A Strategic Foundation for Alphabetical Ordering of Authors

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Abstract

In a setup with two authors A and B, with heterogeneous experience, we rationalize the alphabetical ordering of author surnames when the market assigns proportionately larger credit to the ideator of a joint project. Even though the market is known to alphabetically discriminate in favor of author A, we counterintuitively show that ideator B may choose the lexicographic norm while making a take-it-or-leave-it offer to A when the cost of effort function is strictly convex, and the cost of effort is sufficiently high. We find (a) B chooses the name order AB (BA) when the experience of A is above (below) a threshold. (b) The thresholds are increasing in the expected quality of a project. (c) Market belief-driven discrimination exists only for an intermediate experience level of A. (d) Author B offsets the market-assigned larger gross payoff to A by extracting the largest effort from her collaborator in this intermediate range. (e) Ideator A of very low experiences may not be able to collaborate with author B of very high experience. However collaboration will be possible when author B is the ideator.

Keywords: Alphabetical discrimination, ultimatum game, name ordering.
JEL codes: A11, C78.

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1 Introduction

The main focus of this paper is to provide a strategic foundation for the extensive use of alphabetical name ordering in academic works of select disciplines such as Economics, Business and Finance, Mathematics, and High Energy Physics (Frandsen and Nicolaisen, (4)). Collaborators often follow the alphabetical name ordering whenever they prefer the lens of public opinion to treat them symmetrically, despite the preponderance of empirical evidence supporting the existence of alphabetical discrimination in favor of authors with surname initials earlier in the alphabet. For example, faculty with one letter closer to the start of the alphabet is (one and a half percent) more likely to secure tenureship in a top 10 Economics department and (one percent) more likely to be elected as a fellow of the Econometric Society (Einav and Yariv (2)).

A section of the extant empirical literature has sought to document the strategic reaction of individuals to such alphabetical discrimination. Citing data from the top five journals in Economics, (Einav and Yariv (2)) show (i) that articles with four or five authors have an average surname initial (coded A=1, Z=26) lower than that of other papers, and (ii) the nonalphabetical norm is more frequently used for papers with higher than average surname initials. Van Praag and van Praag ((8)) control for age and productivity of authors and demonstrate that articles that deviate from the lexicographic norm have higher surname initials than those who adhere to it. These findings suggest that authors with late last name initials prefer to work on papers using contribution-based ordering or choose not to collaborate in projects with a larger cohort of authors.

Keeping the above findings on alphabetical discrimination and the concomitant strategic response of authors in retrospect, the decision to use the alphabetical ordering is counterintuitive when late surname authors are not bound by journals' conventions. In contrast to the extant empirical literature, which highlights alphabetical discrimination in favor of authors with earlier surnames through gross payoffs, we rationalize the continual use of the lexicographic norm through net payoffs in a setup where the market assigns proportionately higher credit to the author who conceived the idea for the project. We show that if the cost of effort is sufficiently large and the cost function is strictly convex, the authors adopt the lexicographic norm in an ultimatum game with outside options. Our insight is particularly relevant at a time when the complexity and associated delays of the peer review process are gaining increasing attention (Björk and Solomon (1)).

Theoretical literature on the choice of name-ordering norms is sparse. One of the first contributions is by Engers et al. ((3)), who show that lexicographic ordering continues to be an equilibrium outcome in a setting where the market assigns credit based on the relative contributions of the collaborators. Their result hinges crucially on the assumption that symmetric players decide between lexicographic and relative contribution ordering using the Nash (cooperative) bargaining solution. The relative contribution ordering rule is immediately ruled out as an equilibrium since the consequent asymmetric credit assignment violates the axiom of symmetry enshrined in the normative approach. Onuchic and Ray ((6)) show that a skewed market prior in favor of specific identities (such as gender, race or nationality) disincentivizes the authors who face such discrimination from forming collaborations and, in turn, conforms the prior. However, gross rather than net payoffs form the basis for their intuition.

We assume that there are two (potential) collaborators who are asymmetric in terms of their reputation or research experience and that nature endows one of them with an idea. We adopt a positive approach and model the bargaining game between the authors as an ultimatum game, with the conceiver making an offer to another author whose outside option is increasing in her experience.[1] The proposer offers either an idea-based (wherein her name appear first) or lexicographic norm (wherein the names appear alphabetically)) to the responder, along with the distribution of effort between the two authors and simultaneously reveals the quality of the research idea. It is common knowledge that an idea of higher quality is more likely to be published in a journal of higher reputation and is associated with a higher cost of effort function. While bargaining between the collaborators takes place under complete information, the market can only observe the experience levels of the collaborators, the order in which the publication lists the two authors, and the reputation of the journal in which the paper was eventually accepted. While the choice of the norm by the author with the

[1] The ultimatum game provides a natural environment to analyze a situation where one of the two players has a proprietary right over an idea, with the bargaining power of the proposer being inversely proportional to the value of the outside option of the responder. If the author with the later surname offers the lexicographic norm in the equilibrium of the ultimatum game, it would be intuitive to expect the same norm to be chosen for a broader range of parameter values for bargaining protocols with multiple rounds of offers and counteroffers.

earlier surname (say author A) has no bearing on the eventual name order (for both norms the name order is AB), the decision to use the idea-based norm by the author with the later surname (say author B) results in a nonalphabetical name order and helps the market infer both the norm and the identity of the ideator.

Independent of the choice of norm, the name order is always AB, when author A is the ideator. However, the name order is also AB with the lexicographic norm but is BA with the idea based when author B is the ideator. The choice of norm is dependent on the quality of the idea. Consequently, from the name order AB, the market will not necessarily be able to decipher the norm or the ideantity of the ideator. For the name order BA the market can always identify the ideator. In order to further develop our intuition, we initially assume that the quality of the idea is observable to the market. Quality of the idea plays an important role, as the choice of norm and effort are determined based on it. Consequently, when the market observes the quality of the idea, it can deduce the norm perfectly. Once the norm is deduced, the market assigns credit based on the ex-post publication, and not on the quality.

When the quality of the idea is observed, for a strictly convex cost function, we show (i) that author B offers the idea-based (lexicographic) norm whenever the responder's experience is below (above) a threshold (Theorem 1). (ii) The choice of the norm by Author A, on the other hand, is contingent on the choice of norm by author B. We show that author A follows B's choice of norm, such that the market can infer the norm in equilibrium. Therefore, there is no belief-driven bias in favor of author A. (iii) Finally, we show that the threshold experience level of author A at which author B switches to the lexicographic norm increases in quality (Remark 4).

Thus, when the quality of the idea is not observed, the market is unable to always decipher the norm, since the choice of norm is dependent on the quality of the idea. In such a case for not very high experiences of author B, we show that there exist an intermediary zone of experiences of author A, where the market assigns a higher credit to her than justified by the prior. This suggests that the market discriminates in favor of early surname authors. We also find that such alphabetical discrimination is more pronounced in higher compared to lower reputation journals. If the idea-based norm is feasible for at least one quality, we show that in equilibrium, author B may use the same threshold for multiple qualities, leading the market to update its prior for a coarser partition of experiences of A (Theorem 3). While author

A chooses not collaborate when the experience of author B is very high[2], as in the observable case, we find that she no longer follows B's decision when quality is unobservable, and adopts the lexicographic norm for the entire intermediary range. For experiences of author A below (above) the lowest (highest) threshold, both authors choose the idea-based (lexicographic) norm, with the market assigning payoffs as per the prior for the lexicographic norm. Therefore, belief-based discrimination in favor of author A occurs only at the mid-career level and fades once he gains sufficient reputation. Our results are similar in spirit to those of Ray and Robson ((7)) who show that the authors use a certified random order whenever the contribution of the early surname author lies in an intermediate zone (Theorem 3). As in the observable quality case, both authors choose the idea-based norm when the cost function is linear.

Our insights suggest that the functional form of the cost of effort function could vary significantly between fields such as Economics (convex) and Sociology (linear), and help us explain the substantially higher rates of alphabetization of authors in the former compared to the latter. Our finding that the lexicographic norm draws more effort than the idea-based norm rationalizes one of the core assumptions of Ong et al. ((5)), who claim that authors with later surnames accept a lower share of the credit following the lexicographic norm, provided the earlier last name collaborator contributes more to the paper quality.

2 Model

An author i has an idea for a research project. The findings of the project could be published in a journal outlet. There are two journals, of reputation high (h) and low (l). The market assigns value V^Q to a publication in journal $Q \in \{h, l\}$, with $V^h > V^l$. A research idea can be of N different qualities. We denote the a quality of an idea, $s_n \in \mathbf{S} = \{s_1, s_2, ..s_N\}$ by the probability by which it can be published in journal h and in l with the remaining probability. Quality s_n is monotonically increasing in n, with s_1 (s_N) being the lowest (highest) quality. Value of an idea is realized only if it finds a journal outlet.

[2] In such circumstances, the idea-based norm is not feasible since B refuses to put in any effort, and author A prefers to work alone rather than under the lexicographic norm.

The expected value of an idea of quality s_n is given by

$$V_n = E(V|s_n) = s_n V^h + (1 - s_n)V^l.$$

All research ideas, independent of the quality requires a total effort E for completion. However, the cost of effort depends on the quality of the idea, and is given by the function $C_n(\cdot) : [0, E] \rightarrow \mathbb{R}_+$. It is natural to expect that the cost of effort would increase in the quality of the idea. To incorporate this feature, we assume $C_n(x) = \lambda_{n-1} C_{n-1}(x)$, where $\lambda_{n-1} > 1$ for $n = 2, ..., N$.

Authors are heterogeneous only with respect to their experience levels. The experience level of author i is denoted by a scalar, $e_i \in e \subset \mathbb{R}_+$, which is measured by her past publication record and is common knowledge.[3] At any point of time, nature endows an author of experience e_i, with an idea with probability $\varphi(e_i) : e \rightarrow [0, 1]$, with $\varphi' > 0$. Nature further draws the quality of the idea, s_n with probability $p(s = s_n) = 1/N$. The quality of the idea is privately revealed to the author who got the idea. The experience of an author also defines her opportunity cost to work on an idea and is given by $\pi(e_i)$, $\pi : e \rightarrow \mathbb{R}_+$.

Once author i gets an nascent idea of quality s_n, she approaches another author, j, with a proposal to collaborate, revealing the quality of the idea truthfully, such that there is no moral hazard. The two authors jointly formulate the initial nascent idea to a research question wherein the quality of the idea may increase (if $s_n < s_N$). The distinction between the quality of the nascent idea and the quality at this stage is immaterial and so we ignore it. Before formulating the nascent idea, it is difficult to propose the effort distribution of the collaboration. Therefore, after formulating the idea, the author with the initial idea proposes a name order and effort division between them. If the proposal is accepted, the two authors work on the research project together; if the proposal is rejected, the two authors get their outside option[4]. We denote the possible actions of the author with the idea by $x_i \in \{CO, NC\}$ where CO denotes a successful collaboration and NC represents an unsuccessful collaboration.

[3] The past publication record comprises the number of past publications in h and l journals and the associated credit the market assigned to each of them.

[4] The reserach project is formulated to a reserach question by the two authors, before they start working. Therefore, even though author i had the nascent idea, if author j rejects the proposal to collaborate after formulating it, author i cannot work on the same research question.

From now on we we denote any two authors who have collaborated or are contemplating on collaboration by A and B, such that author A has an earlier surname initial. The name order of any successful project between two authors A and B is based on the norm adopted by them. The authors can opt for one of two norms: idea-based (I) or lexicographic (L). For norm I, the name of the author who came up with the idea, appears first. Therefore, if author A (author B) was the one with the idea, the order in which the names will appear is AB (BA). In case of the lexicographic norm the name order is always AB, irrespective of the source of the idea.

Once the research idea successfully finds a journal outlet following a collaboration, the market observes only the final publication along with the name order, but remains unaware of the quality of the idea, or which author had the idea. The market assigns a greater proportion of credit, $\beta \in (0.5, 1)$ to the author with the idea, and the remaining proportion to the author without the idea-based on the journal outlet Q. Even though, the market is unaware of the identity of the author with the idea, it has a prior belief as to which author had the idea for any given collaboration. The experience levels of the two authors respectively determine the probability, $\varphi(\cdot)$, that each could have got the idea. Thus, the *prior* probability that author i had the idea given a collaboration, is the composite function, $\boldsymbol{\mu_i}(\varphi(e_i), \varphi(e_j)) = \mu_i(e_i, e_j)$ where $\mu_i : e \times e \rightarrow [0, 1]$, where $i = \{A, B\}$. Without loss of generality we assume that only one author could have the idea for a project[5], such that $\mu_i(e_i, e_j) + \mu_{-i}(e_i, e_j) = 1$. For simplicity henceforth we denote the prior that author A had the idea by $\mu(e_A, e_B)$, and B by $1 - \mu(e_A, e_B)$.

After observing the journal outlet and the name order, the market updates it's prior (if possible) and assigns credit to the two authors. Notice, when author B has the idea and opts for the idea-based norm, the market can always decipher the norm from the name order BA in any journal. However, when author B selects the lexicographic norm and author A chooses either norm, the market may not always be able to decipher the norm from the name order AB. If the market is able to correctly infer the norm, the expected gross payoff from idea-based norm when author A has the idea is given as:

$$\beta V_n = \gamma_n^{IA} (\text{say}); \qquad (1 - \beta) V_n = (V_n - \gamma_n^{IA}) \tag{1}$$

[5]We allow for the possibility that both authors are simulatenously are working on multiple projects with each other or other authors. For some projects author A might have had the idea and for some author B or other authors could have had the idea.

for authors A and B respectively for an idea of quality s_n. Equivalently, when author B has an idea, we have $(1-\beta)V_n = (V_n - \gamma_n^{IB})$ and $\beta V_n = \gamma_n^{IB}$. The expected gross payoff for the lexicographic norm, when market can decipher the norm, no matter which author had the idea is given by $\gamma_n^{Li}, i = \{A, B\}$, where

$$[\mu(e_A, e_B)\beta + (1-\mu(e_A, e_B))(1-\beta)]\, V_n = V_n\, [(1-\beta) + \mu(e_A, e_B)(2\beta - 1)] = \gamma_n^{LA} \tag{2}$$

$$[(1-\mu(e_A, e_B|AB))\beta + \mu(e_A, e_B|AB)(1-\beta)]\, V_n = V_n\, [\beta - \mu(e_A, e_B)(2\beta - 1)] = \gamma_n^{LB} \tag{3}$$

denotes payoffs for A and B respectively. The sum of the expected gross payoffs for both the norms is V_n, thereby, $\gamma_n^{LA} = V_n - \gamma_n^{LB}$. Observe, for any $\mu(e_A, e_B)$, the lexicographic norm distributes gross payoff more equitably for any quality V_n,

$$V_n - \gamma_n^{IA} = V_n - \gamma_n^{IB} \le \{\gamma_n^{LA}, \gamma_n^{LB}\} \le \gamma_n^{IA} = \gamma_n^{IB} \tag{4}$$

no matter which author has the idea.

We formulate the strategic interaction between the two authors as an ultimatum game. For any such collaboration, the indicator function $1_i = 1$, $i \in \{A, B\}$ denotes that author i had the idea and $1_i = 0$ otherwise. While the authors know which of them had the initial idea and its quality, the market is not privy to such information. Therefore, we represent the private information of each collaboration as its type, $\theta = \{s_n, 1_A, 1_B\} \in \Theta$, where Θ denotes the set of all possible types. Nature could have endowed only one of the two authors with the idea, such that $(1_A, 1_B) \in \{(1,0),(0,1)\}$. Author i with $1_i = 1$ first chooses $x_i \in \{NC, CO\}$. If $x_i = CO$, she then chooses the action $a_i = \{E_j^{nk}, k\} \in A_i$ where a_i denotes the proposal that the author with the idea makes to her potential collaborator. The proposal comprises the amount of effort to be put in by the responder j for an idea of quality s_n, along with the norm $k \in \{I, L\}$ that will be used to determine the order in which their names will appear in the publication.

