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Abstract
Concern has been expressed at the long delays (especially in economics) faced by authors who aim to publish in prestigious refereed academic journals. Time delays and the associated uncertainty are an important part of the cost of submitting to any top journal. A commonsense economic principle is that if costs increase, supply will fall. Thus time delays can be used as an implicit rationing device to save scarce editorial and refereeing resources. The submission process is seen as a signal extraction problem, where the statistical noise is the difference in opinion between the journal's editors and an author's own view. It is shown how submission costs can ration the supply of submissions and how it influences the quality of submissions depending on the signal to noise ratio and where authors may have rational expectations in estimating their chances of acceptance. An alternative rationing system, which would speed up the decision process, is explored.

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Ellison (2002a; 2002b) has confirmed that time lags from submission to acceptance in refereed journals are becoming longer. He suggests an evolving social norm as a possible explanation, with more demands now made on authors for their work to be considered publishable. However, time delays have an additional effect, which is to limit the flow of submissions. If submission to academic journals is effectively costless, with decisions rapidly reached, then the best strategy is to start at the `top' journal and work down until the article is accepted. Better journals are unlikely to welcome the prospect of reviewing the large number of submissions this implies.

Submitting to a peer reviewed journal is not a costless activity. There are direct costs such as the submission fee, postage, letter writing, adopting the journal style and so on. There is another major cost, which is the *time* and its associated uncertainty that must be spent waiting for a decision. Not only have first response times increased but `revise and resubmit' without any guarantee of eventual publication has also become a common response. These surely act as a disincentive to undertake the painful but necessary process of peer review. Ellison notes that time lags are longest for the top five economics journals at around six to eleven months longer than the rest. Furthermore, he comments that

> `There appears to be increased competition to publish in the top journals, in part because the profession has grown, but because the number of slots in the top journals has decreased and the top journals have become more prestigious.'

Despite the increase in prestige, the number of submissions to the top journals have remained fairly static, according to Ellison's data. Increased submission costs are one way whereby a top journal can ration the supply of submissions and save editorial and refereeing resources, which most academics do *pro bono*.

So how do submission costs, of which time is a significant factor, ration the supply of the papers and influence their average quality? Increasing submission costs lower supply and make the editorial burden manageable, but raise the possibility that some top papers will self-select to alternative journals. If higher submission costs mean a large fall in low quality submissions then there is little incentive to reverse the trend of rising submission costs. What follows explains this trade-off using a statistical model of the submission process, which takes account of the fact that submission is inherently chancy.

The concluding comments suggest an alternative to the *pro bono* system. There is a general awareness that the world is suffering from `information overload', yet, despite these changes, the means by which such information is quality ranked has hardly changed at all, beyond a gradual grinding to a halt of peer review. Time delays are a pure deadweight loss. People want to be made aware of what is really worth knowing about faster.

I. Signal Extraction

A. The omniscient referee

Do better papers direct themselves towards better journals? The problem is that authors are not necessarily the best judges of the quality of their own work, but it is authors who decide where to submit their work. One's own evaluation is bound to be an imprecise signal of true quality; one function of peer review is to determine the true worth of an academic paper.

The issue is a signal extraction problem and the framework can show how submission costs affect the submission process and the quality of papers a journal will receive. Phelps (1972) and Lucas (1977) previously used this approach in two classic papers on job search and the business cycle. If authors with a low perception of the quality of their work find it too costly to submit to top journals and if this perception is correlated with true quality, then there is useful self-selection.

Assume there is an `omniscient referee' who can determine a paper's true quality and let the distribution of true quality given by $z \sim N(\bar{z}, \sigma_z^2)$. Think of z as some univariate scale with higher values indicating better quality. Let the distribution of authors' beliefs (denoted as q) be related to z as follows:

$$q = z + v \tag{1}$$

where v is a random variable $\sim N(\bar{v}, \sigma_v^2)$. The v term represents the noise, with q the noisy signal of true quality. The larger σ_v^2 then the less accurate are authors' perceptions about the true worth of their own work. One's guess is that σ_v^2 is likely to be large. Typically, authors will solicit feedback on their work by sending off discussion papers to colleagues, giving seminars etc., which will enable them to give a more accurate assessment of their own work. Experience no doubt contributes to the accuracy of q as a signal – previous successes, esteem of colleagues and so on. All these factors will contribute to the size of σ_v^2 relative to σ_z^2. The point is that the `omniscient referee' usually has a different view and v represents this difference of opinion. A positive v means a negative view relative to an author's personal opinion.

A positive $\bar{v}$ term represents a systematic overestimate of true quality. Overconfidence is an endemic human quality and most likely $\bar{v}$ is positive.[1] True quality on average is likely to somewhat less than our own beliefs. It turns out that systematic optimism is not important to the effectiveness of the signal extraction process. On one set of assumptions, it may have a role in determining a journal's efficiency. A second approach, which assumes that authors have rational expectations, implies that systematic optimism is unimportant.

z and v are possibly correlated, which could be denoted as the `vanity' and `modesty' factors. Suppose it turns out that someone with a high z tends to have negative value of v, i.e. the person undervalues his or her work, and a low z author tends to have an exaggerated opinion with a positive v. In this case σ_{vz} will be < 0. The opposite case is $\sigma_{vz} > 0$, with the high achievers tending to vanity and the low achievers exhibiting modesty. To simplify and because it makes no central difference, assume $\sigma_{vz} = 0$.

The distribution of z and q will then be:

[1] Smith (1776) summed this up as `the natural confidence which every man has more or less, not only in his own abilities, but in his own good fortune.' (chap.10)

$$\begin{bmatrix} z \\ q \end{bmatrix} = \begin{bmatrix} \bar{z} \\ \bar{z} + \bar{v} \end{bmatrix}, \begin{bmatrix} \sigma_z^2 & \sigma_z^2 \\ \sigma_z^2 & \sigma_z^2 + \sigma_v^2 \end{bmatrix} \quad (2)$$

To establish the conditional expectation $Ez \mid q$, think of regression line of *z* on *q*:

$$z = a + bq + \varepsilon \quad (3)$$

where *a* and *b* are parameters and ε is a statistical error ($E\varepsilon = 0$). It follows that:

$$b = \frac{\operatorname{cov}(q,z)}{\operatorname{var}(q)} = \frac{\sigma_z^2}{\sigma_q^2} \text{ and } a = (1-b)\bar{z} - b\bar{v} \quad (4)$$

It can also be shown that:

$$\sigma_\varepsilon^2 = (1-b)\sigma_z^2 \le \sigma_z^2 \quad (5)$$

and this error term is homoscedastic, independent of *q*. Equation (3) shows that quality z will be correlated with *q* (when $\sigma_{zv} = 0$, the correlation coefficient for eq.(3) will be $\sqrt{b}$) and eq.(5) shows that as long as $b > 0$ the conditional standard error will be smaller than the unconditional variance of true quality σ_z^2. So the signal offers two properties; it improves the forecast of mean quality and it makes the forecast less prone to error.

