha)2c} \left( \frac{y-2c\theta-\sqrt{y^2-4c\theta y}}{\sqrt{y^2-4c\theta y}} \right) < 0
\end{align*}
\]  \hspace{1cm} (17) \]

Hybrid 2: \( \lambda_2 \in [0,1] \)

The condition \( \lambda_2 < 1 \) implies \( y - 2c + \sqrt{y^2 - 4c\theta y} < 0 \), a condition that can only be satisfied if \( y - 2c \) is negative. But, after some simplifications, the first inequality appears to be equivalent to \( c > (1 - \theta)y \), which implies that \( c > y/2 \). The necessary condition for \( 0 < \lambda_2 < 1 \) is thus (remark that condition \( y/4\theta > (1 - \theta)y \) is verified whatever the parameter


\[
\frac{y}{4\theta} > c > (1-\theta)y \tag{18}
\]

After substitution of \( y \) by its definition, this last equation leads to the necessary and 
sufficient condition for \( 0 < \lambda_2 < 1 \):

\[
\frac{(4\theta-\alpha)c}{\alpha} < [W^j-W^b] < \frac{(1-\alpha)(1-\theta)c}{\alpha(1-\theta)} \tag{19}
\]

Remark that \( \lambda_2 = 1 \) when \([W^j - W^b]\) reaches the upper bound. The pooling equilibrium 
appears to be the limiting case of the hybrid 2 equilibrium.

Finally, the differentiation of Eq. (8) allows to check that, in this equilibrium, an increase of the 
cost \( c \) would induce a drop of the \( b \)-type submissions, \( d\lambda_2/dc < 0 \) and that a rise of the 
reward \( W^j \) would produce the same result: \( d\lambda_2/dW^j > 0 \):

\[
\frac{d\lambda_2}{dc} = -\frac{[1-\alpha]\lambda_2(\alpha+(1-\alpha)\lambda_2)+\theta\alpha}{(1-\alpha)\sqrt{y^2-4c\theta}} < 0
\]

\[
\frac{d\lambda_2}{dW^j} = \frac{\alpha}{(1-\alpha)2c} \left( \frac{y-2c\theta+\sqrt{y^2-4c\theta}}{\sqrt{y^2-4c\theta}} \right) > 0 \tag{20}
\]

Figure 2. presents the feasible values of \( \lambda_1 \) and \( \lambda_2 \) according to the value of \([W^j - W^b]\).

### Section 4: Discussion

In the previous section, we established the necessary conditions for the existence of three

different equilibria. For a low spread between the rewards \( W^j \) and \( W^b \), i.e. for:

\([W^j - W^b] < c\frac{(4\theta-\alpha)}{a}\), the only feasible equilibrium is the separating one. When the spread

exceeds the previous threshold, three equilibria coexist.
In the range, \( \frac{(4\theta - a)}{a} - c < \left[ W^g - W^b \right] < \frac{(1 - a(1 - \theta))}{a(1 - \theta)} - c \), the separating equilibrium is still feasible, however the hybrid equilibria where the \( b \)-type researcher plays the J-strategy with either probability \( \lambda_1 \) or \( \lambda_2 \) also exist. Moreover, when \( \frac{(1 - a(1 - \theta))}{a(1 - \theta)} - c < \left[ W^g - W^b \right] \), the hybrid 2 degenerates into a pooling equilibrium, an equilibrium that coexists with the separating and the Hybrid 1 equilibria.

In case of multiple equilibria, the prevailing equilibrium relies on the players' beliefs. For instance, when researchers expect a perfect refereeing process, they do not submit bad papers. In this case, submission is restricted to the sole \( g \)-type papers and expectations are self-fulfilling. When a researcher believes that the papers' selection is imperfect, he may submit a medium quality paper hoping that the overwhelmed editor will send it to an inaccurate referee. Massive submissions from \( b \)-type researchers thus lead to the congestion of the editorial board.

Since academic publications tend to become the most important measure of research performance, the value of a publication in a scientific journal increases, and, as a result, the
number of submissions is growing at a dramatic speed. According to our model, as long as the submitted papers are of the g-type, this does not affect the quality of academic journals. However, when the reward of peer reviewed publications exceeds the threshold $W^h + (4\theta - \alpha)c/\alpha$, authors will also submit their b-type papers to the academic journal. The mean quality of the published papers will drop because the quality of the selection process is being severely challenged. Note that the switch from an equilibrium to another is not continuous: as $\lambda$ jumps from zero to a strictly positive value, the quality of the published papers drops sharply.

As a response to the increase of the number of submissions, a possible answer for the editor is to increase the cost $c$ paid by the researchers in case of rejection. The increase of the fees, the rise of the mean time before first answer, or the decreasing content of the referee reports are the main usual solutions to foster self-selection and to reduce the propensity of researchers to submit their b-type papers (Moyer and Crockett 1976, Leslie 2005, Azar 2005, 2006). However, the model shows that this would only be the case in the hybrid equilibrium 2 ($d\lambda_2/dc < 0$). In the hybrid equilibrium 1, this policy would have counterproductive results as $d\lambda_1/dc > 0$.