Author j with $1_j = 0$ responds to the proposal with $d_j \in D = \{A, R\}$. If $d_j = A$, the proposal is accepted with author j putting in effort $E_j^{nk} \in [0, E]$ and i, $E - E_j^{nk}$. The resultant name ordering is indexed by $m \in \{AB, BA\}$. If $d_j = R$, the offer is rejected such that author i has to work alone, while author j can access an outside option of value $\pi(e_j)$. The *pure strategy* of author i comprises the actions x_i, a_i when she has the idea and a response to a proposal when she doesn't have the idea. We represent this strategy with the map

$$\sigma_i : \{s_1, ..., s_N\} \times (1_A, 1_B) \rightrightarrows R_i$$

where $R_i = \{NC, CO\} \times A_i \times D$. Our signaling game involves two authors who non-cooperatively decide to send a signal, $m \in \{AB, BA\}$, to the market. The market observes the signal m and the experience tuple (e_A, e_B). However, both the source and the quality of the idea are private information.

We make the following assumptions in our setup.

Assumption A.1: The cost function $C_n(\cdot)$ is strictly increasing, convex such that $C'_n > 0$, $C''_n > 0$ with $C_n(0) = 0$. For any quality s_n, $C_n(\cdot) = \lambda_{n-1}C_{n-1}(\cdot)$ with, $1 < \lambda_n < \frac{V_{n+1}}{V_n}$ $\forall n = 1, 2, ..., N-1$. For any quality s_n, the total cost of effort satisfies, $\frac{V_n}{2} < C_n(E) < V_n$.

Assumption A.2: The opportunity cost, $\pi(e_i)$ is increasing and convex over $e_i \in [0, \bar{e}]$, with $\pi(0) = 0$, $\pi(\bar{e}) = V_1/2 - C_1(E/2)$, $i = \{A, B\}$ for all n.

Assumption A.3: The function $\varphi(\cdot)$ is nondecreasing and concave. Therefore the function $\mu(\cdot, \cdot) : [0, \bar{e}] \times [0, \bar{e}] \to [0, 1]$ is nondecreasing and concave in the first argument and nonincreasing and convex in the second argument. The right hand partial derivative, $\mu_1(0, e_B)$, exists for $e_B \in [0, \bar{e}]$. The function is summetric with negative cross partials,$\mu_{12} \leq 0$ for all experience tuple.

Assumption A.4: The parameter, β, lie in the interval $[0.5, \beta^{n0}]$, where $\beta^{n0} = 1 - \frac{C_n(E/2)}{V_n}$. Further, $(1-\beta)V_N - \frac{V_1}{2} < \pi(\bar{e})$.

Assumption A.5: If the author with the idea is indifferent between the two norms, she selects the idea-based norm. Further, we rule out the reverse idea based norm. In other words, if author A has the idea she does not adopt the name order BA.

We assume that the cost function is convex and the total net payoff, $V_n - C_n(E)$, (without considering the opportunity cost) is increasing in quality.[6] The oppotunity cost for an researcher for working on any project is increasing and convex in her experience. The lowest quality is feasible with the lexicographic norm for the two most experiences researchers. Assumption A3 ensures that for any given experience, e_j, as the experience of author i increases, the prior that she could have the idea weakly increases at a decreasing rate, $i, j = \{A, B\}$, $i \neq j$. The fourth assumption is a technical assumption that ensures the idea based norm is preferred for all qualities

[6] If $V_{n+1} > \lambda_n V_n$, then $V_{n+1} - C_{n+1}(\cdot) > \lambda_n(V_n - C_n(\cdot)) > V_n - C_n(\cdot)$, $\because \lambda_n > 1 \forall n = 1, 2, ..., N-1$.

when the author without the idea have no experiences, but is not feasible when she has the highest possible experience. This assumption ensures interior solutions.The last assumption acts as a convenient tie-breaking rule. It also rules out reverse idea based norm.

3 Market Can Infer the Norm

We begin our analysis by characterizing the equilibrium of the setup in which the market observes the quality of the idea, s_n. While solving her optimization problem, author B assumes that the market will be able to correctly infer the norm she used, and assign the corresponding credits, an assumption that turns out to be correct in equilibrium**.**

Author B's problem. Without loss of generality, we assume that author B has an idea of quality s_n. She offers the proposal $\{k, E_A^{nk}\}$ to author A of experience e_A, that maximizes her expected net payoff subject to participation and feasibility constraints:

$$\max_{k\in\{I,L\},E_A^{nk}} \gamma_n^{kB} - C_n(E - E_A^{nk}) \tag{P1}$$

subject to

$$(V_n - \gamma_n^{kB}) - C_n(E_A^{nk}) - \pi(e_A) \geq 0 \tag{5}$$

$$\gamma_n^{kB} - C_n(E - E_A^{nk}) \geq \pi(e_B) \tag{6}$$

$$\text{and } E_A^{nk} \in [0, E]. \tag{7}$$

The first constraint is the participation constraint for author A, and the second for author B, for any norm k. The last constraint, ensures feasibility of the research output. If for any experience tuple (e_A, e_B), neither norm satisfies the above inequalities, collaboration is not feasible between them.

Before proceeding we make the following observations. First, for any given experience e_A the expected net payoff to author B increases in the effort level of author A with any norm k, subject to feasibility and participation constraints. This ensures that the participation constraint of author A given by constraint (5) always hold with equality. Therefore, we define the the effort levels, $E_A^{nI}(e_A, e_B)$, and $E_A^{nL}(e_A, e_B)$

$$\begin{aligned} C_n(E_A^{nI}(e_A, e_B)) &= (1-\beta)V_n - \pi(e_A) \\ C_n(E_A^{nL}(e_A, e_B)) &= \gamma_n^{LB} - \pi(e_A) \end{aligned}$$

subject to feasibility $E_A^{nI}(e_A, e_B), E_A^{nL}(e_A, e_B) \in [0, E]$. For simplicity of exposition we denote these variables as E_A^{nI} and E_A^{nL} unless the arguments are needed.

Second, since $\beta > \frac{1}{2}$ and $0 \leq \mu(e_A, e_B) \leq 1$, it follows that $0 \leq E_A^{nI} \leq E_A^{nL}$ such that author A puts in more effort under the lexicographic norm for any feasible experience tuple.

Next we define the experience ranges of the two authors such that for quality s_n, a given norm k is feasible. Assumption **A4** ensures that norm L is feasible for all experience tuple. However, norm I is not feasible for all experience tuples. For any quality norm I is feasible if and only if is feasible for author B with experience e_B, with author A of experience $e_A = 0$ if and only if

$$G(e_A, e_B) = V_n - C_n(E_A^{nI}) - C_n(E - E_A^{nI}) - \pi(e_A) - \pi(e_B) \geq 0$$

with,

$$V_n(1-\beta) - C_n(E_A^{nI}) = \pi(e_A), \ \frac{dE_A^{nI}}{de_A} = -\frac{\pi'(e_A)}{C_n'(E_A^{nI})}$$

The function $G(e_A, e_B)$ is decreasing in both arguments,

$$\begin{aligned} G_1(e_A, e_B) &= -\left[C_n'(E - E_A^{nI}) - C_n'(E_A^{nI})\right] \frac{\pi'(e_A)}{C_n'(E_A^{nI})} - \pi'(e_A) = -\frac{C_n'(E - E_A^{nI})}{C_n'(E_A^{nI})}\pi'(e_A) < 0 \\ G_2(e_A, e_B) &= -\pi'(e_B) < 0 \end{aligned}$$

We denote $\overline{e}^n$ as the experience of author B such that at experience $e_A = 0$, of author A, the functional value of G is zero, $G(0, \overline{e}^n) \geq 0$. For any such $e_B \leq \overline{e}^n$, we have $G(0, e_B) > 0$, since $G_2(e_A, e_B) < 0$. For any $e_B \leq \overline{e}^n$, we define the experience $\overline{e}_A^n(e_B)$ of author A, such that $G(\overline{e}_A^n(e_B), e_B) = 0$. Note for $e_B \leq \overline{e}^n$, $G(e_A, e_B) \geq (<)0$, for $e_A \leq (>)\overline{e}_A^n(e_B)$, since $G_2(e_A, e_B) < 0$. Finally, for for $e_B > \overline{e}^n$, $G(e_A, e_B) < 0$ for all e_A.[7]

Therefore, for quality s_n, the experience tuple (e_A, e_B) is feasible with $G(e_A, e_B) \geq 0$, if $e_A \leq \overline{e}_A^n(e_B)$, for $e_B \leq \overline{e}^n$. For all other experience tuple $G(e_A, e_B) < 0$, and therefore norm I is not feasible.

We fix the experience level, e_B of author B, such that $e_B \leq \overline{e}^n$. For $e_A \in [0, \overline{e}_A^n(e_B)]$, both norms are feasible. From our first observation for

[7] When author A has an idea of quality s_n, the threshold experience beyond which idea based norm is infeasible would also be $\overline{e}^n$.

$e_A \in [0, \bar{e}_A^n(e_B)]$ author A is tied down to her outside option, $\pi(\cdot)$ for both the norms:

$$V_n - \gamma_n^{IB} - C_n(E_A^{nI}) = \pi(e_A) = V_n - \gamma_n^{LB} - C_n(E_A^{nL}) \tag{8}$$

$$\Rightarrow (2\beta - 1)\mu(e_A, e_B)V_n = C_n(E_A^{nL}) - C_n(E_A^{nI}) \tag{9}$$

Thus, the gain in expected gross benefit from the lexicographic norm is completely offset by a corresponding increase in effort, such that the expected net benefits are identical for author A (author without the idea).

The net gain of author B from adopting the idea-based norm over the lexicographic norm with author A is given by,

$$\begin{aligned}\Delta^n(e_A, e_B) &= \gamma_n^{IB} - C_n(E - E_A^{nI}) - \left[\gamma_n^{LB} - C_n(E - E_A^{nL})\right] \\ &= C_n(E - E_A^{nL}) - C_n(E - E_A^{nI}) + (2\beta - 1)\mu(e_A, e_B)V_n. \end{aligned} \tag{10}$$

Author B opts for the idea-based (lexicographic) norm whenever,

$$\begin{aligned} &\Delta^n(e_A, e_B) \geq (<)0 \\ \Leftrightarrow\ &C_n(E_A^{nL}) - C_n(E_A^{nI}) \geq (<) C_n(E - E_A^{nI}) - C_n(E - E_A^{nL}) \\ \Leftrightarrow\ &C_n(E_A^{nL}) + C_n(E - E_A^{nL}) \geq (<) C_n(E_A^{nI}) + C_n(E - E_A^{nI}). \end{aligned} \tag{11}$$

from equation (9). For a strictly increasing and strictly convex cost function, C_n, and $\beta \in (0.5, \beta^{n0})$, we conclude from condition (11) that author B prefers the norm that distributes effort more equitably (Appendix A, Lemma 8).

The sum of the expected gross payoffs for an idea of quality s_n is V_n for both the norms, however, the sum of expected net payoff increases as the effort distribution between the two authors become more equitable with convex cost. It is maximized at the effort level $E_A^{nk} = \frac{E}{2}$ for both norms (Appendix A, Lemma 9). However, the effort level $E_A^{nk} = \frac{E}{2}$ may not be feasible with any norm k (the participation constraint of author A may be violated) and when it is feasible may not necessarily maximize the net benefit of author B (the participation constraint of author A will be slack). Consequently, instead author B opts for the norm that minimizes the sum of the cost of effort for the two of them subject to author A being tied to her participation constraint. She thereby simultaneously maximizes her expected net benefit from the collaboration.

Notice, if the cost function is *linear* and is given by $C_n(x) = c_n x$ for any given s_n, then $\Delta^n(e_A, e_B) = 0$ for $e_A \leq \bar{e}_A^n(e_B)$ for any e_B. This implies that author B is indifferent between the two norms for $e_A \in [0, \overline{e}_A^n(e_B)]$[8]. Consequently, the convexity of the cost function plays a key role in the emergence of norm L.

For each quality s_n, we define a function $f^n : [0, \overline{e}_A^n(e_B)] \times [0, \overline{e}^n] \times [0.5, 1] \rightarrow \mathbb{R}$

$$f^n(e_A, e_B) = (2\beta - 1)\mu(e_A, e_B)V_n - [C_n(E - E_A^{nI}(e_A, e_B)) - C_n(E_A^{nI}(e_A, e_B))]$$

with $(1 - \beta)V_n - C_n(E_A^{nI}(e_A, e_B)) = \pi(e_A)$[9]. The function $f^n(e_A; e_B)$ is once continuously differentiable in (e_A, e_B). Further, it is twice continuously differentiable, since $C_n(\cdot)$, $\pi(\cdot)$ and $\mu(\cdot; e_B)$ are twice continuously differentiable for $e_A \in (0, \overline{e}_A^n(e_B))$. On the boundaries 0 and $\overline{e}_A^n(e_B)$ the right and left hand derivatives exist. The relationship between the functions $f^n(e_A, e_B)$ and $\Delta^n(e_A, e_B)$ is summarized in the following Lemma.

Lemma 1 *For any given $\beta \in (0.5, 1)$ for $e_A \in [0, \overline{e}_A^n(e_B)]$ we conclude that*

$$\Delta^n(e_A, e_B) \geq (<) 0 \Leftrightarrow f^n(e_A, e_B) \geq (<) 0.$$

Proof. See Appendix B. ■

For a given e_B and β, Lemma 1 show that the sign of $f^n(e_A, e_B)$ determines the choice of norm by author B, for an idea of quality s_n, with author A of experience $e_A \in [0, \overline{e}_A^n(e_B)]$. The first term of the function, $f^n(e_A, e_B)$ is nonnegative but the second term cannot be signed. At experience $e_A = 0$, the effort level of author A with with norm I satisfy $E_A^{nI}(0, e_B) \geq E/2$ by assumption, thereby, the expression $f^n(0, e_B)$, is nonnegative. As the experience of author A increases, her opportunity cost increases and therefore her effort with norm I decreases monotonically. Thus, we define the experience level $\underline{e}_A^n(e_B)$, such that the corresponding effort level $E_A^{nI}(\underline{e}_A^n(e_B), e_B) = E/2$. For all $e_A \in [0, e_A^{n0}]$, the corresponding effort level satisfies $E_A^{nI}(e_A, e_B) \geq E/2$, implying that function $f^n(e_A, e_B)$ is nonpositive, thereby norm I is preferred to norm L. The relevant range of experience for author A wherein either norm may be optimal is therefore $[\underline{e}_A^n(e_B), \overline{e}_A^n(e_B)]$, with $f^n(\underline{e}_A^n(e_B), e_B) \geq 0$. For this range of experience, the following lemmata state the properties of the function $f^n(e_A, e_B)$.

[8]Similarly, if the value of the parameter, β was 0.5, then the effort level for author A would be ideantical for the two norms $E_A^{nI} = E_A^{nL}$, with $\Delta^n(e_A, e_B) = 0$ for all (e_A, e_B), for all s_n. Author B again would be indifferent between the two norms.