Equations (3) and (5) offer insights as to how better quality submissions might self-select into better journals. The constant term obviously exercises no (relative) influence, rather it is the value of *b* that matters. Since $0 \le b \le 1$, *z* will on average be better for those whose own perception of quality, *q*, is higher except when noise totally dominates and *b*= *0*. This signal will, however, be imperfect. The nearer *b* is to zero the less effective the signal. In the limit, as $\sigma_v^2 \to 0$, the signal will become perfect with $b \to 1$ and $\sigma_\varepsilon^2 \to 0$. So editors and referees will, because of noisy signals, spend considerable time rejecting unsuitable articles, despite some self-selection. The idea is to explore the relationship between the level of noise in the signal and the motivation for the journal to be efficient.

B. What happens if referees are not omniscient?

Referees are human and so in addition to eq.(1), let $r = z + \zeta$, where *r* is the referee's opinion, which is additionally a noisy signal of true worth, which is *z* as before. The competence of the editorial process is therefore measured by σ_ζ^2. However, what matters is *r* rather than *z* - authors want a top journal publication, and will let posterity be the judge of *z*. So the relevant question is how good a signal *q* is for *r* not for *z*. The distribution of *r* and *q* (assuming zero covariances across *z*, ξ and *v*) is

$$\begin{bmatrix} r \\ q \end{bmatrix} = \begin{bmatrix} \bar{z} + \bar{\xi} \\ \bar{z} + \bar{v} \end{bmatrix}, \begin{bmatrix} \sigma_z^2 + \sigma_\xi^2 & \sigma_z^2 \\ \sigma_z^2 & \sigma_z^2 + \sigma_v^2 \end{bmatrix}.$$

So for the modified signal extraction process $r = a + bq + \varepsilon$, the value of *b* is exactly as before. However, for any given value of *b,* the signal will become noisier. The variance of σ_ε^2 = $\sigma_\xi^2 + (1-b)\sigma_z^2$ increases by σ_ξ^2. Later eq.(3) is used to calculate the probability that a submission for a given *q* exceeds an acceptance standard. For the omniscient referee this will be the probability that *z* exceeds the standard and for the non-omniscient case this would be the probability that *r* exceeds the standard (now calculated from the $r = a + bq + \varepsilon$ line). If authors submit on the basis of probabilities, it is what the referee thinks rather than the unobservable truth that really matters. All that would be required would be to factor in the additional noise σ_{ξ}^{2} in making this second calculation.[2] A second effect of non-omniscience would be to negatively affect the average quality of accepted papers. Clearly, a top journal would not remain top for long if its refereeing procedures were fundamentally flawed. The following assumes omniscience.

II. The top journal's objectives and instruments.

The first objective is an acceptance standard z_T and the top journal will publish submitted articles with $z \geq z_T$ (though it may not aim to `capture' all papers that meet this standard). In practice good referees, through useful comments, will help generate negative $v$ for `nearly there' papers, but this process is ignored here. The omniscient referee's primary role is a talent spotter.

The journal's second objective is to fill the `available slots' (call it *n)* with articles that meet the acceptance standard (so *n* cannot exceed the number papers with $z \geq z_T$). This objective can be equivalently expressed as a target success rate, i.e. the journal will aim to publish a given proportion of the population of papers with $z \geq z_T$. Given that uncertainty is the norm, the best that a journal can do is to ensure that the expected flow of accepted articles equals *n.* One reason why journals keep a backlog

[2] It is not necessarily the case that the referee will report *z* plus a random error as the above assumes. If referees were aware of their fallibility, they would engage in the same type of signal extraction process as the author (my own personal preference). Authors are aware of how referees make their fallible judgments and it is possible to write out equations for the submission probability for either of the two assumptions made about the non-omniscient referee. This gives two possible equations, equivalent to

of publishable papers is to smooth out fluctuations in submission quality – in the same way as a firm keeps inventories to iron out fluctuations in demand. A systematic change in the backlog would be a useful signal to change the acceptance standard or submission costs. A journal might also have some limited flexibility in the size of n to iron out fluctuations. However, a noticeably `thin' issue might be thought of as a bad signal, which editors would seek to avoid. A third (less precise) objective is to have an acceptable refereeing burden – how many papers have to be processed to meet n and z_T? Is this burden acceptable?

The journal has two instruments to meet these three objectives. The first is z_T, so the acceptance standard is both an instrument and objective. The second instrument is submission costs. Now a general rule is that with two instruments, three objectives are not always achievable; there is one degree of freedom short. Where there is certainty, it will be seen that the top journal has considerable power and flexibility and can easily meet its objectives. A degree of uncertainty, which is the only realistic possibility, leads to limitations on what can be achieved. Since the third objective has not been made exact, it may be that the journal is content with the required editorial burden that the two other objectives imply, but the objectives may need to change when this is not the case.

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eq. A3 in the appendix. In other words, there is a large amount that could be written on the issue of `two-sided uncertainty'. Leslie (2004) looks at this.

III. Submission strategy

The decision process is the following. The author assesses the costs and benefits of submitting. A breakeven probability is established at or above which it is considered worthwhile to take a chance on submitting. The next stage is to calculate the probability of acceptance on the basis of one's own q value and the journal's acceptance standard. If this assessment of the personal probability of success is at or above the breakeven value then submit. This probability can be given an exact value if rational expectations are assumed.

A. Calculating the breakeven probability

The choice is submit to the top journal or decide (because of submission costs) that it is not worthwhile to do this. If the choice is to submit to the top journal, expected utility is:

$$V(1) = p^1 U(1) + (1 - p^1)V(2) - C^1 \tag{6}$$

U(1) is the utility of a top journal acceptance; p^1 *is* the probability of a top journal acceptance, C^1 is submission costs (measured in lost utility) to the top journal and *V(2)* is the expected utility of the alternative strategy ($= p^2 U(2) + (1 - p^2)V(3) - C^2$ and so on). Being top implies $U(1) > U(2)$ and $p^1 < p^2$ and so on. So if $V(1) \geq V(2)$ then submit to the top journal, otherwise choose *V(2)*. The frowned upon practice of simultaneous adoption of both strategies is ruled out.

Several reasons have already been suggested for a positive C^1: (1) direct costs, which are submission fees, postage, general bother and so on (2) disappointment costs, which is the pain of rejection (3) (and probably now the most important) the long and uncertain time lags involved in reaching a decision. In a world where the probability of acceptance in the top journal is low, many will simply decide that it is not worthwhile to hang around for a decision. C^1 is an instrument that can be used to ration the supply of submissions.

The breakeven acceptance probability (denoted p^*) occurs when $V(1) = V(2)$ and the solution is seen in fig.(1), which plots $V(1)$ and $V(2)$ against p^1. $V(2)$ increases with p^1, because someone with a high p^1 would be correspondingly more optimistic about success in the alternative strategy. $V(1)$ lies below $V(2)$ when $p^1 = 0$ and above $V(2)$ when $p^1 = 1$ (so the latter rules out an unrealistic case whereby, even if a top journal publication is guaranteed submission costs are so high, the $V(2)$ strategy is chosen at all values of p^1). So if $p^1 < p^*$ then do not submit to the top journal, and if $p^1 \geq p^*$ choose the top journal. The same breakeven value of p^* is assumed for all, which is a useful but probably unrealistic simplification. For example, some may be more desperate for a publication than others (imminent tenure decision) and place a high value on time. Others (professorial application) value quality and place a lower value on time delays.