The rationale behind this counter-intuitive equilibrium is rather obvious: in case of higher rejection costs, researchers have to compensate for this higher cost by a higher probability of publication in the journal. However, an increase in $\lambda$ presents two opposite consequences for a b-type researcher. It raises the probability $(1 - P)$ of being refereed by a bad referee and simultaneously drops the probability $\pi$ of being accepted by the editor in case of bad refereeing. In the hybrid equilibrium 2 the increase of the rejection cost involves a reduction of the frequency

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11For instance, the Economic Journal reports that, from 2002 to 2007, the number of submissions raised from 446 to 704 (Cf. Editors’ reports 2006 and 2007). A more dramatic increase holds true for the American Economic Review (Borts, 1980, and Ashenfelter, 1999)
of b-type submissions, a higher probability of being refereed by a good referee, but also a higher probability of being accepted after an evaluation by a bad referee and finally a global increase in the probability of publication for bad papers. The opposite effect is at work in the hybrid 1 equilibrium in which a higher propensity \( \lambda_1 \) for a researcher to submit its b-type paper induces a positive effect on \((1 - P)\) that offsets the adverse effect on \( \pi \) and finally leads to a global increase in the probability of publication for bad papers.

In the same vein, an increase in the reward of a refereed publication must come in both equilibria associated with a decrease in the probability of acceptation of a b-type submission by the review\(^{12}\). In the Hybrid equilibrium 2 (resp. 1), the increase (resp. decrease) of the number of submissions entails an increase (resp. decrease) of the congestion effect and a drop (resp. a rise) in the probability \((1 - P)\) of an evaluation by an inefficient referee. At the same time, the frequency \( \pi \) of accepted papers rises (resp. drops), balancing the previous effect on congestion of the editorial process. In both cases, the two opposite effects lead to a global decrease of the publication probability for a b-type paper.

### Conclusion

This paper studies the various equilibria that could result from a publishing game under an impartial selection process. It states that when the reward of a refereed publication increases, the incentive to submit papers to academic journals could lead authors of low quality papers to take their chance in the refereeing process. In this case, some congestion in the editorial

\footnote{\textsuperscript{12}In the hybrid equilibria, the authors of b--type papers must be indifferent between the two alternative publication strategy. As a publication in a book leads to a certain reward, the expected reward of a bad paper's submission should stay constant in equilibrium. In case of a rise in \( W_j \), the probability of acceptation must drop.}
mechanism may occur and the efficiency of the selection process is challenged. As bad papers could be accepted in case of congestion, this effect is obviously detrimental to the quality of academic journals.

Facing an increase in the number of submissions, editors often try to restrict the refereeing burden by raising the cost of a rejection for the authors. The model shows that this could present some counterproductive effects. Another remedy, not taken into account by the model, is for the editor to pre-assess the quality of a paper, limiting external assessments to those papers that have a better chance of being of the top quality. This ultimately leads the editor to only accept submissions of authors known as good, therefore creating a club, because unknown authors will have no chance to publish. These measures, again, seem detrimental to research and journals’ quality.

Last but not least, an obvious solution for the reduction of the congestion burden consists in the increase in the number of academic journals. As the number of academic journal follows a long run increasing trend it appears somewhat logical that the pool of top reviews follow the same evolution, reducing the monopoly power of top journals. Such an evolution could reduce the number of submissions received by each journal, increase the global pool of good referees (as identified by the editors) and finally increase the possibility for the efficient separating equilibrium to be the sole feasible equilibrium.

Annexe: Pooling equilibrium

In this equilibrium, each researcher will play the J-strategy.\(^\text{13}\) Researchers’ beliefs are thus

\(^{13}\)A pooling equilibrium where each researcher plays the B-strategy is not feasible as, in this case, a \( g \) - researcher would have a strong incentive to change his strategy and to submit to the journal.
\( \lambda = 1, \ l = 1 \). For a \( g \)-researcher, the expected payoff of a submission is given by:

\[
E[U^g|s = R] = W^j - (1 - \alpha)(1 - \theta)[W^j - W^b + c]
\]

and the necessary condition for this equilibrium \( E[U^g|s = B] < E[U^g|s = R] \) implies:

\[
(W^j - W^b) > \frac{(1 - \alpha)(1 - \theta)}{[1 - (1 - \alpha)(1 - \theta)]} c \quad (A1)
\]

For a \( b \)-type researcher, the expected payoff of a submission is:

\[
E[U^b|s = R] = (W^b - c) + \alpha (1 - \theta)[W^j - W^b + c],
\]

and the necessary condition for this equilibrium, \( E[U^b|s = B] < E[U^b|s = R] \), implies:

\[
[W^j - W^b] > \frac{(1 - (1 - \theta)\alpha)}{(1 - \theta)\alpha} c \quad (A2)
\]

Some simple calculus allows checking that condition (A1) is verified under condition (A2), so this last equation is also the necessary condition for this equilibrium. For a low cost \( c \) or an important difference between the rewards \( W^j \) and \( W^b \), the congestion effect is at its maximum.

REFERENCES