[9]Notice, the effort level $E_A^{nI}(e_A, e_B)$ is independent of e_B.

Lemma 2 *The function $f^n(e_A, e_B)$ is not necessarily monotonic, but is strictly concave in $e_A \in (\underline{e}^n_A(e_B), \overline{e}^n_A(e_B)(\beta))$.*

Proof. See Appendix B. ■

Lemma 3 *$f^n(e_A, e_B)$ is monotonically decreasing in e_B. It is monotonically decreasing in β for $e_A \in (\underline{e}^n_A(e_B), \overline{e}^n_A(e_B))$.*

Proof. See Appendix B. ■

The sign of $f^n(e_A, e_B)$ at the upper bound, $e_A = \overline{e}^n_A(e_B)$ can be positive, negative or zero. We will show subsequently that norm L is opted by author B for some range of experiences of author A only if the sign is negative. We thus state this as a separate condition.

Condition C1: For a given quality the cost function satisfies:

$$f^n(\overline{e}^n_A(e_B), e_B) = (2\beta - 1)\mu(\overline{e}^n_A(e_B), e_B)V_n - [C_n(E - E^{nI}_A) - C_n(E^{nI}_A)] < 0. \quad (12)$$

For any quality s_n, the first term denotes the loss in gross payoff to author B in switching from norm I to norm L.

Now we state our first result. For any idea of quality s_n, there exist a *unique* threshold experience of author A, $e^{n*}_A(e_B) \in (0, \overline{e}^n_A(e_B)]$ such that for any experience level $e_A \leq e^{n*}_A(e_B)$, author B opts for norm I and for any $e_A > e^{n*}_A(e_B)$. If condition C1 hold, then $e^{n*}_A(e_B)$ is in the interior of the set $(0, \overline{e}^n_A(e_B))$. in other words norm L is opted even when norm I is feasible. However if condition C1 is violated $e^{n*}_A(e_B) = \overline{e}^n_A(e_B)$, implying that norm L is opted only when norm I is not feasible. We show this below.

Proposition 1 *For a given s_n for any experience e_B of author B, if condition C1 hold, there always exist a threshold experience $e^{n*}_A(e_B) \in [0, \overline{e}^n_A(e_B))$ such that $f^n(e_A, e_B) \geq 0$, for $e_A \leq e^{n*}_A(e_B)$ and $f^n(e_A, e_B) < 0$.*

Proof. See Appendix B. ■

If condition C1 hold, then norm L is opted even when norm I is feasible. Notice, convexity of the cost function is necessary for condition C1. Had the cost function been linear, condition C1 would fail and like in the next proposition idea based norm would always prevail.

Proposition 2 *For an idea of quality s_n for experience level e_B, if condition C1 fail, then the threshold experience is given by $e^{n*}_A(e_B) = \overline{e}^n_A(e_B)$ such that $f^n(e_A, e_B) > 0$, for $e_A \leq e^{n*}_A(e_B)$.*

Proof. See Appendix B. ■

We now turn to the maximization exercise for author A when she has an idea. Interestingly, even though the market can calculate the threshold experience, it will not always be able to deduce the choice of norm through the observed name order. This makes the maximization problem for author A significantly different from that of author B.

Author A's problem. Author A with the idea can propose $\{I, E_B^{nI}\}$ or$\{L, E_B^{nL}\}$[10] to author B, subject to feasibility when she has an idea of quality s_n. For either norm, the name order is AB, however, the effort levels are different. The name order AB arises when author A has the idea, and chooses either norm, and additionally, when author B uses the lexicographic norm. Thus, author A cannot use the name order AB to signal that the norm used was idea-based or lexicographic, without considering the choice of norm by author B. For instance, when author B chooses the idea-based norm with name order BA, the market is able to infer the source of the idea when it observes the name order AB. In such a case, on observation of name order AB, the market assigns β proportion of credit to her and the remaining $(1-\beta)$ to author B. Thus, the proposal $\{L, E_B^{nL}\}$, with effort $E_B^{nL} > E_B^{nI}$ violates the participation constraint of author B,

$$(1-\beta)V_n - C_n(E_B^{nL}) < (1-\beta)V_n - C_n(E_B^{nI}) = \pi(e_B)$$

and therefore not feasible for author A. Consequently she proposes $\{I, E_B^{nI}\}$ which is accepted, subject to feasibility. As will be seen in Theorem 2, at times norm I may not be feasible, when author A has the idea, but feasible when author B has the idea. In such a case, even though author B with the idea collaborates with author A with norm I, there will be no collaboration when author A has the idea. Thus, subject to feasibility author A follows the the strategy adopted by author $B$when they respectively have the idea.

On the other hand, had author B chosen the norm L, the market would be unable to update its prior irrespective of the norm chosen by A. For any name order AB, it assigns credit according to the prior. In this case, the proposal $\{I, E_B^{nI}\}$ will be feasible but suboptimal for author A. Thus, yet again the optimization problem of author A, has a singleton feasible norm, $k = L$. Therefore, she advances the $\{L, E_B^{nL}\}$, such that

$$V_n\left[\beta - \mu(e_A, e_B)(2\beta - 1)\right] - C_n(E_B^{nL}) = \pi(e_B),$$

[10] The efforts E_B^{nI} and E_B^{nL} are defined such that the participation constraint of author B binds, analogous to the efforts E_A^{nI} and E_A^{nL}.

and author B accepts. Again author A with the idea mimics the strategy of author B with the idea.

Author A, therefore, faces a problem strikingly different from the optimization problem of author B, since her choice of norm is rendered inconsequential with respect to market updates. The only respect in which author A can distinguish her proposals is through the effort level he imposes on her collaborator. In Theorem 1 we show that author A always follows the choice of norm of author B if it is feasible when he has an idea of quality s_n. We finally describe the perfect Bayesian equilibrium for an idea of quality s_n when experience of author B satisfies $e_B \leq \overline{e}^n$.

Theorem 1 *The Perfect Bayesian Equilibrium for any quality s_n, for any experience $e_B \leq \overline{e}^n_A(e_B)$ is given as follows:*

$$\begin{aligned}
\sigma^*_A(s_n,(1,0)) &= \begin{cases} CO, \{I,\ E^{nI}_B\}, \textit{ for } \{(e_A,e_B): e_A \leq e^{n*}_A(e_B)\} \\ CO, \{L,\ E^{nL}_B\}, \textit{ for } \{(e_A,e_B): e_A > e^{n*}_A(e_B)\} \end{cases} \\
\sigma^*_B(s_n,(1,0)) &= \{Y\}, \textit{ for all } e_B \leq \overline{e}^n_A(e_B)
\end{aligned}$$

$$\begin{aligned}
\sigma^*_B(s_n,(0,1)) &= \begin{cases} CO, \{I,\ E^{nI}_A\}, \textit{ for } \{(e_A,e_B): e_A \leq e^{n*}_A(e_B)\} \\ CO, \{L,\ E^{nL}_A\}, \textit{ for } \{(e_A,e_B): e_A > e^{n*}_A(e_B)\} \end{cases} \\
\sigma^*_A(s_n,(0,1)) &= \{Y\}, \textit{ for all } e_A.
\end{aligned}$$

Market posterior on which author had the idea, for idea s_n, in any journal is summarized as,

$$\mu^n(e_A,e_B|\sigma^*,AB) = \begin{cases} 1 \textit{ for } e_A \leq e^{n*}_A(e_B) \\ \mu(e_A,e_B) \textit{ for } \{(e_A,e_B): e_A > e^{n*}_A(e_B)\} \end{cases}$$
$$\mu^n(e_A,e_B;|\sigma^*,BA) = 0, \textit{ for all } (e_A,e_B).$$

Proof. See Appendix B. ■

Theorem 2 *The Perfect Bayesian Equilibrium for any quality s_n, for any experience $e_B > \overline{e}^n_A$ is given as follows:*

$$\begin{aligned}
\sigma^*_A(s_n,(1,0)) &= \begin{cases} NC, \textit{ for } \{(e_A,e_B): e_A \leq e^{n*}_A(e_B)\} \\ CO, \{L,\ E^{nL}_B\}, \textit{ for } \{(e_A,e_B): e_A > e^{n*}_A(e_B)\} \end{cases} \\
\sigma^*_B(s_n,(1,0)) &= \{Y\}, \textit{ for all } e_B \leq \overline{e}^n_A(e_B)
\end{aligned}$$

$$\sigma_B^*(s_n,(0,1)) = \begin{cases} CO, \{I,\ E_A^{nI}\}, \text{ for } \{(e_A,e_B) : e_A \leq e_A^{n*}(e_B)\} \\ CO, \{L,\ E_A^{nL}\}, \text{ for } \{(e_A,e_B) : e_A > e_A^{n*}(e_B)\} \end{cases}$$
$$\sigma_A^*(s_n,(0,1)) = \{Y\}, \text{ for all } e_A.$$

Market posterior on which author had the idea, for idea s_n, in any journal is summarized as,

$$\mu^n(e_A,e_B|\sigma^*,AB) = \begin{cases} 1 \text{ for } e_A \leq e_A^{n*}(e_B) \\ \mu(e_A,e_B) \text{ for } \{(e_A,e_B) : e_A > e_A^{n*}(e_B)\} \end{cases}$$
$$\mu^n(e_A,e_B;|\sigma^*,BA) = 0, \text{ for all } (e_A,e_B).$$

Proof. See Appendix B. ■

Contrary to Theorem 1 author A for experiences $e_A \leq e_A^{n*}(e_B)$, is unable to follow the strategy of author B since the participation constraint of author B is violated in case. As a result, there will be no collaboration when author A has the idea for such an experience tuple.

To summarize, uncertainty in the publication process does not hinder the market from deciphering the norm that was used once the quality of the idea is observable. The market correctly infers the norm and assigns due credit.

As the experience level of author B increases, the market posterior on observation of name order AB decreases (since the prior decreases). Thus, the effort level of author A decreases for the lexicographic norm for any e_A. This makes the effort distribution with the lexicographic norm more equitable, making the range of experience of author A wherein the idea based norm is optimal shrink. We show this below.

Remark 1 *The threshold level, $e_A^{n*}(e_B)$ is nonincreasing in the experience level e_B of author B.*

Proof. See Appendix B. ■

At the lowest experience level of author B, $e_B = 0$, if the experience level of author A is below $e_A^{n*}(e_B)$ the two authors adopt the idea based norm for an idea of quality s_n, when they respectively have the idea. Similarly, Now when the experience of author B increases, the range of experience of author A, wherein the two authors opt for the idea based norm decreases. Thus, we find that the idea based norm is opted by the author when both their experiences are low. As both their experiences increase they both adopt the lexicographic norm. We conclude that when the experiences of the two authors are not very disperse, the authors opt for idea based norm at early stages of their career and the lexicographic norm at the later stage (as in Onuchic and Ray (6)). However, from Remark (1) we find when the experience level of one author increases, the range of experiences of the other author wherein the lexicographic norm is adopted increases.

Remark 2 ***Remark 3*** *With linear cost function given by $C_n(x) = c_n x$ for any given quality s_n, the threshold experience is given by $e_A^{n*}(e_B) = \overline{e}_A^n(e_B)$. For such a threshold level Theorem 1 and 2 hold.*

Proof. See Appendix B. ■

Remark 4 *For any two qualities of idea s_p, s_{p+1} with $s_{p+1} > s_p$, the cutoff levels satisfy $e_A^{p+1*}(e_B) > e_A^{p*}(e_B)$ when the total cost of publication for both the qualities $C_p(E), C_{p+1}(E)$ satisfy C1 and $\lambda_p < \frac{V_{p+1}}{V_p}$.*

Proof. See Appendix B. ■

Interestingly, the range of experiences over which the authors adopt the idea-based norm is falling in β.

Remark 5 *The cutoff level $e_A^{n*}(e_B)$ decreases in the value of β, for a given experience level, e_B.*

Proof. See Appendix B. ■

If the value of the parameter increases the participation constraint of the author A (the author with the idea) becomes tighter. Consequently, the range of experiences for which the idea-based norm is optimal decreases.

4 Market is Unable to Infer the Norm

In the previous section, for any successful collaboration, the market observed the journal quality, the name order in print, the experience tuple of the two authors along with the quality of the idea. Since, the market observed the quality of the idea, for any experience level, e_B of author B it could deduce the corresponding benchmark experience, $e_A^{n*}(e_B)$ of author A. Consequently, the market could perfectly decipher if the name order AB was the outcome of the idea-based norm or the outcome of the lexicographic norm. However, without observing the quality of the idea, the market cannot perfectly deduce the benchmark experiences used by the authors, and hence may not always be able to decipher the norm from the observed name order. However, for very low or very high experiences of the two authors we have seen that both authors follow the idea based or the lexicographic norm respectively, independent of the quality of the idea. In such a case, even though the market cannot deduce the benchmark experiences, it can perfectly decipher the norm from the name order and experience tuple. However, in the intermediary range of experiences of the two authors (especially in the intermediary zone of experience of author A), their choice of norm is a contingent on the quality of the idea. In this range, the market will not be able to decipher the norm from the name order and experience tuple. Interestingly, even for very low experiences of author B, there will exist an intermediary zone of experiences of author A such that the market will not be able to decipher the norm.

For instance consider the experience level of author B in the range $e_B \leq \overline{e}^1$. For such an e_B, consider the intermediary experience range of author A, $e_A \in (e_A^{1*}(e_B), e_A^{N*}(e_B)]$. For any successful collaboration, author B will always adopt the idea-based norm with name order BA for at least quality, s_N, and the lexicographic norm with name order AB for at least quality s_1. Author A, on the other hand, adopts name order AB for all qualities. The market cannot distinguish the norm adopted when name order AB is observed in either journal. Thus, the market updated belief that author A had the idea will always satisfy,

$$\mu(e_A, e_B) < \mu^l(e_A, e_B|AB, \sigma^*), \mu^h(e_A, e_B|AB, \sigma^*) < 1$$

for both the journals. Whenever, the market updates for name order AB in journal Q are in the open interval $(\mu(e_A, e_B), 1)$, it suggests that the market is unable to decipher the norm completely. With such imperfect market updates, whenever author A has an idea of any quality, he deviates from strategy σ^* as shown below.

Lemma 4 *For any experience tuple* (e_A, e_B), $e_A \in (e_A^{1*}(e_B), e_A^{N*}(e_B)]$ *if the market update is given by* $\mu(e_A, e_B) < \mu^l(e_A, e_B|AB, \sigma^*), \mu^h(e_A, e_B|AB, \sigma^*) < 1$, *author A with the idea deviates from the strategy* (σ^*) *for any quality* s_n. *Particularly, for all quality* s_n *author A deviates from idea-based norm if* $e_A \in (e_A^{1*}(e_B), e_A^{n*}(e_B)]$ *and the lexicographic norm if* $e_A \in (e_A^{n*}(e_B), e_A^{N*}(e_B)]$.

Proof. See Appendix C. ■

The above Proposition shows that author A deviates when he has an idea of quality s_n, when $e_A \in (e_A^{1*}(e_B), e_A^{n*}(e_B)]$. Therefore, the strategy σ^* is no longer an equilibrium.