As an example, in a one journal world where $V(2)$ is the fixed, zero cost, no publication utility $U(0)$, then the breakeven probability would be:

$$p^* = \frac{C^1}{U(1) - U(0)} \tag{7}$$

With a two journal pecking order, p^* would be a function of the three alternative utilities and two submission costs and so on.

It is clear that in rise in C^1 relative to other journal submission costs will raise p^*, just as a rise in submission costs for other journals, relative to C^1 will lower p^*. Less obvious is the proposition that a general rise in submission costs, caused say by a general rise in delays across all journals, will raise p^*. To see this let the pecking order of journals be indexed *1, 2, 3…* and the associated probabilities of acceptance be p^1, p^2, p^3…. . , where $p^1 < p^2 < p^3$ …. . By successively substituting out *V(2), V(3)* and so on derive an expression for the change in *V(1)-V(2)* for a common change in submission costs ΔC . This is:

$$\Delta[V(1)-V(2)] = \Delta C[-1 + p^1(1+(1-p^2)+(1-p^2)(1-p^3)+...] \leq 0 \qquad (8)$$

Equation (9) would equal zero only if there was an infinite number of iterations and $p^1 = p^2 = p^3$ …. In practice, neither condition will hold, so a general cost rise means p^* will rise. Ellison (2002a) observed both rises in relative and general delays.

B. Calculating the probability of acceptance

Authors are assumed to be well informed about the acceptance standard.[3] A simple view would be that only those with a $q \geq z_T$ will submit to the top journal, but introspection shows that this is not how most will operate. Where there is uncertainty, people submit on the basis of probabilities, and only a few `superstars' will think that acceptance in the top journal is a done deal, irrespective of their perception of q.

[3] In economics, we all have a fairly close idea of what these are. Some examples: Smyth and Smyth (2001), Diamond (1989), Burton and Phimister (1995), Conroy and Dusansky (1995), Smyth (1999). Ellison (2002a) also suggests that there is a self-evident core of top journals.

The non-rational approach assumes that the probability of acceptance is independent of a knowledge of the signal extraction process. So one plausible view might be to assume:

$$p^1 = p(q, z_T) \quad p_q^1 > 0, p_{z_T}^1 < 0 \tag{9}$$

These may or may not coincide with the rational probabilities. These `true' probabilities, which are the signal extraction model's predictions, are now discussed.

Authors will be aware of the general idea that journal submission is risky and that the omniscient referee's opinion does not always coincide with one's own q value. With typical rejection rates of over 95% or higher, more often than not the median submission will be rejected. Rejection is part and parcel of the peer review process. Indeed a rational individual will be aware of the signal extraction process. Looking at eq.(3), a specific author will have a *fixed* value for his or her q. So the relevant question for the rational author is `What is the probability I will be accepted in the top journal, i.e. what is $P(\varepsilon \geq z_T - a - bq)$? Is this larger than the breakeven p^* value?' This takes account of the fact that authors are aware of the signal extraction process and that high q will have on average a higher value of v. The rational approach is to use these objective probabilities as the basis for decision-making. Rationality means authors know something about the distribution of z and v as well as their own q value and can take these into account when they make the submission decision. What they do not know is the precise value of z, at least not before receiving the editor's report!

Rationality can be understood by considering the limiting case where noise dominates with $b=0$. In this case everyone submits to the top journal or nobody submits at all if submission costs are the same for all. The reason is this. Under rationality authors are aware that they are their own worst judges of quality – the omniscient referee places no weight on q and *authors know this*. Hence authors all consider themselves to have an equal chance of acceptance. Hence submit if the expected utility of submission exceeds the utility of the alternative strategy.

In short, the rational individual is governed by eq.(3) and the irrational individual by a simplistic interpretation of eq.(1). The properties of the rational probability $P(\varepsilon)$ are straightforward apart from the effect of changes in b (noise). A fall in b causes the distribution of q to become more spread out and has two possibly opposing forces. First it reduces $Ez \mid q$, which tends to make $P(\varepsilon)$ smaller. However it also increases the variance of ε, which also affects $P(\varepsilon)$. Section VII and the appendix discuss rationality for all values of b (including the special case $b=0$ discussed). It is shown that more noise, *cet. par.,* can lead to more or fewer submissions depending on parameter values. The next section explores the least complicated case when $b=1$.

IV. The certainty case

A. The simple (in)efficiency hypothesis

Figure (2) is the starting point; $b=1$ and there is no systematic optimism, thus $q = z$. q is plotted along the horizontal axis and z on the vertical and is the 45-degree line shown. z_T is shown as the horizontal line, at or above which an article is accepted. Assume individuals are not rational and from eq.(9) a critical value of q^* can be calculated associated with p^*. A q value at or above q^* means p^1 is at or above p^* and these individuals submit to the top journal.

q^* is shown as the vertical line and in this situation all articles between q' and q^* will be rejected. However, the journal can avoid this oversupply of sub-standard articles by raising p^* to ensure that q^* equals q' by increasing submission costs. In this situation the editor's task will be easy since all submitted articles will reach the required standard. Rational expectations change this result as the following will show.

B. The effect of overconfidence

This encourages inefficiency and the intuition is quite clear. Overconfidence encourages submissions to the top journal. The work minimizing response is to ration by raising submission costs. Figure (3) illustrates this, where there is a parallel shift in the 45-degree line by the amount $\bar{v}$. There is now an oversupply of articles and the response will be to become less efficient and raise q^* to q''.

The certainty case illustrates the self-equilibrating effect when probabilities are calculated rationally. Forget about eq.(9) and reason as follows. Rationality would cause authors to re-calculate their probabilities. In the fig.(2) case under rationality, there would be no need to adjust submission costs. Suppose q^* led to an oversupply of articles. Since there is no uncertainty authors would realize that articles between q^* and q' are bound to be rejected, so consequently these people would adjust their p^1 probability to zero. Rationality would automatically cause q^* to rise to q'. A similar argument can be applied to fig.(3) so q^* will automatically chase q'' under rationality and no uncertainty.

The logic in this zero noise case is pretty compelling. However, the information requirements for rationality are minimal in the certainty case, but when there is uncertainty it is less self-evident that authors are capable of all the complex calculations that complete rationality would require. Nevertheless, the example surely shows that to ignore rationality altogether is also an extreme assumption.

Suppose in fig.(2) $q^* = q'$ and the top journal becomes less efficient by increasing the time delay. The q^* line will shift to the right. Now with z_T unchanged it turns out that some papers with $z > z_T$ go elsewhere. Rationality dictates that these articles ought to be submitted to the top journal. So the line shifts back to its original q' position once more. This illustrates the proposition that top journals can be as efficient or as inefficient as they like, when authors automatically react to such behavioural changes. In this simple set-up the top journal bears no cost for its inefficiency – the best articles still roll in no matter what. The only limiting factor would be when C^1 becomes so high that $V(2)$ lies above $V(1)$ in fig.(1) when $p^1 = 1$.

So rationality under certainty gives the top journal considerable power in terms of its objectives. Setting n to some desirable level establishes z_T. No need to worry unduly about submission costs because the objectives are automatically achieved when authors are rational. Uncertainty limits this power.