Notice author B opts for norm I for $e_A \leq e_A^{n*}(e_B)$ whereas the choice of norm I by author A cannot be distinguished from the choice of norm L by either author. If for some reason, author A did not collaborate with author B for quality s_1, when $e_A \leq e_A^{n*}(e_B)$, but collaborated with norm L for experiences $e_A > e_A^{n*}(e_B)$, the market update in the intermediary zone would not be affected. This would indeed be the case for higher experiences of e_B, say $\bar{e}^1 < e_B \leq \bar{e}^2$. Now say the experience of author B further increase to $\bar{e}^2 < e_B \leq \bar{e}^3$. Author A consequently do not collaborate with the I norm for $e_A \leq e_A^{2*}(e_B)$ for qualities s_1 and s_2, but collaborates with norm L for $e_A > e_A^{2*}(e_B)$. In such a case the market updates get adjusted but qualitatively remain unchanged. Therefore, in this section we only consider $e_B \leq \bar{e}^1$.

As in the last section, the choice of norm by author B is instrumental in the market figuring out the norm when the name order AB is observed. We first analyze the choice of name order by author B. For an idea of quality s_n, for any given experience e_B, we assume that there exist an unique threshold experience level of author A denoted by $e_A^n(e_B)$, such that for all $e_A \leq e_A^n(e_B)$ ($e_A > e_A^n(e_B)$) author B prefers the name order BA (AB). These threshold experiences will determine the market beliefs on which author had the idea for any name order m. Given the market updates the thresholds have to be optimal for both authors so as to rule out unilateral profitable deviations.

For the time being we impose the following for each quality s_n,

(a) There exist an unique threshold experience $e_A^n(e_B) \in [e_A^{1*}(e_B), e_A^{N*}(e_B)]$,

(b) The threshold experiences are monotonically increasing in quality,

$$e_A^1(e_B) \leq .... \leq e_A^n(e_B) \leq e_A^{n+1}(e_B).... \leq e_A^N(e_B).$$

In the rest of this section, we will determine the above threshold experiences and show that this indeed is the case. Notice, we do not rule out the possibility that for some qualities the thresholds coincide with the thresholds corresponding to strategy σ^*.

As will be seen later, the market updates fall discontinuously at every (distinct) threshold $e_A^n(e_B)$. Intuitively we explain this result by considering three distinct thresholds $e_A^{n-1}(e_B)$, $e_A^n(e_B)$ and $e_A^{n+1}(e_B)$. For experiences in the interval $e_A \in (e_A^{n-1}(e_B), e_A^n(e_B)]$ for any quality $s_p \leq s_{n-1}$ both authors adopt the name order AB but for any quality $s_p > s_{n-1}$ only author A adopts the the name order AB when they respectively have the idea. However, for $e_A \in (e_A^n(e_B), e_A^{n+1}(e_B)]$, author B additionally follows the name order AB for quality s_n. Author B thus follows the name order AB for a strictly larger set of qualities. Thus, the updated belief that author A has the idea when name order AB is observed in either journal, is discontinuously lower in this interval from the previous interval. The discontinuity is exactly at the threshold experiences, making it is technically difficult to solve for these thresholds. To avoid such technical challenges we digress and adopt the following work-around. For each quality s_n, we define the corresponding *pseudo market beliefs* for all experiences e_A in the interval $[e_A^{1*}(e_B), e_A^{N*}(e_B)]$.

We first compute the probability that the idea is at most of quality s_n given the journal outlet as follows:

$$\begin{aligned} P(s_p \quad \leq \quad s_n|l) &= \frac{\sum_{p=1}^{n} P(l|s_p)P(s_p)}{\sum_{p=1}^{N} P(l|s_p)P(s_p)} = \frac{\frac{1}{N}\sum_{p=1}^{n}(1-s_p)}{\frac{1}{N}\sum_{p=1}^{N}(1-s_p)} = \frac{n-S_n}{N-S_N} \quad (13) \\ P(s_p \quad > \quad s_n|l) &= 1 - P(s_p \leq s_n|l) = \frac{N-n-(S_N-S_n)}{N-S_N} \end{aligned}$$

$\forall s_n \in s$, where $S_n = \sum_{p=1}^{n} s_p$ and $P(l|s_p) = 1 - s_p$. Likewise,

$$P(s_p \leq s_n|h) = \frac{S_n}{S_N} \text{ and } P(s_p > s_n|h) = \frac{S_N - S_n}{S_N} \; \forall s_n \in s. \quad (14)$$

For each quality s_n, the *pseudo market beliefs* contingent on the journal outlet, are such that for all qualities $s_p \leq s_n$ both authors adopt the name order AB and for all qualities $s_p > s_n$ only author A adopts the the name order AB when they respectively have the idea is given by,

$$\begin{aligned} \widetilde{\mu}^l(e_A, e_B, n|AB) &= P(s_p \leq s_n|l)\mu(e_A, e_B) + (1 - P(s_p \leq s_n|l)) \\ &= \frac{n-S_n}{N-S_N}\mu(e_A, e_B) + \frac{N-n-(S_N-S_n)}{N-S_N} \quad (15) \\ \widetilde{\mu}^h(e_A, e_B, n|AB) &= P(s_p \leq s_n|h)\mu(e_A, e_B) + (1 - P(s_p \leq s_n|h)) \\ &= \frac{S_n}{S_N}\mu(e_A, e_B) + \frac{S_N - S_n}{S_N} \quad (16) \end{aligned}$$

for the entire interval $(e_A^{1*}(e_B), e_A^{N*}(e_B)]$.[11] We refer to these as *pseudo market beliefs* to distinguish them from the market updated beliefs, (18), (19). The market updated beliefs defined subsequently are formed with Bayes updates on the appropriate intervals given the thresholds $e_A^n(e_B)$. The pseudo beliefs are twice continuously differentiable in the first two arguments and preserves all properties of the prior. Notice, the *pseudo market beliefs* for quality s_N coincide with the prior.

Lemma 5 *Each set of pseudo market belief,* $\widetilde{\mu}^Q(e_A, e_B, n|AB)$, $Q = \{l, h\}$ *are twice continuously differentiable with* $\mu(e_A, e_B) < \widetilde{\mu}^Q(e_A, e_B, n|AB)$ *for* $n \neq N$. *Further,* $\widetilde{\mu}^Q(e_A, e_B, n|AB)$ *is increasing and concave in* e_A, *and decreasing and convex in* e_B *for all* $e_A \in (e_A^{1*}(e_B), e_A^{N*}(e_B)]$.

Proof. See Appendix C. ■

For each quality s_n for the name order AB we define the expected payoffs with respect to the corresponding pseudo updates, $\widetilde{\mu}^Q(e_A, e_B, n|AB)$. The expected gross payoff and the corresponding effort for name order BA remain identical to norm I. We then compare the choice of name order by author B for each quality s_n, with the corresponding pseudo updates, $\widetilde{\mu}^Q(e_A, e_B, n|AB)$ for $[e_A^{1*}(e_B), e_A^{N*}(e_B)]$. Since the pseudo updates preserve the properties of the prior, in essence for any given quality, s_n, the choice of name order by author B remain qualitatively remain unaltered to problem (P1).

The expected gross payoff and effort level of author A (author without the idea) for name order AB, changes from that of the lexicographic norm to:

$$\left[(1-\beta) + (2\beta - 1)\widetilde{\mu}^l(e_A, e_B, n|AB)\right](1 - s_n)V^l$$
$$+ \left[(1-\beta) + (2\beta - 1)\widetilde{\mu}^{lh}(e_A, e_B, n|AB)\right] s_n V^h] - C_n(\widetilde{E}_A^n) = \pi(e_A)$$

for any $e_A \in (e_A^{1*}(e_B), e_A^{N*}(e_B)]$. As before author B adopts the name order BA (AB) if and only if,

$$\widetilde{\Delta}^n(e_A, e_B)$$
$$= (2\beta - 1)[(1 - s_n)\widetilde{\mu}^l(e_A, e_B, n|AB)V^l + s_n\widetilde{\mu}^h(e_A, e_B, n|AB)V^h]$$
$$-(C_n(E - E_A^{nI}) - C_n(E - \widetilde{E}_A^n) \geq (<).$$

[11] To be precise, the updated beliefs $\widetilde{\mu}^l, \widetilde{\mu}^h$ are actually consistent with experiences $e_A \in (e_A^n(e_B), e_A^{n+1}]$. However, for analytical tractability, we assume that the market uses these beliefs for the entire interval $(e_A^{1*}(e_B), e_A^{N*}(e_B)]$.

In problem (P1) we restricted our attention to the interval $[0, \overline{e}_A^n(e_B)]$ but here we consider the interval to be $[e_A^{1*}(e_B), e_A^{N*}(e_B)]$. We adapt Lemma (1) to conclude that,

$$\widetilde{\Delta}^n(e_A, e_B) \geq (<) 0 \Leftrightarrow g^n(e_A, e_B) \geq (<) 0$$

where $g^n(e_A, e_B)$ is given by,

$$\begin{aligned} g^n(e_A, e_B) = (2\beta - 1)[(1 - s_n)\widetilde{\mu}^l(e_A, e_B, n|AB)V^l + s_n\widetilde{\mu}^h(e_A, e_B, n|AB)V^h] \\ - \left[C_n(E - E_A^{nI}) - C_n(E_A^{nI})\right] \geq f^n(e_A, e_B). \end{aligned}$$

for $e_A \in [e_A^{1*}(e_B), e_A^{N*}(e_B)]$. The last inequality follows from $\widetilde{\mu}^Q(e_A, e_B, n|AB) \geq \mu(e_A, e_B)$ for all qualities, s_n. Observe, for experiences, $e_A \in [e_A^{1*}, e_A^{n*}]$, we have

$$\begin{aligned} g^n(e_A, e_B) &\geq f^n(e_A, e_B) \geq 0 \\ &\Leftrightarrow \widetilde{\Delta}^n(e_A, e_B) \geq 0 \end{aligned}$$

Ergo, author B strictly prefers the name order BA to the name order AB, for $e_A \leq e_A^{n*}$. The name order AB with the corresponding pseudo beliefs confers a higher (lower) credit to author A (author B) compared to the prior for all quality s_n. Thereby, the net gain for author B, from the name order BA over the name order AB with the pseudo updates increases from that of the previous section.

Next we show there always exist an unique *pseudo* experience, $\widetilde{e}_A^n(e_B) \in (e_A^{n*}(e_B), e_A^{N*}(e_B)]$ such that author B prefers the name order BA for $e_A < \widetilde{e}_A^n(e_B)$ and the name order AB otherwise. Further, we know that for experiences $e_A > \overline{e}_A^n(e_B)$, the name order BA is not feasible. Therefore, if $\overline{e}_A^n(e_B) < e_A^{N*}(e_B)$, the unique threshold, $\widetilde{e}_A^n(e_B)$ lie in the interior of the set $(e_A^{n*}(e_B), e_A^{N*}(e_B)]$. However, if $\overline{e}_A^n(e_B) \geq e_A^{N*}(e_B)$ for such an interior threshold a similar condition like C1 needs to be imposed. We state the condition below.

Condition C2: For a given quality either of the following conditions hold:

(i) $\overline{e}_A^n(e_B) < e_A^{N*}(e_B)$ or

(ii) the cost function satisfies

$$\begin{aligned} & g^n(e_A^{N*}(e_B), e_B) \\ = (2\beta - 1)[(1 - s_n)\widetilde{\mu}^l(e_A^{N*}(e_B), e_B, n|AB)V^l + s_n\widetilde{\mu}^h(e_A^{N*}(e_B), e_B, n|AB)V^h] \\ -C_n(E - E_A^{nI}) - C_n(E_A^{nI}) < 0. \end{aligned}$$

Proposition 3 *For a given quality s_n and experience level e_B of author B, if condition C2 satisfied there always exist an experience $\widetilde{e}^n_A \in [e^{n*}_A(e_B), z_n(e_B)]$ such that $g^n(e_A, e_B) > 0$ for $e_A < \widetilde{e}^n_A$, and $g^n(e_A, e_B) < 0$ for $e_A > e^n_A$. If condition C2 fails, then $\widetilde{e}^n_A = e^{N*}_A(e_B)$ with $g^n(e_A, e_B) \geq 0$ for $e_A < e^{N*}_A(e_B)$. For quality s_N, $\widetilde{e}^n_A = e^{N*}_A(e_B)$.*

Proof. The proof follows by adapting Proposition (2). ■

From above we conclude that for $e_A \in [e^{1*}_A(e_B), \widetilde{e}^n_A(e_B))$ author B adopts the name order BA, and for $e_A \in (\widetilde{e}^n_A(e_B), e^{N*}_A(e_B)]$ she chooses AB instead. Ergo, for any quality s_n, the range of experience $e_A \in [e^{1*}_A(e_B), e^{N*}_A(e_B)]$ where author B opts for the name order AB, with the corresponding pseudo belief is nonempty if either $\overline{e}^n_A(e_B) < e^{N*}_A(e_B)$, or $g^n(e^{N*}_A(e_B), e_B) < 0$.

Observe, for each quality we have determined the experiences above which name order AB is preferred by author B with the corresponding pseudo belief. In effect for each quality we have solved a separate maximization exercise. Not surprisingly, the monotonicity property of the last section given by Remark 4 need not necessarily hold. Monotonicity may fail since lower the quality the more (less) favorable is the corresponding market pseudo updates for author A (author B), when the name order AB is observed. Consequently, for such qualities author B may find the name order BA optimal for a very large range of experiences of author A. However, if the corresponding pseudo $\widetilde{\mu}^l(\cdot)$ and $\widetilde{\mu}^h(\cdot)$ could be lowered, the range of experience of author A wherein the name order BA is optimal for author B shrinks. Thus, for any quality s_p, the range of experience of author A wherein the name order AB is preferred weakly expands for a lower pseudo updates $\mu^Q(e_A, e_B, n|AB)$, instead of $\mu^Q(e_A, e_B, p|AB)$, $Q = \{l, h\}$ whenever $p < n$.

Lemma 6 *For a given market belief, $\mu^Q(e_A, e_B, n|AB)$, $Q = \{l, h\}$, if author B prefers the name order AB (BA) for quality s_n, then she prefers the name order AB (BA) for all qualities, s_p, where $s_p \leq s_n$ ($s_p > s_n$).*

Proof. See Appendix C. ■

The pseudo beliefs $\widetilde{\mu}^Q(e_A, e_B, n|AB)$, $Q = \{l, h\}$ are calculated for any e_A such that the name order AB is observed whenever author A has an idea of any quality, and author B has the idea of quality s_p, where $s_p \leq s_n$. Thus, $\mu^Q(e_A, e_B, n|AB)$ is in tune with author B following the name order AB (BA) for all qualities $s_p \leq s_n$ ($s_p > s_n$). From the above Lemma we conclude that at threshold experience, $e^n_A(e_B)$, author B prefers the name order AB with pseudo beliefs $\widetilde{\mu}^Q(e_A, e_B, n|AB)$ for all qualities $s_p \leq s_n$. Ergo we construct the unique equilibrium thresholds $e_A^n(e_B)$, for each quality from the pseudo thresholds as follows:

$$\begin{aligned} e_A^n(e_B) &= \min\{\widetilde{e}_A^n(e_B), \widetilde{e}_A^{n+1}(e_B), ..., \widetilde{e}_A^{N-1}(e_B), \widetilde{e}_A^N(e_B)\} \\ &\leq \widetilde{e}_A^n(e_B) \end{aligned} \tag{17}$$

Since the minimization is on a set comprising finite elements, for all quality s_n there exists an s_r, such that $e_A^n(e_B) = \widetilde{e}_A^r(e_B)$, for $n \leq r$. Further if $n < r$, for any quality s_p such that $n \leq p \leq r$, the threshold experience for quality s_p will satisfy, $e_A^p(e_B) = \widetilde{e}_A^r(e_B)$. In such cases, multiple qualities will share the same threshold $\widetilde{e}_A^r(e_B)$. By definition the threshold for the highest quality is given by, $e_A^N(e_B) = \widetilde{e}_A^N(e_B) = e_A^{N*}(e_B)$. The set of all such distinct threshold are given by,

$$\widehat{\mathbf{e}}(e_B) = \left\{e_A^r(e_B) : e_A^r(e_B) = \widetilde{e}_A^r(e_B) \neq e_A^N(e_B)\right\} \cup \{e_A^N(e_B)\}.$$

The set $\widehat{\mathbf{e}}(e_B)$ is nonempty since by definition $e_A^N(e_B)$ is a element of it. Without loss of generality we assume the cardinality of the set is $T \leq N$. We arrange the elements of this set ascending order, where the t^{th} element is denoted by $\widehat{e}_A^t(e_B)$, satisfies the inequality $\widehat{e}_A^{t-1}(e_B) < \widehat{e}_A^t(e_B)$, for $t = 2, 3...T$. Therefore, we must have $\widehat{e}_A^T(e_B) = e_A^{N*}(e_B)$.

For each threshold $\widehat{e}_A^t(e_B)$, we partition the qualities such that,

$$\widehat{s}^t = \{s_n \in \mathbf{s} : \min_{n \leq p \leq N}\{\widetilde{e}_A^p(e_B)\} = \widehat{e}_A^t(e_B)\} \subset \mathbf{s}$$

whereby all qualities in the subset $\widehat{s}^t$ have the same threshold $\widehat{e}_A^t(e_B)$. Notice, if $s_r = \max \widehat{s}^t$, it implies that $e_A^r(e_B) = \widetilde{e}_A^r(e_B)$. The T partitions, $\widehat{s}^t$, comprise mutually exclusive and exhaustive set of qualities in $\mathbf{s}$.

The interval $(\widehat{e}_A^1(e_B), \widehat{e}_A^T(e_B)]$ can be partitioned into subintervals $(\widehat{e}_A^t(e_B), \widehat{e}_A^{t+1}(e_B)]$, $t = 1, 2, ..T - 1$. For $e_A \in (\widehat{e}_A^t(e_B), \widehat{e}_A^{t+1}(e_B)]$, author B adopts the name order BA for qualities $s_n \leq s_r$, and name order AB otherwise, where $s_r = \max \widehat{s}^t$.[12] Author A on the other hand always follows the name order AB. Therefore, on observing the journal outlet, the market first updates the belief on the quality being of at least quality s_r, $P(s_p \leq s_r|l)$ and $P(s_p \leq s_r|h)$ as in equations (13) and (14) respectively. Consequently,

[12] For any $e_A \in (\widehat{e}_A^t(e_B), \widehat{e}_A^{t+1}(e_B)]$, author B adopts the name order BA only if the quality $s_n \in \widehat{s}^1 \cup \widehat{s}^2 \cup ...\widehat{s}^t$. For $s_n \in \widehat{s}^{t+1} \cup ...\widehat{s}^T$ she adopts the name order AB.

following (15) and (16), the market updated beliefs for $e_A \in (\widehat{e}_A^t(e_B), \widehat{e}_A^{t+1}(e_B)]$ are given by,

$$\widehat{\mu}^l(e_A, e_B|AB) = \frac{r - S_r}{N - S_N}\mu(e_A, e_B) + \frac{N - r - (S_N - S_r)}{N - S_N} \tag{18}$$

$$\widehat{\mu}^h(e_A, e_B|AB) = \frac{S_r}{S_N}\mu(e_A, e_B) + \frac{(S_N - S_r)}{S_N}. \tag{19}$$

with $s_r = \max \widehat{s}^t$. Notice the market updates in the subinterval coincides with the pseudo updates $\widehat{\mu}^Q(e_A, e_B, r|AB)$. These market updates lie in the open interval $(\mu(e_A, e_B), 1)$, and discontinuously drop at each threshold $\widehat{e}_A^t(e_B)$ as shown below.

Lemma 7 *The market update satisfies the condition* $\mu(e_A, e_B) < \widehat{\mu}^l(e_A, e_B|AB) < \widehat{\mu}^h(e_A, e_B|AB) < 1$ *for* $e_A \in (\widehat{e}_A^1(e_B), \widehat{e}^T(e_B)]$. *The market update is discontinuous with a drop at each* $\widehat{e}_A^t(e_B)$, *i.e.*

$$\begin{aligned} \lim_{e_A \to \widehat{e}_A^t(e_B)^+} \widehat{\mu}^l(e_A, e_B|AB) &< \widehat{\mu}^l(\widehat{e}_A^t(e_B), e_B|AB) \\ \lim_{e_A \to \widehat{e}_A^t(e_B)^+} \widehat{\mu}^h(e_A, e_B|AB) &< \widehat{\mu}^h(\widehat{e}_A^t(e_B), e_B|AB). \end{aligned}$$

Proof. See Appendix C. ∎

Therefore, for $e_A \in (\widehat{e}_A^{t-1}(e_B), \widehat{e}_A^t(e_B)]$ the name order AB results from author B having the idea for qualities $s_p \leq s_v$, where $s_v = \max \widehat{s}^{t-1}$, or with author A making the proposal for any quality. Similarly, for experiences $e_A \in (\widehat{e}_A^t(e_B), \widehat{e}_A^{t+1}(e_B)]$ the corresponding range of qualities for which we get the name order AB through B's offer is $s_p \leq s_r$, where $s_r = \max \widehat{s}^t > \max \widehat{s}^{t-1} = s_v$. Consequently, the updated belief that author A had the idea conditional on the name order AB is lower in each successive interval.[13]

Both authors are cognizant that the market attributes credit according to (18) and (19) on observing name order AB whenever $e_A \in (\widehat{e}_A^1(e_B), \widehat{e}_A^T(e_B)]$. The expected gross payoffs to author A and B, denoted as γ_n^{UA} and γ_n^{UB}

[13] Even if exactly one quality s_n satisfies condition C2, there would be exactly two partitions, with $\widehat{s}^1 = \{s_p : s_p \leq s_n\}$ and $\widehat{s}^2 = \{s_p : s_p > s_n\}$ with corresponding distinct thresholds $\widehat{e}_A^1(e_B) = \widehat{e}_A^n(e_B)$ and $\widehat{e}_A^2(e_B) = \widehat{e}_A^N(e_B)$ respectively. Thus, even though condition C2 is violated for all s_p, with $s_p < s_n \neq s_1$, the threshold for all such qualities will be $\widehat{e}_A^1(e_B)$, which is distinct from $\widehat{e}_A^N(e_B)$. Consequently, if condition C2 is satisfied for at least one quality, there exists a zone for which the market updates for name order AB is given by (18) and (19).

respectively, for the name order AB in this region are different from those obtained from the lexicographic norm of the previous section. These gross payoffs satisfy the conditions,

$$\gamma_n^{UA} = (1-s_n)[\beta\widehat{\mu}^l(e_A,e_B|AB) + (1-\beta)(1-\widehat{\mu}^l(e_A,e_B|AB))]V^l \\ +s_n[\beta\widehat{\mu}^h(e_A,e_B|AB) + (1-\beta)(1-\widehat{\mu}^h(e_A,e_B|AB))]V^h > \gamma_n^{LA}$$

and

$$\begin{aligned}\gamma_n^{UB} &= (1-s_n)[\beta(1-\widehat{\mu}^l(e_A,e_B|AB)) + (1-\beta)\widehat{\mu}^l(e_A,e_B|AB)]V^l \\ &\quad +s_n[\beta(1-\widehat{\mu}^h(e_A,e_B|AB)) + (1-\beta)\widehat{\mu}^h(e_A,e_B|AB)]V^h < \gamma_n^{LB}\end{aligned}$$

respectively for $e_A \in (\widehat{e}_A^1(e_B), \widehat{e}_A^T(e_B)]$. For any quality s_n, author A with the idea always opts for the name order AB. As in the last section, she proposes an effort level, E_B^{nU}, such that author B is tied to her outside option given the market updates:

$$\gamma_n^{UB} - C_n(E_B^{nU}) = \pi(e_B)$$

However when author B has the idea, she proposes the name order that maximizes her payoff. With both name orders author A is tied to her outside option. For name order BA the effort level for any quality remains identical to the last section, but for AB it changes

$$\gamma_n^{UA} - C_n(E_A^{nU}) = \pi(e_A)$$

Since $\gamma_n^{UA} > \gamma_n^{LA}$ ($\gamma_n^{UB} < \gamma_n^{LB}$) therefore $E_A^{nU} > E_A^{nL}$ ($E_B^{nU} < E_B^{nL}$), such that when author A (author B) has the idea, the loss (gain) in expected gross payoff by author B (author A) is compensated by a commensurate decrease (increase) in the responder's effort level.

For experiences $e_A \leq \widehat{e}_A^1(e_B)$, author B opts for name order BA for all qualities, such that the market updates it's belief to $\mu^Q(e_A,e_B|AB) = 1$, $\mu^Q(e_A,e_B|BA) = 0$, for $Q = \{l,h\}$. On the other hand for $e_A > \widehat{e}_A^T(e_B)$, author B opts for name order AB for all qualities, whereby $\mu^Q(e_A,e_B|AB) = \mu(e_A,e_B)$, for $Q = \{l,h\}$[14].

It is only in this intermediary zone that authors (may) adopt a new norm that has the same name order as the lexicographic norm but a different effort level we label this norm as updated lexicographic norm, U. We denote the proposal given by author i corresponding to this norm by $\{L_u, E_{-i}^{nU}\}$, where

[14]The name order BA appears off the equilibrium, with $\mu^Q(e_A,e_B|BA) = 0$.

$i = \{A, B\}$. If condition C2 holds for even one quality, an intermediary zone emerges wherein this new norm L_u emerges. Norm L_u uses the name order AB, as norm L, but the market assigns credit according to its update that satisfy $\mu(e_A, e_B) < \widehat{\mu}^l(e_A, e_B|AB), \widehat{\mu}^h(e_A, e_B|AB) < 1$. There is an alphabetical discrimination in favor of author A in this zone, since the updated belief is higher than the prior.

Theorem 3 *If Condition C2 holds for at least one quality, then the Perfect Bayesian Equilibrium for* $e_B \leq \overline{e}^1$ *is given as follows:*

$$\begin{aligned}
\widehat{\sigma}_A(s_n, 1, 0) &= \begin{cases} CO, \{I, E_B^{nI}\}, \textit{ for } \{(e_A, e_B) : e_A \leq \widehat{e}_A^1(e_B)\} \\ CO, \{L_u, E_B^{nU}\}, \textit{ for } \left\{(e_A, e_B) : \widehat{e}_A^1(e_B) < e_A \leq \widehat{e}_A^T(e_B)\right\} \\ CO, \{L, E_B^{nL}\}, \textit{ for } \left\{(e_A, e_B) : \widehat{e}_A^T(e_B) < e_A \leq \overline{e}_A^n\right\} \end{cases} \\
\widehat{\sigma}_B(s_n, 1, 0) &= \{Y\}, \textit{ for all } e_B
\end{aligned}$$

$$\begin{aligned}
\widehat{\sigma}_B(s_n, 0, 1) &= \begin{cases} CO, \{I, E_B^{nI}\}, \text{ for } \{(e_A, e_B) : e_A \leq \widehat{e}_A^1(e_B)\} \\ CO, \{I, E_B^{nI}\}, \text{ for } \{(e_A, e_B) : \widehat{e}_A^1(e_B) < e_A \leq \widehat{e}_A^t(e_B)\}, \, s_n \in \widehat{s}^t \\ CO, \{L_u, E_B^{nU}\}, \text{ for } \left\{(e_A, e_B) : \widehat{e}_A^t(e_B) < e_A \leq \widehat{e}_A^T(e_B)\right\}, \, s_n \in \widehat{s}^t \\ CO, \{L, E_B^{nL}\}, \text{ for } \left\{(e_A, e_B) : \widehat{e}_A^T(e_B) < e_A \leq \overline{e}_A^n\right\} \end{cases} \\
\widehat{\sigma}_A(s_n, 0, 1) &= \{Y\}, \text{ for all } e_A
\end{aligned}$$

with updated market belief for any (e_A, e_B) given by

$$(\widehat{\mu}^l(e_A, e_B|AB), \widehat{\mu}^h(e_A, e_B|AB)) = \begin{cases} (1, 1), \text{ for } \{(e_A, e_B) : e_A \leq \widehat{e}_A^1(e_B)\} \\ \left(\frac{r - S_r}{N - S_N}\mu(e_A, e_B) + \frac{N - r - (S_N - S_r)}{N - S_N}, \frac{S_r}{S_N}\mu(e_A, e_B) + \frac{(S_N - S_r)}{S_N}\right), \\ \text{for } \left\{(e_A, e_B) : e_A \in (\widehat{e}_A^t(e_B), \widehat{e}_A^{t+1}(e_B)]\right\} \\ (\mu(e_A, e_B), \mu(e_A, e_B)), \text{ for } \left\{(e_A, e_B) : e_A > \widehat{e}_A^T(e_B)\right\} \end{cases} \quad (20)$$

where $s_r = \max \widehat{s}^t$ and $\widehat{e}_A^T(e_B) = e_A^{N*}(e_B)$.

Proof. See Appendix C. ■

For a given e_B, we divide the experience of author A in three mutually exclusive and exhaustive regions. In the first region, $e_A \leq \widehat{e}_A^1(e_B)$, both authors offer the idea-based norm, for all s_n. In this region once a research project is published in journal Q, the marker updates the prior after observing the name order to $\mu^Q(e_A, e_B|\widehat{\sigma}, AB) = 1$ and $\mu^Q(e_A, e_B|\widehat{\sigma}, BA) = 0$, for $Q = \{l, h\}$. In addition to deciphering the norm, the market is able to figure out which author had the idea. For instance on observing the name order AB, the ex-post gross credit to authors A and B are given as $V^Q\beta$ and $V^Q(1-\beta)$ respectively.

When $e_A > \widehat{e}_A^N(e_B) = e_A^{N*}(e_B)$ both authors choose the lexicographic norm when they respectively have an idea, for all s_n. Unlike the first case the market cannot work out the source of the idea but can completely figure out the norm. The market is unable to update its prior, such that $\mu^Q(e_A, e_B|\widehat{\sigma}, AB) = \mu(e_A, e_B)$. Following equations 2 and 3, the ex post credit for publication in journal Q with name order AB is given as:

$$V^Q\left[(1-\beta) + \mu^Q(e_A, e_B)(2\beta - 1)\right] \tag{21}$$

$$V^Q\left[\beta - \mu^Q(e_A, e_B)(2\beta - 1)\right] \tag{22}$$

for authors A and B respectively. The name order BA occurs on off the equilibrium path with strategies $\widehat{\sigma}$, wherein the market can completely decipher which author had the idea, with $\mu^Q(e_A, e_B|\widehat{\sigma}, BA) = 0$.

In the intermediary zone, like in the high experience zone, the market is able to decipher the norm completely from the observed name order but not the source of the idea. However, now author B with an idea opts for the name order BA for high enough quality. The name order BA is no longer off the equilibrium path. For $m = AB$, the market updates $\mu^Q(e_A, e_B|\widehat{\sigma}, AB) \in (\mu, 1)$ for $Q = \{l, h\}$. Only in this zone author A is assigned a credit higher than the prior for any publication in either journal when the name order AB is observed. The ex-post credit assigned by the market for a name order AB in journal Q, to authors A and B, are respectively given by

$$V^Q\left[(1-\beta) + \mu^Q(e_A, e_B|\widehat{\sigma}, AB)(2\beta - 1)\right] \tag{23}$$

$$V^Q\left[\beta - \mu^Q(e_A, e_B|\widehat{\sigma}, AB)(2\beta - 1)\right]. \tag{24}$$

Next we consider the special case where not only condition C2 holds for all quality s_n, $n = 1, 2, ..N-1$, but additionally the threshold experiences satisfy, $\widehat{e}_A^n(e_B) = \widetilde{e}_A^n(e_B)$, $\forall n$.The cardinality of the set $\widehat{e}(e_B)$ is N and the thresholds $\widehat{e}_A^n(e_B)$ are distinct and increasing in quality.