V. The effect of uncertainty

Introducing noise into fig.(2) (i.e. some fixed positive value of σ_v^2) will have the effect of pivoting the 45-degree line clockwise, where the pivot point will be at the mean values of z and q, which are $\bar{z}$, $\bar{z}+\bar{v}$. It is reasonable to assume that the top journal sets z_T above $\bar{z}$. Figure (4) illustrates, where for convenience the origin is set at $\bar{z}$, $\bar{z}+\bar{v}$. Recall from eq.(3) that this new line plots the expected quality of submissions, so the journal's editors and the `omniscient referee' now have a real job. Realized quality will be distributed around this line, with variance σ_{ε}^{2} for any given q. Shown also is a critical value q^*. Below q^* it is not worthwhile to submit.

The z_T and q^* lines divide fig.(4) into four quadrants. In quadrant 1 are found papers with a standard $\geq z_T$ but which are not submitted. In quadrant 2 are found submitted papers that are accepted. Quadrant 3 are rejected papers and quadrant 4 are below standard papers that are not submitted. Quadrants 1 and 3 might be thought of as Type 1 and Type 2 error and there is now a trade-off between the two. Shifting q^* left reduces Type 1 error at the expense of increased Type 2 error. The top journal may not necessarily regard Type 2 error as a bad thing; high rejection rates are sometimes viewed as an important signal of journal quality. Type 1 error is probably good for democracy; the top journal can never establish a complete hegemony over the best articles. It can at best ensure that the expected standard of accepted articles is better than the rest, but it cannot guarantee always to publish the best articles.

So do submission costs have a role to play? In the certainty case it was seen that under rationality the submission decision does not depend on costs (extreme values excepted). Now there is a role for these as an independent instrument to affect the relative size of the two types of error. A lowering of costs reduces p^* and accordingly q^* will shift left. Notice that lower submission costs have diminishing returns, because the expected quality of the marginal (q^*) paper will decline.

Consequently, the effect of lower costs will be to increase the journal's expected rejection rate, even though the omniscient referee will identify a larger number of acceptable papers.

Figure (4) can illustrate the difference between the rational approach and the non-rational approach, by considering a useful benchmark case. Suppose that $p^* = 0.5$. Under rationality, q^* would locate exactly where z_T exactly intersects the $Ez \mid q = a + bq$ line. Only at that point would there be a 50% chance that z would exceed z_T. Under non-rationality, it would not be possible to be so precise, because the subjective probability of acceptance of the marginal paper need not equal the objective probability as embodied in the signal extraction process (the appendix calculates the rational probabilities more generally).

Because rationality helps tie down the analysis and a view that rationality is a sensible way to make optimal decisions, this will be the assumption from now on. But the usual criticism of rational expectations models applies and whether the subjective and objective probabilities coincide are not issues that can be solved by an appeal to theory alone.

VI. Raising standards

Suppose the top journal raises z_T. When there is no uncertainty, the effect is simple since q^* will chase z_T as authors automatically adjust to new information. Under uncertainty, Figure (5) shows the impact of raising the minimal acceptance standard by an amount Δz_T. Assume initially that this has no impact on $U(1)$. Clearly at q^* the probability of acceptance has now declined and the breakeven q shifts right.

Under rationality it is seen that the rise in the expected standard of the marginal paper must be exactly Δz_T, thus q rises to q^{**} as shown. This arises because the probability of acceptance is a function of the difference between $z_T - Ez \mid q$. The same difference will (for a given σ_ε^2 which is the case here as b has not changed) have the same probability of acceptance.

But that is not the end of the matter. Raising standards will increase the prestige of publishing in the top journal. So $U(1)$ will rise and p^* falls in consequence. So the breakeven q will shift left from q^{**}. The `prestige' effect is not readily quantifiable, but it could be considerable. This is the age of superstardom as in Rosen (1981), where being worthy counts for less. As an example, in the UK academic market departments are graded from 5* down to 1 for their research prowess. Resources, which are mostly from state funds, are disproportionately directed towards those few departments with top grades, which basically means how many articles are published in the best journals. Indeed departments with grade 3* and below receive no funding. So it is not unrealistic to think that there could be a large fall in p^* and the final position of the breakeven q could even lie to the left of q^*, meaning more not fewer submissions.

If the journal's objective is to restore q to q^{**}, i.e. to raise the expected standard of the marginal submission by the same amount as it raises its acceptance standard, then the appropriate response is to raise C^1 to exactly offset the prestige effect. Increasing inefficiency is therefore a rational response to rising standards and a world where rewards become more disproportionately skewed towards the subset of elite academic journals. It is noteworthy that Ellison (2002a) observes that citations are increasingly skewed towards a small number of key journals.

VII. The effect of increasing noise for a given z_T

Assume that the top journal sets a high submission cost regime, or more precisely where the breakeven probability of acceptance, p^*, exceeds $P(z \geq z_T)$. The appendix explains the following predictions as well as exploring predictions from other (less tough) regimes as b moves from 1 to 0. Typically, a top journal would set a `tough' regime described here.

- The impact will be to increase the journal's overall submission rate, but at lower values of b the submission rate will decline to zero.
- The acceptance rate for submitted papers declines from 100% to p^*.
- The success rate (i.e. the proportion of the population of top papers that the top journal publishes) declines from 100% to zero.
- The expected standard of submitted papers declines.
- The expected standard of accepted papers will increase.

Figure (6) illustrates these results for a hypothetical top journal whose objective is to publish the top 0.1% of papers. Four submission regimes are shown in each panel. In regime 1 the breakeven probability of acceptance p^* is set at 1% - authors submit if there is a 1% chance or better of being accepted. Other regimes are a p^* of 3%, 5% and 10%, so they represent increasing submission costs.

The z distribution has an arbitrary mean value of 100 and standard deviation 4, implying a z_T of 112.36 shown in the panel 1. Panel 1 shows the declining submission standard as noise increases as well as a small rise in the expected standard of accepted papers. The probabilities shown in panels 2-4 are independent of this arbitrary scaling of the z distribution (see appendix); what matters is the size of $p*$ relative to the 0.1% target.

The second panel shows the submission rates, with their characteristic inverted U shape for a given $p*$. As $p*$ rises submissions decline for any given b level. Panels 3 and 4 illustrate the Type 2 and Type 1 error trade-off. In panel 3, the acceptance rate falls fairly sharply from 100%, rapidly coming close to its minimum $p*$ value. Higher $p*$ means a greater probability of acceptance for any given b, which is reflected in panel 1 where, given b, the expected standard of submission rises with $p*$. Panel 4 shows the Type 1 error. For any given b the success rate (the percentage of all the papers with $z \geq z_T$ that the top journal publishes) declines as $p*$ rises.

Panel 4 shows how the journal might achieve its other two objectives (having established z_T), given that the parameter b is outside the journal's control. The available slots n imply a target success rate, so together with b, where these two lines intersect will determine the required level of $p*$, which in turn determines the submission costs. The submission rate and acceptance rate will be determined from panels 2 and 3, which together determine the editorial burden. Thinking now of the journal's third objective concerning an acceptable editorial burden, this may or may not be achieved. The journal could respond to a high editorial burden by raising its submission costs, reducing submissions and increasing the acceptance rate – but the second objective of a given success rate would have to become less ambitious.