Corollary 1 *If Condition C2 holds for all s_n, and $e_B \leq \overline{e}^1$, then the Perfect Bayesian Equilibrium is given as in Theorem 3, with $T = N$.*

Finally, suppose condition C2 is violated for all quality s_n, such that, $\widetilde{e}_A^n(e_B) = e_A^{N*}(e_B)$. Since independent of the quality, the threshold level for author B is $e_A^{N*}(e_B)$, the number of partitions is exactly one, with

$$\widehat{s}^1 = \{s_n \in \mathbf{s} : \min_{n \leq t \leq N}\{\widetilde{e}_A^t(e_B)\} = \widehat{e}_A^1(e_B\} = \mathbf{S}$$

For any $e_A \leq e_A^{N*}(e_B)$ authors follow the idea-based norm and for $e_A > e_A^{N*}(e_B)$, they follow the lexicographic norm. The alphabetical bias in favor of author A is no longer present. The Perfect Bayesian equilibrium is as follows.

Theorem 4 *If Condition C2 fails for all quality s_n, then the Perfect Bayesian Equilibrium is given as follows $e_B \leq \overline{e}^1$*[15]*:*

$$\widehat{\sigma}_A(s_n, 1, 0) = \begin{cases} CO, \{I, E_B^{nI}\}, \textit{ for } \left\{(e_A, e_B) : e_A \leq e_A^{N*}(e_B)\right\} \\ CO, \{L, E_B^{nL}\}, \textit{ for } \left\{(e_A, e_B) : e_A > e_A^{N*}(e_B)\right\} \end{cases}$$
$$\widehat{\sigma}_B(s_n, 1, 0) = \{Y\}, \textit{ for all } e_B$$

$$\widehat{\sigma}_B(s_n, 0, 1) = \begin{cases} CO, \{I, E_A^{nI}\}, \text{ for } \left\{(e_A, e_B) : e_A \leq e_A^{N*}(e_B)\right\} \\ CO, \{L, E_A^{nL}\}, \text{ for } \left\{(e_A, e_B) : e_A > e_A^{N*}(e_B)\right\} \end{cases}$$
$$\widehat{\sigma}_A(s_n, 0, 1) = \{Y\}, \text{ for all } e_A$$

with updated market beliefs for any journal $Q = \{l, h\}$, is given by,

$$\mu^Q(e_A, e_B|AB) = \begin{cases} 1 & \text{for } e_A \leq e_A^{N*}(e_B) \\ \mu(e_A, e_B) & \text{for } e_A > e_A^{N*}(e_B) \end{cases}$$
$$\mu^Q(e_A, e_B|BA) = 0.$$

Proof. **Proof.** Follows from the proof of Theorem 1 with threshold experience $e_A^{n*}(e_B) = e_A^{N*}(e_B)$, for all n for a given e_B. ■ ■

For any name order m the market can perfectly decipher the norm for all e_A, as in the observable case. Additionally for $e_A \leq e_A^{N*}$ the market has perfect information as to which author had the idea from the name order. The quality of the idea determines teh effort distribution between the authors but has no effect on the threshold experience level. We find that unobservability of quality leads to an increased prevalence of the idea-based norm for both types of equilibria.

Interestingly, the prevalence of idea-based norm decreases when β increases.

[15] Qualitatively the equilibrium the market updates remain identical for $\overline{e}^I < e_B \leq \overline{e}^N$. For $e_B > \overline{e}^N$, collaboration in the intermediary zone always uses the norm L.

Remark 6 *The threshold experience for quality s_n, $\widehat{e}_A^n(e_B)$, decreases with the experience level e_B and β.*

Proof. See Appendix C. ■

The intuition behind the equilibrium of the unobservable case when condition C2 holds for at least one quality is as follows. Both authors adopt the idea-based norm (provided it is feasible) when author A is early in his career ($e_A \leq \widehat{e}_A^1$) as the market is able to correctly infer both the source of the idea and the norm. Once author A achieves an intermediate level of reputation, both authors switch to the lexicographic norm when the market is unable to infer the norm but is able to update the prior for the name order AB. In this case, the market assigns payoffs $\gamma_n^{UA}, \gamma_n^{UB}$ to authors A, B respectively. We show that author B adopts the lexicographic (idea-based) norm for a shorter (larger) range of experiences than her collaborator. This result is driven on one hand by the fact that author B is able to precisely signal to the market that she was the source of the idea through the name order BA. On the other hand, author A is indifferent between the two norms since both fetch the same gross payoffs. Consequently, he chooses the effort level that ties his collaborator to her outside option, E_B^{nU}, which conforms to her gross payoff γ_n^{UB}. Finally, both authors adopt the lexicographic norm and the effort level identical to the observable case (E_A^{nL}, E_B^{nL}), once author A is late in his career. The structure of our equilibrium is similar to that of (7), where the authors use a (reverse) alphabetical order when the contribution of the early surname author is large (small) and a certified random order for an intermediate range of contributions.

Linear Cost Case. As in the observable cost case, the authors choose the idea-based norm whenever $e_A \leq \overline{e}_A^n(e_B)$ for an idea of quality s_n. However, since the idea-based norm is not feasible beyond experience $\overline{e}_A^n(e_B)$, the threshold experience remains $\widehat{e}_A^n = e_A^{n*} = \overline{e}_A^n(e_B)$. The Perfect Bayesian equilibrium in this case is given by Theorem (3) with $\widehat{e}_A^n = e_A^{n*} = \overline{e}_A^n(e_B)$ and $T = N$.

For a linear cost function, there is no gain from dividing the effort more equitably between the two authors. The author with the idea is thus indifferent between the two norms whenever both are feasible. However, in equilibrium she opts for idea-based norm. Strict convexity of the cost function is therefore essential for authors to opt for lexicographic norm.

5 Symmetric Priors

In this section we assume $\mu(e_A, e_B) = 0.5$. Note, we are not assuming that the authors are necessarily symmetric, but that market a priori assumes that the two authors (with different experiences) have the same probability of getting an idea. Thus, if authors differ in their experiences, it is only reflected in their opportunity cost.

Example: We consider authors A, B with experience e_A and e_B. The market prior is $\mu(e_A, e_B) = 0.5$. We normalize the values of publication in the two journals to $V^h = 2, V^l = 1$ and set $E = 2$. We assume that $\pi(e) = e$ and that either author could come up with an idea of five equally likely qualities, $s_1 = 0.25, s_2 = 0.45, s_3 = 0.5, s_4 = 0.85, s_5 = 0.9$ with the corresponding cost of effort given by the following functions:

$$\begin{aligned} C_1(x) &= \tfrac{x^2}{4}, \, x \in [0, 2] \\ C_{n+1}(x) &= \lambda_n C_n(x), \, n = 1, 2, .., 5 \end{aligned}$$

where $\lambda_1 = 1.127, \lambda_2 = 1.017, \lambda_3 = 1.094, \lambda_4 = 1.013$ and $\beta = 0.8$.

Proof.

Acknowledgement 5 *Since the prior remains constant for all experience tuple, the experience level at which author B of experience e_B is indifferent between the name order BA and name order AB is also independent of e_B. For any experience e_B the pseudo threshold experiences are, $\widetilde{e}^1 = 0.22, \widetilde{e}^2 = 0.25, \widetilde{e}^3 = 0.245, \widetilde{e}^4 = 0.311$ and $\widetilde{e}^5 = 0.284$. Therefore, $\widehat{e}(e_B) = \{e_A^1(e_B), e_A^3(e_B), e_A^5(e_B)\}$ and $\widehat{e}_A^1 = 0.22, \widehat{e}_A^2 = 0.245, \widehat{e}_A^3 = 0.284$. The market partitions the qualities in $T = 3$ subsets, with $\widehat{s}^1 = \{s_1\}, \widehat{s}^2 = \{s_2, s_3\}, \widehat{s}^3 = \{s_4, s_5\}$, such that $e_A^1(e_B) = 0.22$, $e_A^2(e_B) = e_A^3(e_B) = 0.245$, and $e_A^4(e_B) = e_A^5(e_B) = 0.284$. The Perfect Bayesian equilibrium is given below.*

■

$$\begin{aligned} \widehat{\sigma}_A(s_n, 1, 0) &= \begin{cases} CO, \{AB, \ E_B^{nI}\}, \text{ for } \{(e_A, e_B) : e_A \leq \widehat{e}_A^1(e_B)\} \\ CO, \{AB, \ E_B^{nU}\}, \text{ for } \{(e_A, e_B) : \widehat{e}_A^1(e_B) < e_A \leq \widehat{e}_A^3(e_B)\} \\ CO, \{AB, \ E_B^{nL}\}, \text{ for } \{(e_A, e_B) : e_A > \widehat{e}_A^3(e_B)\} \end{cases} \\ \widehat{\sigma}_B(s_n, 1, 0) &= \{Y\}, \text{ for all } e_B \end{aligned}$$

$$\widehat{\sigma}_B(s_n,0,1) = \begin{cases} CO, \{BA,\ E_A^{nI}\}, \text{ for } \{(e_A,e_B) : e_A \leq \widehat{e}_A^1(e_B)\} \\ CO, \{BA,\ E_A^{nI}\}, \text{ for } \{(e_A,e_B) : \widehat{e}_A^1(e_B) < e_A \leq \widehat{e}_A^t(e_B)\}, \ s_n \in \widehat{s}^t \\ CO, \{AB,\ E_A^{nU}\}, \text{ for } \{(e_A,e_B) : \widehat{e}_A^t(e_B) < e_A \leq \widehat{e}_A^3(e_B)\}, \ s_n \in \widehat{s}^t \\ CO, \{AB,\ E_A^{nL}\}, \text{ for } \{(e_A,e_B) : e_A > \widehat{e}_A^3(e_B)\} \end{cases}$$

$$\widehat{\sigma}_A(s_n,0,1) = \{Y\}, \text{ for all } e_A$$

with updated market beliefs

$$(\mu^l(e,e|\widehat{\sigma},AB), \mu^h(e,e|\widehat{\sigma},AB)) = \begin{cases} (1,1) \text{ for } e_A \leq \widehat{e}^1 \\ (0.817, 0.957) \text{ for } \widehat{e}^1 < e_A \leq \widehat{e}^2 \\ (0.561, 0.796) \text{ for } \widehat{e}^2 < e_A \leq \widehat{e}^3 \\ (0.5, 0.5) \text{ for } e_A > \widehat{e}^3 \end{cases}$$

$$(\mu^l(e,e;|\widehat{\sigma},BA), \mu^h(e,e;|\widehat{\sigma},BA)) = 0, \text{ for all } (e_A,e_B)$$

As is evident from the above example, the market assigns higher credit to author A for publications in both outlets for the name order AB for an intermediate range of experiences $e_A \in (0.22, 0.284)$. It also awards a higher credit for publication in journal h vis-a-vis l, even though $\mu = 0.5$.

6 Conclusion

A recurring rationale for the lexicographic norm has been that it is used by collaborators to equalize payoffs. A pertinent question to ask is why this convention has emerged in select disciplines and not others. We argue that equalizing payoffs cannot be the primary reason for the emergence of the lexicographic norm. This norm arises even when the author with the idea makes a take it or leave offer to the author without the idea and pushes her to her outside option. Thus, we have assumed away warm glow effects or any audience effects, whereby the proposer would like to be perceived as fair.

We show that the cost function plays a crucial role for the emergence of the lexicographic norm. The sum of the gross payoffs to the two authors is a constant for each quality, implying that the game is zero-sum for any given norm. However, the sum of the net payoffs is not a constant for the two norms since the cost function is convex for every quality of an idea. Convexity results in an increase in the total payoff with a more equitable distribution of efforts. The most equitable effort distribution with each author putting in effort level of $E/2$ maximizes the total net payoff but not necessarily the net payoff of the author with the idea. Thus, given the participation constraint, the author with the idea chooses the norm that distributes effort more equitably. In this setup, some amount of convexity of the cost function is crucial for the emergence of the lexicographic norm even when the idea-based norm is feasible (i.e. when $e_A \leq \overline{e}^n_A(e_B))$).

Since author B occasionally may choose the idea based norm with name order BA, the market ascribes a higher credit to author A, on observing name order AB. This bias in gross payoff in favour of author A is taken into account at the bargaining stage, wherein the name order and the effort division between are determined between the two authors. A higher gross payoff will be balanced by a higher effort to equalize net payoff subject to feasibility.

Our analysis offers a different take on the prominence authors with earlier surnames enjoy following an alphabetical ordering. Ong et al. ((5)) attribute such advantages to the conjecture that high-ability authors with earlier surnames can collaborate with the largest set of incentive-compatible coauthors. In contrast, we contend that the market, and more specifically promotion committees, assign more credit to author A due to her inability to differentiate a name order AB to be an outcome of an idea based norm from the lexicographic norm. The empirical literature fails to account for the differences in the effort levels that the authors put in to mitigate the bias in favour of author A. Therefore, these papers may have overemphasized the bias in favour of author A. Moreover, these papers do not account for the unsuccessful collaborations between a low experienced author A, and a high experienced author B.

7 References

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A Appendix A

We first show two properties of a convex function. For any real valued function $C : [a, b] \to \mathbb{R}$, we define a new real valued function $\tau : [0, \frac{a+b}{2}] \to \mathbb{R}$

$$\tau(x) = C\left(\frac{a+b}{2} + x\right) + C\left(\frac{a+b}{2} - x\right).$$

Notice, τ is continuous on on $[0, \frac{a+b}{2}]$ and differentiable on $(0, \frac{a+b}{2})$.
Proof.