VIII. Concluding comments

One lesson of rational expectations is that changing the rules alters behavior. So are there useful policy prescriptions from this view of the submission process, in particular is there a better rationing regime than time delays? The current *pro bono* system is sustained by a type of Akerlof (1982) gift relationship principle of `I referee because in return someone else will referee my papers – so overall I will break even'. Nevertheless, the opportunities for free-riding and lethargy when faced with a specific refereeing task do not need to be spelt out, much as the public spiritedness behind the present system is commendable. Sometimes refereeing can inform the referee and is willingly done, but this is often not the case. Journals have little incentive (or indeed the means) to change the present system.

So the policy suggestion is to substitute an *explicit* and *transparent* price mechanism, far beyond the present fees charged by some journals. Such a system will have many benefits, chief among which is to eliminate the deadweight losses associated with lengthy decision lags.

- Referees are paid a fee, which is sufficient to make it worthwhile to undertake the task and is only payable if a response is made within a preset (short) time limit. Unacceptably brief reports would not be paid.
- All submissions are charged a fee, sufficient to maintain the journal's three key objectives. It would be important that institutions not subsidize submission fees to avoid reducing the private costs of submission.
- Accepted articles will have the submission fee refunded.

- A strict time limit for `first response' and subsequent iterations are set. Late responses will imply a compensation payment to the author from the journal. Journals would be obliged to disclose its compensation payments.

So the idea is to substitute a fee for time delays and this is consistent with the analysis of the submission process. If the journal wishes to maintain the same p^* it can set an appropriate submission fee to achieve this. Given the refund aspect in point 3, the implicit fee is $(1- p^*)C^1$, so the fee that maintains the *status quo ante* would be the monetary equivalent of $C^1/(1-p^*)$.

The financial technology now exists to run such a system where academics are spread worldwide. For example `Paypal' or an equivalent could be used for submission debits and refereeing credits. Thus the claim that a payment system penalizes academics outside of the dollar zone is no longer credible. An appropriate temporary `overdraft' facility could be set to ameliorate capital market constraints; academic institutions could also operate an overdraft facility (but not a direct subsidy). A databank of available referees, their relevant experience and availability could be maintained, available to journal editors to consult. Given the financial incentives, referees would become an army of willing volunteers, as opposed to the present system of often reluctant conscripts.

In this system `equilibrium authors' will neither gain nor lose over their academic lifecycles. They more or less receive in refereeing what is paid out in submission fees. So much of the process would be a game of monetary `musical chairs' with debits going out of one pocket and credits into another. But this game changes *incentives* at the margin. At present, a specific refereeing task offers less incentive in contrast to a system of monetary rewards.

The system is fairer, because those who choose not to referee do not get paid. The system does not penalize success, because successful authors are refunded. The system eliminates not only the long average delays, but also the uncertainty that surrounds these delays. It is my view that it is the uncertainty that most academics find so irritating and costly. All the deadweight losses of these two aspects of time are eliminated. Those with a comparative advantage in publishing will have an incentive to do less refereeing. Refereeing will be seen as an honorable profession, rather than as a chore. For example, many older academics have a comparative advantage in refereeing compared with the young. So an academic lifecycle might see deficits at the beginning and surpluses at the end. Monetary credibility, however, would require that accounts be settled at appropriate intervals. The compensation principle would force editors to be effective, or face sanctions from their management boards as the journal loses money and its reputation. The fact that a fee is involved makes it clear that authors can expect a service. The present system often makes people reluctant to complain about unacceptable delays for fear of jeopardizing their chances of eventual publication. Finally, the system would discourage consistent `no hopers' from continuing to submit articles. Rejection would imply real costs and those with little reputation would receive few refereeing requests. The collective editorial burden would fall.

Can journals operate such a system independently, or is a collectively agreed monetary union required? My guess is that if a few lead journals took the initiative, the rest would soon follow. Non-paying journals would soon find it difficult to obtain quality referees, and their reputation would quickly fall.

Is such a system viable? Recall that the submission fee is such that the journal achieves its three objectives, alongside a prompt service. This may not exceed the amount that referees would need to be paid to provide a prompt and thorough report – especially if a journal asks for more than one report per submission. I fully concur with Bergstrom (2001) that academics should take away control from commercial publishers. Some of these rentals could be used to finance any shortfall in the above calculation. I happen to edit a small circulation economic journal, and to be viable it is necessary to be efficient. By doing all operations in-house including printing (moving from a commercial printer reduced printing costs by an amazing 75% and with better quality). It amazes me just how cheaply an academic journal can be produced. Either large circulation journals have too high a cost base and/or make huge profits. Cost reform combined with a universal system of proper rewards for referees and financial sanctions against journals that fail to deliver on promises could do much to improve the lives of academic researchers.

Appendix Summary under rational expectations

Assume $\bar{v} = 0$, as this makes no difference to the rational model. p^* is the breakeven acceptance probability from fig.(1). Let z^* be the unconditional probability that an article meets the submission standard, i.e. $P(z \geq z_T)$ and assumed to be 0.1% in

Section VII. Only in special cases will the journal achieve 100% success and publish all papers with $z \geq z_T$.

1 Submission probability

Let $p^* =$ 1-$\Phi(\tilde{p})$,where Φ is cumulative standard normal distribution function and $\tilde{p}$ is the associated critical value. Let $\tilde{z}$ be the associated critical value of Φ for z^*. Hence $z_T = \bar{z} + \tilde{z}\sigma_z$. The key task is to calculate from eq.(3) the rational expectations critical value of q^* associated with p^* . Those with a $q \geq q^*$ submit, and are those whose rational expectations probability of success is at least p^*. We require the q^* that satisfies:

$$P(z \geq z_T \mid q^*) = P(\varepsilon \geq z_T - (1-b)\bar{z} - bq^*) = p^* \tag{A1}$$

Because $\dfrac{\varepsilon}{(1-b)^{0.5}\sigma_z}$ is a standard normal variable, it follows that:

$$q^* = \bar{z} + \frac{\sigma_z(\tilde{z} - \tilde{p}(1-b)^{0.5})}{b} \tag{A2}$$

(Note that if $p^* = 0.5 \Rightarrow \tilde{p} = 0$ (the benchmark case discussed in Section V) then $Ez \mid q^* = \bar{z} + \tilde{z}\sigma_z = z_T$, which is independent of b.)

Because $q \sim N(\bar{z}, \frac{\sigma_z^2}{b})$, then the normalized critical value of q^* is:

$$\tilde{q} = \tilde{z}b^{-0.5} - \tilde{p}b^{-0.5}(1-b)^{0.5} \sim N(0,1) \tag{A3}$$

This is the critical equation that drives the results in Section VII. The submission rate is $P(q \geq q^*)$, which is exactly $1 - \Phi(\tilde{q})$. Clearly a rise in $\tilde{q}$ means a fall in the submission rate. The point is that this can rise or fall as b declines depending on the value of p^* relative to z^* (Section VII assumes $p^* > z^*$).