Lemma 8 *If $C(\cdot)$ is strictly increasing and strictly convex, then $\tau(x)$ is strictly increasing for all $x \in [0, \frac{a+b}{2}]$.*

Proof. The function $\tau(\cdot)$ is given by,

$$\tau(x) = C\left(\frac{a+b}{2} + x\right) + C\left(\frac{a+b}{2} - x\right).$$

Thus, for all $x \in (0, \frac{a+b}{2})$,

$$\tau'(x) = C'(\frac{a+b}{2} + x) - C'(\frac{a+b}{2} - x) > 0$$

since C' is positive and strictly increasing. Next consider any two distinct points $x, y \ni 0 \leq x < y \leq \frac{a+b}{2}$. From the Mean Value Theorem $\exists z \in (x, y)$ such that,

$$\frac{\tau(y) - \tau(x)}{y - x} = \tau'(z) > 0$$

implying $\tau(y) > \tau(x)$ for all $y > x$. ■

Lemma 9 *If $C(\cdot)$ is strictly increasing and strictly convex, then $\tau(\cdot)$ achieves the minimum at $x = 0$.*

Proof. The function τ is continuous on $[0, \frac{a+b}{2}]$. Therefore, from Weierstrass Theorem τ achieves a maxima and a minima on $[0, \frac{a+b}{2}]$. From the previous Lemma τ is strictly increasing on $[0, \frac{a+b}{2}]$, thus it achieves a minima at $x = 0$. ■

Finally, substituting $a = 0$ and $b = E$, we conclude that if the total effort E, is split up into $\frac{E}{2} + x$ and $\frac{E}{2} - x$, with $x \in \left[0, \frac{E}{2}\right]$ then the total cost of effort $C(\frac{E}{2} + x) + C(\frac{E}{2} - x)$ is minimized at $\frac{E}{2}$. ■

B Appendix B

Lemma 1.
Proof. (i) If $\Delta^n(e_A, e_B) \geq 0$, from (9) we conclude condition (11)

$$C_n(E_A^{nL}) + C_n(E - E_A^{nL}) \geq C_n(E - E_A^{nI}) - C_n(E - E_A^{nL})$$

since $E_A^{nI} \leq E_A^{nL}$ by definition, the above condition show that the effort level of the idea-based norm is more equitable with,

$$E - E_A^{nL} \leq E_A^{nI} \leq \frac{E}{2} \leq E - E_A^{nI} \leq E_A^{nL} \tag{25}$$

from Lemma (8). Replacing E_A^{nL} by $E - E_A^{nI}$ in the condition (9) we conclude that

$$\begin{aligned} 0 &= (2\beta - 1)\mu(e_A, e_B)V_n - \left[C_n(E_A^{nL}) - C_n(E_A^{nI})\right] \\ &\leq (2\beta - 1)\mu(e_A, e_B)V_n - [C_n(E - E_A^{nI}) - C_n(E_A^{nI})] \\ &= f^n(e_A e_B) \end{aligned}$$

(ii) If $f^n(e_A, e_B) \geq 0$, from (9) $E - E_A^{nI} \leq E_A^{nL}$. Also, we know $E_A^{nI} \leq E_A^{nL}$. From these two inequalities we conclude that,

$$E - E_A^{nL} < \min\{E_A^{nI}, E - E_A^{nI}, \tfrac{E}{2}\} < E_A^{nL}$$

Therefore, by substituting the participation constraint in $\Delta^n(e_A, e_B)$ we have:

$$\begin{aligned} \Delta^n(e_A, e_B) &= (2\beta - 1)\mu(e_A, e_B)V_n - [C_n(E - E_A^{nI}) - C_n(E - E_A^{nL})] \\ &\leq (2\beta - 1)\mu(e_A, e_B)V_n - [C_n(E - E_A^{nI}) - C_n(E_A^{nI})] \\ &= f^n(e_A, e_B) \geq 0 \end{aligned}$$

The last inequality follows from Lemma (8). ■

Proof of Lemma 2. We first consider the condition $(1 - \beta)V_n - C_n(E_A^{nI}) = \pi(e_A)$. For a given V_n, the total derivative is given by:

$$\begin{aligned} &-V_n d\beta - C_n'(E_A^{nI})dE_A^{nI} - \pi'(e_A)de_A = 0 \\ \Rightarrow\ &\frac{dE_A^{nI}}{de_A} = -\frac{\pi'(e_A)}{C_n'(E_A^{nI})}, \qquad \frac{dE_A^{nI}}{d\beta} = -\frac{V_n}{C_n'(E_A^{nI})} \end{aligned} \tag{26}$$

The partial derivative of $f^n(e_A, e_B)$ with respect to e_A is given by:

$$\begin{aligned} f_1^n(e_A, e_B) &= (2\beta - 1)\mu_1(e_A, e_B)V_n + [C_n'(E - E_A^{nI}) + C_n'(E_A^{nI})]\frac{dE_A^{nI}}{de_A} \\ &= (2\beta - 1)\mu_1(e_A, e_B)V_n - [C_n'(E - E_A^{nI}) + C_n'(E_A^{nI})]\frac{\pi'(e_A)}{C_n'(E_A^{nI})} \end{aligned}$$

from condition 26. Thus, it is not necessarily monotonic. The function $f^n(e_A e_B)$ is strictly concave since,

$$\begin{aligned} f^{n\prime\prime}(e_A^n e_B) &= (2\beta - 1)\mu_{11}(e_A, e_B)V_n - \left(\frac{C_n'(E - E_A^{nI})}{C_n'(E_A^{nI})} + 1\right)\pi''(e_A) \\ &\quad -\frac{C_n'(E_A^{nI})C_n''(E - E_A^{nI}) + C_n''(E_A^{nI})C_n'(E - E_A^{nI})}{\left(C_n'(E_A^{nI})\right)^2}\left(\frac{\pi'(e_A)}{C_n'(E_A^{nI})}\right)\pi'(e_A) \\ &< 0. \end{aligned}$$

Proof of Lemma 3

Proof. The partial derivative of $f^n(e_A, e_B)$ with respect to e_B is given by:

$$f_2^n(e_A, e_B) = (2\beta - 1)\mu_2(e_A, e_B)V_n < 0$$

The partial derivative of $f^n(e_A, e_B)$ with respect to β is given by:

$$\begin{aligned} f_3^n(e_A, e_B) &= 2\mu(e_A, e_B)V_n - [C_n'(E - E_A^{nI}) + C_n'(E_A^{nI})]\frac{dE_A^{nI}}{d\beta} \\ &= V_n\left[2\mu(e_A, e_B) - \frac{[C_n'(E - E_A^{nI}) + C_n'(E_A^{nI})]}{C_n'(E_A^{nI})}\right] \end{aligned}$$

from condition 26. The above expression is nonpositive for $e_A \in [\underline{e}_A^n(e_B), \overline{e}_A^n(e_B)]$ where in $E_A^{nI} \leq \frac{E}{2}$. ■

Proof of Proposition 1

Proof. From condition C1 we conclude $f^n(\overline{e}_A^n(e_B), e_B) < 0$. The function f^n is continuous with $f^n(\underline{e}_A^n(e_B), e_B) > 0$ and $f^n(\overline{e}_A^n(e_B), e_B) < 0$. From the intermediate value theorem there exists at least an experience $e_A \in (0, \overline{e}_A^n(e_B), e_B)$, such that $f^n(e_A^{n*}, e_B) = 0$. For any such an experience level e_A^{n*}, since $f^n(\cdot, \cdot)$ is strictly concave, it satisfies the following condition

$$\begin{aligned} f^n(\underline{e}_A^n(e_B), e_B) - f^n(e_A^{n*}, e_B) &< f^{n\prime}(e_A^n, e_B)(\underline{e}_A^n(e_B) - e_A^{n*}) \\ \Leftrightarrow f^n(\underline{e}_A^n(e_B), e_B) - 0 &< -f^{n\prime}(e_A^{n*})(\underline{e}_A^n(e_B) - e^{n*}(e_B)) \\ \Leftrightarrow f^{n\prime}(e_A^{n*}, e_B) &< 0. \end{aligned} \tag{27}$$

For $e_A \in [e_A^{n*}, \overline{e}_A^n(e_B)]$, we have,

$$\begin{aligned} f^n(e_A, e_B) - f^n(e_A^{n*}, e_B) < f^{n\prime}(e_A^{n*}, e_B)(e_A - e_A^{n*}) < 0 \\ \Rightarrow f^n(e_A, e_B) < 0 \Rightarrow \Delta^n(e_A, e_B) < 0 \end{aligned} \tag{28}$$

thus the lexicographic norm is opted.
Both $f^n(e_A, e_B), \Delta^n(e_A, e_B) \geq 0$ for $e_A \in [0, e_A^{n*}]$ and $f^n(e_A, e_B), \Delta^n(e_A, e_B) < 0$ for $e_A \in (e_A^{n*}, \overline{e}_A^n(e_B)]$. ■

Proof of Proposition 2

Proof. Next we will show that $f^n(e_A, e_B) \geq 0$ in the subset $[0, \overline{e}_A^n(e_B)]$[16]. We proceed by contradiction. Suppose there exist a subset $(a, b) \subset [0, \overline{e}_A^n(e_B)]$ such that $f^n(e_A, e_B) < 0$, for $e_A \in (a, b)$. Since, $f^n(0, e_B) > 0$ and $f^n(a) < 0$, by the intermediary value theorem there exist an experience $x \in [0, a]$, such that $f^n(x, e_B) = 0$. From (27) we deduce $f^{n\prime}(x, e_B) < 0$. Now we consider two mutually exclusive and exhaustive cases:

(a) Suppose $f^n(\overline{e}_A^n(e_B), e_B) > 0$. Therefore, $f^n(e_A, e_B) > 0$ for $e_A \in B_\epsilon(\overline{e}_A^n(e_B)) \cap [0, \overline{e}_A^n(e_B)]$ where $B_\epsilon(\overline{e}_A^n(e_B))$ is a open neighborhood around $\overline{e}_A^n(e_B)$. Since $f^n(x, e_B) = 0$, with $f^{n\prime}(x, e_B) < 0$, as in condition (28) we conclude that $f^n(e_A, e_B) < 0$, for $e_A \in (x, \overline{e}_A^n(e_B))$, which contradicts $f^n(e_A) > 0$, for $e_A \in B_\epsilon(\overline{e}_A^n(e_B)) \cap [0, \overline{e}_A^n(e_B)]$.

(b) Suppose $f^n(\overline{e}_A^n(e_B), e_B) = 0$. Since $f^n(x, e_B) = 0$, by Rolle's theorem there exist $y \in (x, \overline{e}_A^n(e_B))$ such that $f^{n\prime}(y, e_B) = 0$. From concavity of the function f, we find

$$\begin{aligned} \left(f^{n\prime}(y, e_B) - f^{n\prime}(x, e_B)\right)(y - x) < 0 \\ f^{n\prime}(y, e_B) < f^{n\prime}(x, e_B) < 0 \end{aligned}$$

since $y > x$ and $f^{n\prime}(x, e_B) < 0$. Which contradicts $f^{n\prime}(y, e_B) = 0$.

Therefore for both cases (a) and (b) there cannot exist $(a, b) \subset [0, \overline{e}_A^n(e_B)]$ such that $f^n(e_A, e_B) < 0$, for $e_A \in (a, b)$. Hence, $f^n(e_A, e_B) \geq 0$ implying that $\Delta^n(e_A, e_B) > 0$, for $e_A \in [0, \overline{e}_A^n(e_B)]$, whereby $e_A^{n*} = \overline{e}_A^n(e_B)$ with $f^n(e_A^{n*}, e_B) \geq 0$. ■

Proof of Remark 1

Proof. From equations

$$(2\beta - 1)\mu(e_A^{n*}(e_B), e_B)V_n - [C_n(E - E_A^{n*}) - C_n(E_A^{n*})] = 0 \tag{29}$$

$$(1 - \beta)V_n - C_n(E_A^{n*}) = \pi(e_A^{n*}(e_B)) \tag{30}$$

[16] As in the proof of Proposition 1 the interval $[0, \overline{e}_A^n(e_B)]$ can be replaced by $[\underline{e}_A^n(e_B), \overline{e}_A^n(e_B)]$. In the interval $[0, \underline{e}_A^n(e_B)]$, norm I is trivially preferred.

we get,

$$V_n(2\beta-1)\left[\mu_1(e_A^*, e_B)\frac{de_A^{n*}}{de_B} + \mu_2(e_A^{n*}, e_B)\right] = -\left(C_n'(E-E_A^{n*}) + C_n'(E_A^{n*})\right)\frac{dE_A^{n*}}{de_A^{n*}}\frac{de_A^{n*}}{de_B}$$

Substituting $\frac{dE_A^{n*}}{de_A^{n*}} = -\frac{\pi'(e_A^{n*})}{C_n'(E_A^{n*})}$,

$$\frac{de_A^{n*}}{de_B} = \frac{\mu_2(e_A^{n*}, e_B)V_n(2\beta-1)C_n'(E_A^{n*})}{\left(C_n'(E-E_A^{n*}) + C_n'(E_A^{n*})\right)\pi'(e_A^{n*}) - V_n(2\beta-1)\mu_1(e_A^{n*}, e_B)C_n'(E_A^{n*})} < 0 \tag{31}$$

The denominator is positive since $f^{n\prime}(e_A^{n*}) < 0$. ■

Proof of Theorem 1

Proof. Given the strategies of the authors the updated market belief is based on Baye's rule. The author without the idea is always indifferent between accepting and rejecting the equilibrium offer of the author with the idea. Given the market beliefs there is no gainful deviation for the author without the idea. ■

Next we consider unilateral profitable deviation for the author with the idea. Given the market belief, for either norm if the author with the idea i deviates from her equilibrium offer and proposes an effort level E_{-i}^{nd}, such that $E_{-i}^{nd} < E_{-i}^{nk}$, for any norm k, the participation constraint of j is not binding and $i's$ payoff drops by

$$C_n(E - E_{-i}^{nd}) - C_n(E - E_{-i}^{nk}) > 0$$

for $i = \{A, B\}$. If however author i proposes an effort level $E_{-i}^{nd} > E_{-i}^{nk}$, such that the participation of author $-i$ is violated, and she will refuse the offer. In this case, author i get's her outside option, which is weakly lower than her net expected payoff from a collaboration. Consequently, author i with the idea will not deviate and propose an effort to author j with an effort different from E_j^{nk}.

Proof. We now rule out deviations to the proposed norm for the author with the idea. We consider two mutually exhaustive and exclusive cases.

(i) $e_A \leq e_A^{n*}(e_B)$. With equilibrium strategy, both authors offer $\{I, E_{-i}^{nI}\}$when they respectively have an idea of quality s_n, $i = \{A, B\}$.

Suppose author A with the idea unilaterally deviates and offers the $\{L, E_B^{nL}\}$ to author B. Since, the name order chosen by author A remains to be AB, the market cannot observe this deviation and hence the updated belief for name order AB remain unchanged to $\mu^n(e_A, e_B|\sigma^*, AB) = 1$. Therefore, author A can propose the effort E_B^{nL}, such that $(1-\beta)V_n - C_n(E_B^{nL}) \geq \pi(e_B)$. Therefore, E_B^{nL} must satisfy

$$(1-\beta)V_n - C_n(E_B^{nL}) = \pi(e_B) = (1-\beta)V_n - C_n(E_B^{nI}) \Rightarrow E_B^{nL} = E_B^{nI}$$

such that the deviation is not profitable.

Now suppose author B has the idea. She unilaterally deviates and offers the lexicographic norm with the effort E_A^{nL}. The market however cannot observe this deviation and hence the updated beliefs do not change. For a name order AB, the market ascribes the credit for the idea to author A. To rule out a profitable deviation, we require

$$\beta V_n - C_n(E - E_A^{nI}) \geq (1-\beta)V_n - C_n(E - E_A^{nL}) \Rightarrow \Delta^n(e_A, e_B) \geq 0 \Rightarrow f^n \geq 0$$

which holds since $e_A \leq e_A^{n*}(e_B)$.

(ii) If $e_A > e_A^{n*}(e_B)$. For an idea of quality s_n, author i offers $\{L, E_{-i}^{nL}\}$ to the author without the idea under the equilibrium strategy, $i = \{A, B\}$.