Some properties of eq.(A3):

1. As $b \to 1$ then $\tilde{q} \to \tilde{z}$. This is the fig.(2) case under rationality, where the submission rate is exactly z^*.
2. As $b \to 0$, then $\tilde{q} \to \infty$ if $\tilde{z} > \tilde{p} \Rightarrow z^* < p^*$. Thus the submission rate will decline to zero if the journal's target proportion of top papers is below the critical probability of acceptance. Section VII assumes this is the case.
3. As $b \to 0$, then $\tilde{q} \to -\infty$ if $\tilde{z} < \tilde{p} \Rightarrow z^* > p^*$. Thus submission rate will rise to 100% if the journal's target proportion of top papers is above p^*. Points 2 and 3 are the either all submit or none submit case described Section II.
4. $\frac{\partial \tilde{q}}{\partial b} = -0.5b^{-1}\tilde{q} + 0.5b^{-0.5}\tilde{p}(1-b)^{-0.5}$. When $\tilde{p} < 0$ (i.e. when $p^* >$ 0.5) this is always negative. Thus the submission rate will steadily decline from z^* to zero. When $\tilde{p} > 0$ then as $b \to 1$, then $\frac{\partial \tilde{q}}{\partial b} \to +\infty$ Taken together this means that where $z^* < p^* < 0.5$, the submission rate will first increase, then decrease as b falls. Section VII assumes this regime.
5. Section VI discussed the effect of an increased acceptance standard.

   $\frac{\partial \tilde{q}}{\partial \tilde{z}} = b^{0.5}$, hence a rise in the acceptance standard will lead to a fall in the submission rate. However, it was argued that this is an unrealistic experiment because p^* (which determines $\tilde{p}$) and z_T (which determines $\tilde{z}$) are not independent. Rising standards raise the returns to success, lowering p^* for given submission costs. From eq.(A3) if the submission rate remains constant then this requires $\Delta\tilde{p} = (1-b)^{-0.5}\Delta\tilde{z}$, where $\Delta\tilde{p}$ is the induced change in $\tilde{p}$

from a change in the acceptance standard. If $\frac{\Delta\tilde{p}}{\Delta\tilde{z}} > (1-b)^{-0.5}$ then the submission rate increases for any rise in $\tilde{z}$. Thus more noise means makes it more likely that that the submission rate will rise in response to rising acceptance standards. To give an idea of numbers, suppose the journal aimed to double its quality by accepting only the top 0.05% of papers instead of the top 0.1%. The submission rate would remain constant if (roughly speaking) the breakeven value of p^* also halved (calculated at $b=0.5$)

2. Success rate

The success rate is $S = \frac{P(z \geq z_T \ \& \ q \geq q^*)}{1-\Phi(\tilde{z})}$. The denominator is constant for a given z_T. The success rate is directly proportional to changes in the joint probability of submission and that the submissions meet the required standard. The numerator is a bivariate normal distribution, where $P(z \geq z_T \ \& \ q \geq q^*) = \Theta(-\tilde{z}, -\tilde{q}, \rho)$, where Θ is the standard joint normal cumulative distribution function and ρ is the correlation coefficient between z and q. When $\rho = \sqrt{b} \to 1$, we know from point 1 above that $\tilde{q} \to \tilde{z}$. So $\Theta(-\tilde{z}, -\tilde{q}, \rho) \to \Phi(-\tilde{z}) = 1 - \Phi(\tilde{z})$. The success rate tends to 100%.

Now consider what happens as $b \to 0$.

$$\frac{\Theta(-\tilde{z}, -\tilde{q}, \rho)}{1-\Phi(\tilde{z})} \to \frac{(1-\Phi(\tilde{z}))*(1-\Phi(\tilde{q}))}{1-\Phi(\tilde{z})} \to 1-\Phi(\tilde{q}) \qquad \text{(A4)}$$

The success rate will tend to zero if $z^* < p^*$ and 100% if $z^* > p^*$ (see points 2 and 3 above). For example, with $p^* =$ 0.1 and $z^* =$ 0.2, the success rate declines to around 92.0 % before steadily increasing to 100%. The intuition is clear, because under these assumptions the submission probability will slowly increase to 100% - and if everyone submits a 100% success rate is guaranteed – not that the top journal would welcome such a possibility. In typical cases, with $z^* < p^*$, the success rate will steadily decline.

3. *Acceptance probability*

The acceptance probability is $R = \frac{\Theta(-\tilde{z}, -\tilde{q}, \rho)}{\Phi(-\tilde{q})}$. For a given z_T and p^* this always declines as b falls. Thus increasing noise means the top journal will receive an increasing proportion of substandard papers.

We can reason that R must always decline as follows. There are two cases to consider. Where $p^* < z^*$ then $R \to z^*$. To see this suppose that $\rho = \sqrt{b} = 0$. In this case:

$$\frac{\Theta(-\tilde{z}, -\tilde{q}, \rho)}{\Phi(-\tilde{q})} = \frac{\Phi(-\tilde{z}) * \Phi(-\tilde{q})}{\Phi(-\tilde{q})} = z^* \qquad \text{(A5)}$$

Now let b increase causing a change in $\tilde{q}$, but restrict ρ to be zero. R would be constant at z^*. Now let the rise in b influence ρ. This will cause R to rise with higher values of ρ giving a greater increase in R. So R will steadily increase as we move towards $\rho = 1$. From before $\Theta(-\tilde{z}, -\tilde{q}, \rho) \to \Phi(-\tilde{q})$ when $\rho \to 1$; hence the acceptance rate will steadily increase to 100% as b rises towards 1.

Where $p^* > z^*$, a slightly different set of considerations apply, because when $b=0$, the submission rate is zero. Recall that p^* is the probability of acceptance of the breakeven paper. So the average acceptance rate can be no lower than p^* for any value of b. If b is arbitrarily close to 0, everyone will have the same perceived probability of acceptance, because noise totally dominates the signal. In practice for very low values of b the submission rate becomes so low that the top journal effectively will publish no articles. So these lower reaches are to say the least hypothetical.

4. Expected standards

The expected standard of submissions, $Ez \mid q \geq q^*$ is given by $\bar{z} + b^{0.5}\lambda(\tilde{q})$, where $\lambda(\tilde{q})$ is the inverse Mills ratio associated $\tilde{q}$ (Greene, 1993, p.707). The expected standard of accepted papers is $Ez \mid q \geq q^* \,\&\, z \geq z_T$. This is calculated using the (lengthy) formula to be found in Maddala (1983, p. 368).

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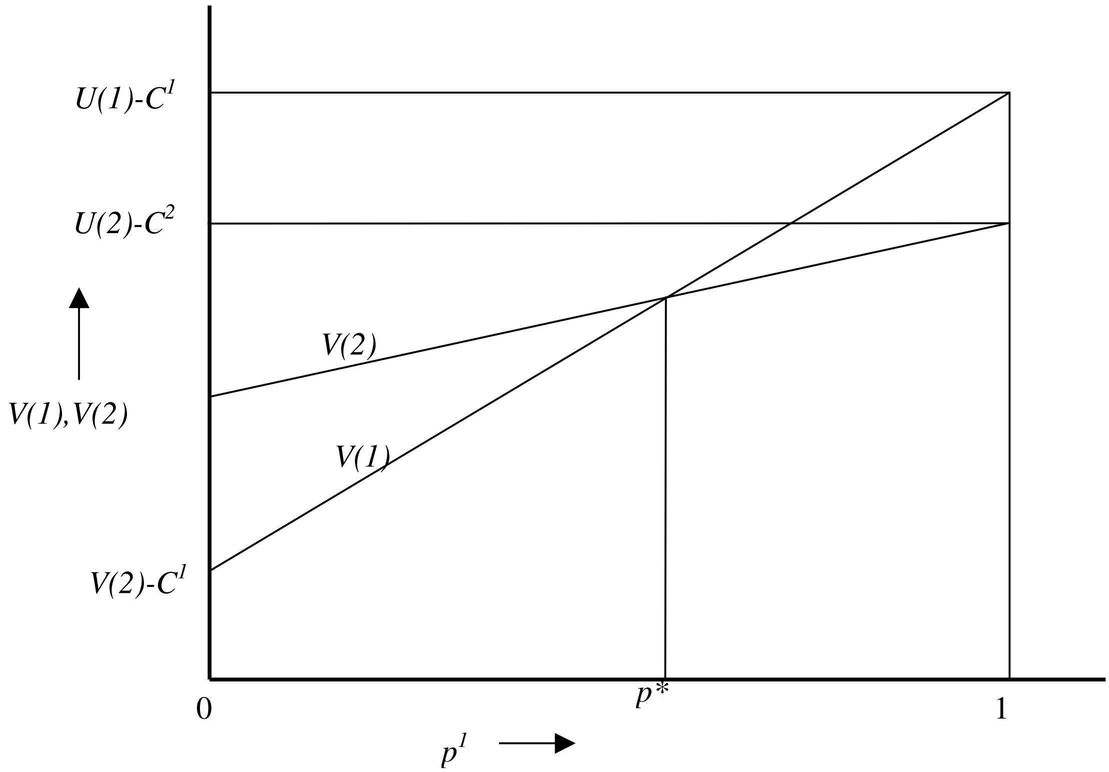


Figure 1 Submission strategy

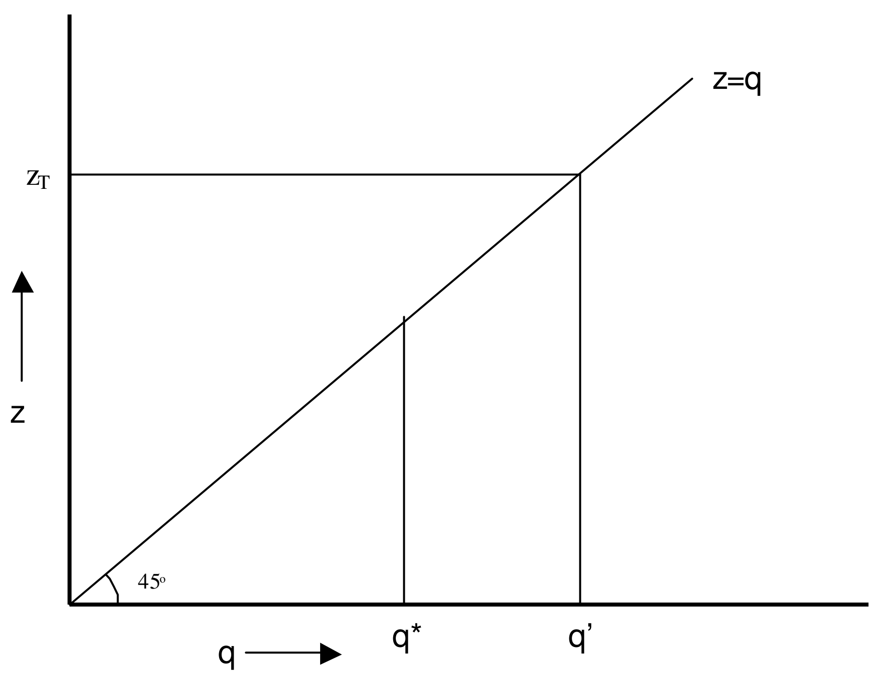


Figure 2 Perfect signal extraction

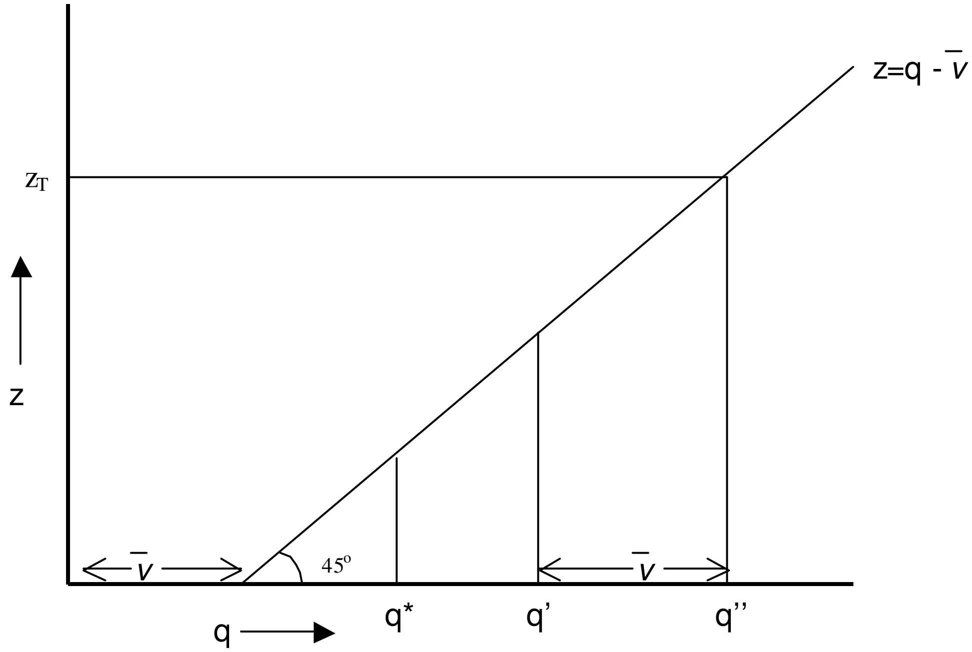


Figure 3 Systematic optimism

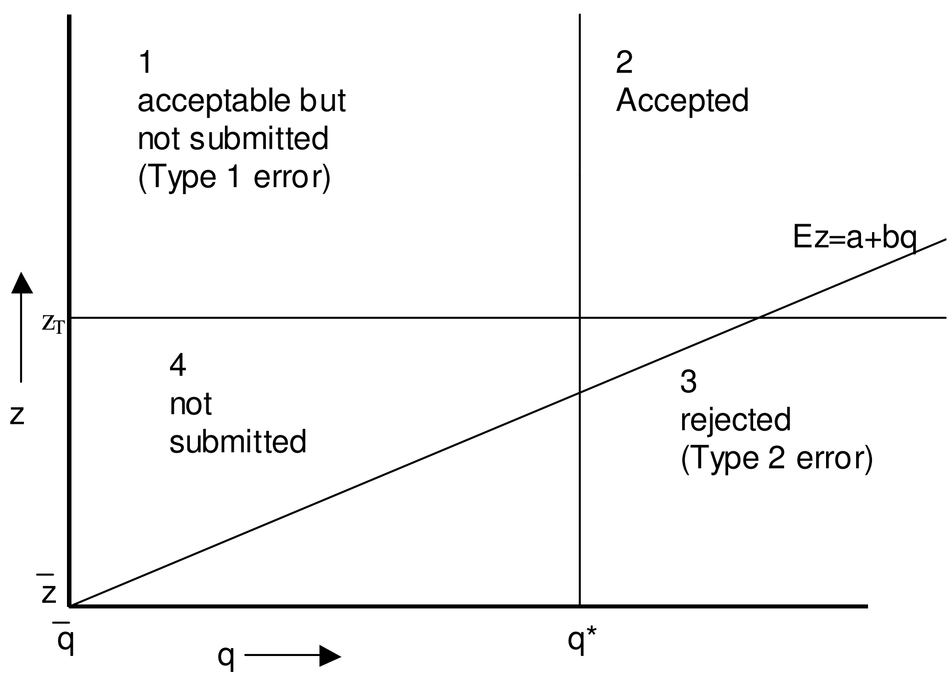


Figure 4 Imperfect signal extraction

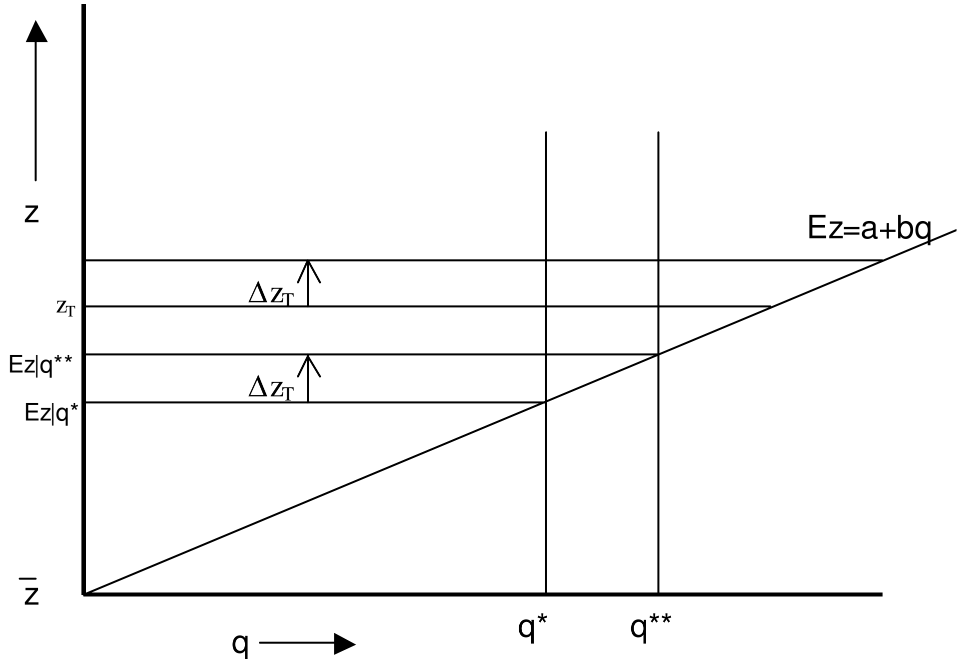
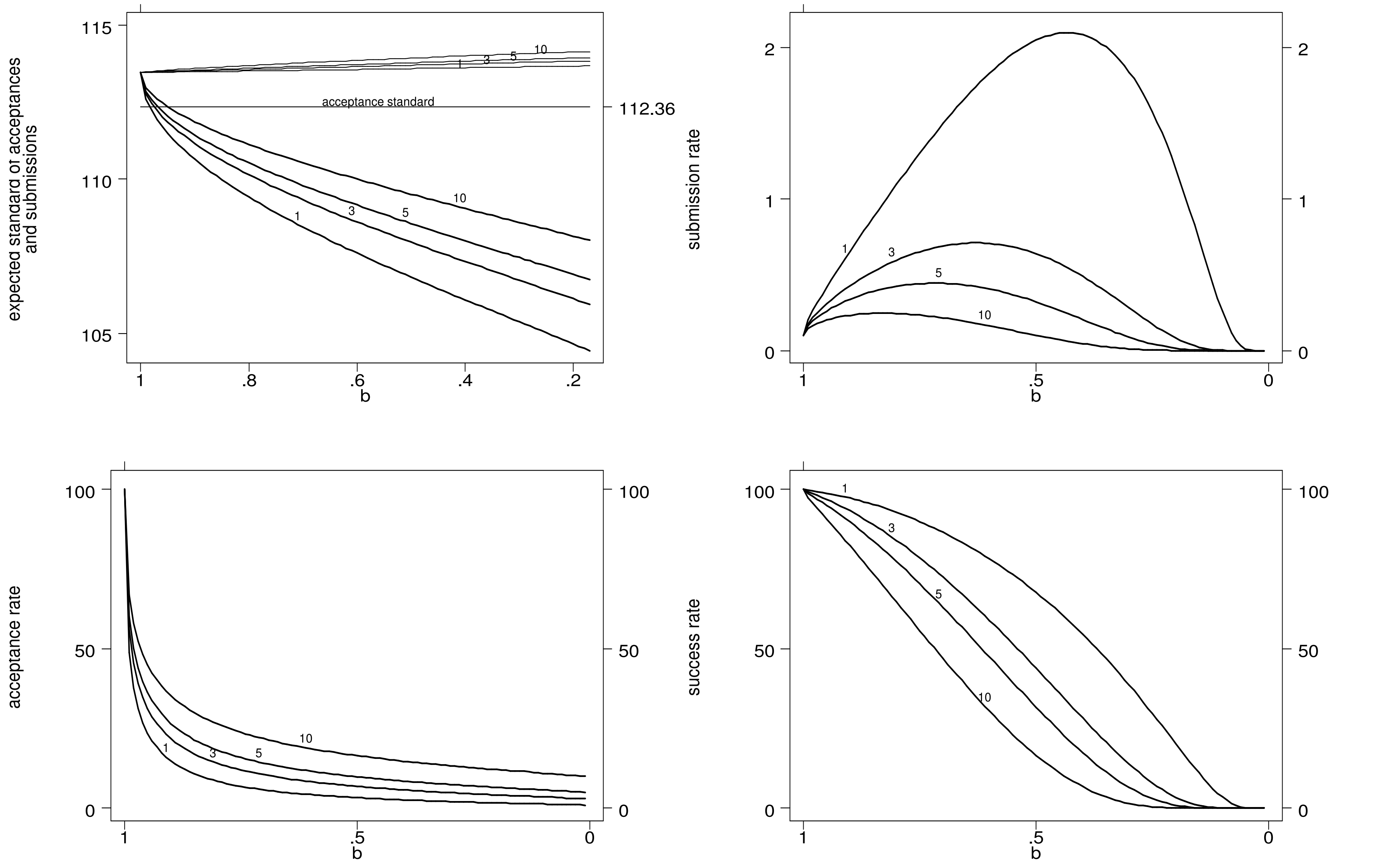


Figure 5 Raising standards – initial impact



The effect of increasing noise
Figure (6)