Suppose author A has the idea and she unilaterally deviates to offer $\{I, E_B^{nI}\}$. Since the name order remains AB, the market cannot observe this move and therefore market beliefs remain $\mu^n(e_A, e_B|\sigma^*, AB) = \mu(e_A, e_B)$. Once again, we must have $\gamma_n^{LB} - C_n(E_B^{nI}) \geq \pi(e_B)$ for the proposal $\{E_B^{nI}, I\}$ to be accepted. Therefore, E_B^{nI} must satisfy

$$\gamma_n^{LB} - C_n(E_B^{nI}) = \pi(e_B) = \gamma_n^{LB} - C_n(E_B^{nL}) \Rightarrow E_B^{nL} = E_B^{nI}.$$

There is no profitable deviation for author A since

$$\gamma_n^{LA} - C_n(E - E_B^{nI}) = \gamma_n^{LA} - C_n(E - E_B^{nL}).$$

Now assume author B has the idea. If she deviates and offers $\{I, E_A^{nI}\}$, the market will update the belief to $\mu^n(e_A, e_B; |\sigma^*, BA) = 0$. Author A will accept the offer as her participation constraint is satisfied, such that B will get $\beta V_n - C_n(E - E_A^{nI})$. For a profitable deviation, we require

$$\begin{aligned} \beta V_n - C_n(E - E_A^{nI}) &> \gamma_n^{LB} - C_n(E - E_A^{nL}) \\ &\Rightarrow (2\beta - 1)\mu(e_A, e_B)V_n > C_n(E - E_A^{nI}) - C_n(E - E_A^{nL}) \end{aligned}$$

which is a contradiction to $\Delta(e_A, e_B) < 0$. ■

Proof of Theorem 2

Proof. The proof follows from Theorem 1, except for the case when author A has an idea of quality s_n. According to the equilibrium stratefy there is no collaboration when author A has an idea of quality s_n. Since whenever norm L is not feasible with author B having the idea, it implies the following inequlity

$$E - E_A^{nL} < \{E - E_A^{nI}, E/2, E_A^{nI}\} < E_A^{nL}.$$

Moreover, the participation constraint of author B is violated. Now if author A has the idea, from the participation constraint of author B we conclude for norm L, her effort will be even lower then her corresponding effort when she had the idea, $E_B^{nL} < E - E_A^{nL}$, making the effort distribution more skewed. Consequently, norm L is not feasible. Recall, with norm I, author $B's$ effort will satisfy, $E_B^{nI} < E_B^{nL} < E - E_A^{nL}$, and is even more skewed, therefore not feasible. ■

Proof of Remark 4

Proof. Consider quality s_p. Following (29) and (30),

$$C_p(E - E_A^{p*}) - C_p(E_A^{p*}) = V_p(2\beta - 1)\mu(e_A^{p*}, e_B) \tag{32}$$

and

$$(1 - \beta)V_p - C(E_A^{p*}) = \pi(e_A^{p*}).$$

Multiplying both sides of (32) by λ_p, we get

$$C_{p+1}(E - E_A^{p*}) - C_{p+1}(E_A^{p*}) = \lambda_p V_p(2\beta - 1)\mu(e_A^{p*}, e_B) < V_{p+1}(2\beta - 1)\mu(e_A^{p*}, e_B)$$

where the inequality follows from $\lambda_p < \frac{V_{p+1}}{V_p}$. $\therefore$ at (e_A^{p*}, E_A^{p*}), author B strictly prefers the idea-based norm for s_{p+1}. Since $f'(e_A^{p*}) < 0\ \forall p$, the threshold level for quality s_{p+1} must satisfy, $e_A^{p+1*}(e_B) > e_A^{p*}(e_B)$. ■

Proof of Remark 5

Proof. Totally differentiating equations (29) and (30):

$$-\left(C_n'(E - E_A^{n*}) + C_n'(E_A^{n*})\right) dE_A^{n*} - V_n(2\beta - 1)\mu_1(e_A^{n*}, e_B)de_A^{n*} - 2V_s\mu(e_A^{n*}, e_B)d\beta = 0$$
$$-C_n'(E_A^{n*})dE_A^{n*} - \pi'(e_A^{n*})de_A^{n*} - V_n d\beta = 0$$

Thus,

$$-\left(C_n'(E - E_A^{n*}) + C_n'(E_A^{n*})\right) \frac{dE_A^{n*}}{d\beta} - V_n(2\beta - 1)\mu_1(e_A^{n*}, e_B)\frac{de_A^{n*}}{d\beta} = 2V_n\mu(e_A^{n*}, e_B)$$
$$C_n'(E_A^{n*})\frac{dE_A^{n*}}{d\beta} + \pi'(e_A^{n*})\frac{de_A^{n*}}{d\beta} = -V_n$$

Cramer's rule gives us

$$\frac{dE_A^{n*}}{d\beta} = -\frac{2V_n\mu(e_A^{n*}, e_B)\pi'(e_A^{n*}) - V_n(2\beta-1)\mu_1(e_A^{n*}, e_B)V_n}{(C_n'(E-E_A^{n*}) + C_n'(E_A^{n*}))\,\pi'(e_A^{n*}) - V_n(2\beta-1)\mu_1(e_A^{n*}, e_B)C_n'(E_A^{n*})}$$

$$\frac{de_A^{n*}}{d\beta} = -\frac{V_n\left[(C_n'(E-E_A^{n*}) + C_n'(E_A^{n*})) - 2\mu(e_A^{n*}, e_B)C_n'(E_A^{n*})\right]}{(C_n'(E-E_A^{n*}) + C_n'(E_A^{n*}))\,\pi'(e_A^{n*}) - V_n(2\beta-1)\mu_1(e_A^{n*}, e_B)C_n'(E_A^{n*})} < 0$$

since the cost function is strictly convex and $f^{n\prime}(e_A^{n*}) < 0$, which implies

$$(C_n'(E-E_A^{n*}) + C_n'(E_A^{n*}))\,\frac{\pi'(e_A^{n*})}{C_n'(E_A^{n*})} > V_n(2\beta-1)\mu_1(e_A^{n*}, e_B).$$

■

C Appendix C

Proof. Lemma 4

Suppse author A of experience $e_A \in (e_A^{1*}(e_B), e_A^{n*}(e_B)]$ has an idea of quality s_n. In accordance with the strategy σ^*, with author B of experience e_B, she proposes $\{I, E_B^{nI}\}$. However, the market updates for any publication with name order AB is given as $\mu^l(e_A, e_B, \sigma^*|AB), \mu^h(e_A, e_B, \sigma^*|AB) < 1$, which gives an expected payoff of

$$\begin{aligned} & (1-s_n)V^l\left[\beta(1-\mu^l(e_A,e_B,\sigma^*|AB)) + (1-\beta)\mu^l(e_A,e_B,\sigma^*|AB))\right] \\ & s_nV^h\left[\beta(1-\mu^h(e_A,e_B,\sigma^*|AB)) + (1-\beta)\mu^h(e_A,e_B,\sigma^*|AB))\right] - C_n(E_B^{nI}) \\ > \; & (1-\beta)V_n - C_n(E_B^{nI}) = \pi(e_B) \end{aligned}$$

to author B. Thus, author A can increase her own expected payoff by increasing the effort offered to author B such that the above inequality holds. Her payoff increases the most if the above inequlity holds with equality. Thus, the proposal $\{I, E_B^{nI}\}$ is not an equilibrium.

Parallely, if author A of experience $e_A \in (e_A^{n*}(e_B), e_A^{N*}(e_B)]$ has an idea of quality s_n. In accordance with the strategy σ^*, with author B of experience e_B, she proposes $\{L, E_B^{nL}\}$. However, the market updates for any publication with name order AB is given as $\mu^l(e_A, e_B, \sigma^*|AB), \mu^h(e_A, e_B, \sigma^*|AB) > \mu^h(e_A, e_B)$, which gives an expected payoff of

$$\begin{aligned} & (1-s_n)V^l\left[\beta(1-\mu^l(e_A,e_B,\sigma^*|AB)) + (1-\beta)\mu^l(e_A,e_B,\sigma^*|AB))\right] \\ & s_nV^h\left[\beta(1-\mu^h(e_A,e_B,\sigma^*|AB)) + (1-\beta)\mu^h(e_A,e_B,\sigma^*|AB))\right] - C_n(E_B^{nI}) \\ < \; & (1-s_n)V^l\beta(1-\mu(e_A,e_B) + s_nV^h\beta(1-\mu(e_A,e_B,) - C_n(E_B^{nI}) = \pi(e_B) \end{aligned}$$

Thus, author B refuses the proposal, and both authors get their outside option. However, author A can deviate and offer $\{L, E_B^{nd}\}$, where E_B^{nd} is a lower effort that satisfies the above condition. ■

Proof. Lemma 5 ■

The posteriors $\widetilde{\mu}^l(e_A, e_B|AB)$, $\widetilde{\mu}^h(e_A, e_B|AB)$ are a convex combination between $\mu(e_A, e_B)$ and 1. Since, $\mu(e_A, e_B) \leq 1$, we have

$$\mu(e_A, e_B) \leq \widetilde{\mu}^l(e_A, e_B|AB), \widetilde{\mu}^h(e_A, e_B|AB) \leq 1$$

with strict inequality for $\mu(e_A, e_B) < 1$. The weights on $\mu(e_A, e_B)$ for $\widetilde{\mu}^l(e_A, e_B|AB)$ is higher than $\widetilde{\mu}^h(e_A, e_B|AB)$ for each interval since

$$\frac{n - S_n}{N - S_N} > \frac{S_n}{S_N} \Leftrightarrow \frac{S_N}{N} > \frac{S_n}{n}$$

since the quality of an idea s_n is increasing in n. Therefore,

$$\mu(e_A, e_B) \leq \widetilde{\mu}^l(e_A, e_B|AB) \leq \widetilde{\mu}^h(e_A, e_B|AB) \leq 1.$$

Since, both $\widetilde{\mu}^l(e_A, e_B|AB)$ and $\widetilde{\mu}^h(e_A, e_B|AB)$ are positive affine transformations of $\mu(e_A, e_B)$, and thus retain being increasing and concave in e_A and decreasing and convex in e_B.

Proof. ■

Proof. Lemma 7

At each $\widehat{e}_A^t(e_B)$, the right hand limit of $\widehat{\mu}^l(e_A, e_B|AB) < \widehat{\mu}^h(e_A, e_B|AB)$ is given by,

$$\begin{aligned}\lim_{e_A \to \widehat{e}_A^t(e_B)^+} \widehat{\mu}^l(e_A, e_B|AB) &= \frac{n - S_n}{N - S_N}\mu(e_A, e_B) + 1 - \frac{n - S_n}{N - S_N} \\ &< \frac{n - 1 - S_{n-1}}{N - S_N}\mu(e_A, e_B) + 1 - \frac{n - 1 - S_{n-1}}{N - S_N} \\ &= \widehat{\mu}^l(\widehat{e}_A^t(e_B), e_B|AB).\end{aligned}$$

The inequality follows from $\frac{n-1-S_{n-1}}{N-S_N} < \frac{n-1-S_{n-1}+(1-s_n)}{N-S_N} = \frac{n-S_{n-1}+s_n}{N-S_N} = \frac{n-S_n}{N-S_N}$. Thus, $\mu^l(e_A, e_B|AB)$ is discontinuous at each $\widehat{e}_A^t(e_B)$, with a downward jump for all $t = 1, 2, ..T - 1$. Similarly, the right hand limit of $\mu^h(e_A, e_B|AB)$

is given by,

$$\begin{aligned}\lim_{e_A \to \widehat{e}_A^t(e_B)^+} \widehat{\mu}^h(e_A, e_B|AB) &= \frac{S_n}{S_N}\mu(e_A, e_B) + 1 - \frac{S_n}{S_N} \\ &< \frac{S_{n-1}}{S_N}\mu(e_A, e_B) + 1 - \frac{S_{n-1}}{S_N} \\ &= \widehat{\mu}^h(\widehat{e}_A^t(e_B), e_B|AB).\end{aligned}$$

The inequality follows from $\frac{S_{n-1}}{S_N} < \frac{S_{n-1}+s_n}{S_N} = \frac{S_n}{S_N}$. Similarly, it can be shown that

$$\begin{aligned}\lim_{e_A \to \widehat{e}_A^t(e_B)^+} \widehat{\mu}^l(e_A, e_B|AB) &< \widehat{\mu}^l(\widehat{e}_A^t(e_B), e_B|AB) \\ \lim_{e_A \to \widehat{e}_A^t(e_B)^+} \widehat{\mu}^h(e_A, e_B|AB) &< \widehat{\mu}^h(\widehat{e}_A^t(e_B), e_B|AB).\end{aligned}$$

■

Proof. Proof of Lemma (6)

Suppose with market belief $\widetilde{\mu}^Q(e_A, e_B, n|AB)$, $Q = \{L, H\}$, author B with an idea of quality s_n prefers the name order AB, thereby,

$$\begin{aligned}&(2\beta - 1)[(1 - s_n)\widetilde{\mu}^l(e_A, e_B|AB)V^l + s_n^h\widetilde{\mu}(e_A, e_B|AB)V^h] \\ \leq\ & C_n(E - E_A^{nI}) - C_n(E_A^{nI}).\end{aligned} \tag{33}$$

Further, note, $V_n > \lambda_{n-1}V_{n-1}$ implies that

$$s_n > \lambda_{n-1}s_{n-1}.$$

Now consider the expression,

$$\begin{aligned}C_{n-1}(E - E_A^{n-1I}) - C_{n-1}(E_A^{n-1I}) &= \frac{1}{\lambda_{n-1}}\left[C_n(E - E_A^{n-1I}) - C_n(E_A^{n-1I})\right] \\ &> \frac{1}{\lambda_{n-1}}\left[C_n(E - E_A^{nI}) - C_n(E_A^{nI})\right]\end{aligned} \tag{34}$$

since $C_n(\cdot) = \lambda_{n-1} C_n(\cdot)$ and $E_A^{n-1I} < E_A^{nI}$. And the expression,

$$\begin{aligned}
& (1-s_{n-1})\widetilde{\mu}^l(e_A, e_B|AB)V^l + s_{n-1}\widetilde{\mu}^h(e_A, e_B|AB)V^h \\
= \;& \widetilde{\mu}^l(e_A, e_B|AB)\left((1-s_{n-1})V^l + s_{n-1}\frac{\widetilde{\mu}^h(e_A, e_B|AB)}{\widetilde{\mu}^l(e_A, e_B|AB)}V^h\right) \\
= \;& \widetilde{\mu}^l(e_A, e_B|AB)\left(V_{n-1} + s_{n-1}\frac{\widetilde{\mu}^h(e_A, e_B|AB) - \widetilde{\mu}^l(e_A, e_B|AB)}{\widetilde{\mu}^l(e_A, e_B|AB)}V^h\right) \\
< \;& \frac{1}{\lambda_{n-1}}\widetilde{\mu}^l(e_A, e_B|AB)\left(V_n + s_n\frac{\widetilde{\mu}^h(e_A, e_B|AB) - \widetilde{\mu}^l(e_A, e_B|AB)}{\widetilde{\mu}^l(e_A, e_B|AB)}V^h\right) \\
= \;& \frac{1}{\lambda_{n-1}}\left[(1-s_n)\widetilde{\mu}^l(e_A, e_B|AB)V^l + s_n^h\widetilde{\mu}(e_A, e_B|AB)V^h\right] \qquad (35)
\end{aligned}$$

The inequality follows from $V_n > \lambda_{n-1}V_{n-1}$ and $s_n > \lambda_{n-1}s_{n-1}$. Substituting inequalities (34) and (35), in (33) we conclude that,

$$(2\beta - 1)[(1-s_{n-1})\widetilde{\mu}^l(e_A, e_B|AB)V^l + s_{n-1}^h\widetilde{\mu}(e_A, e_B|AB)V^h] < C_{n-1}(E - E_A^{n-1I}) - C_{n-1}(E_A^{n-1I}).$$

Hence, author B of experience e_B opts for the name order AB for an idea of quality s_{n-1}, with market updates $\mu^Q(e_A, e_B|AB)$, $Q = \{l, h\}$ with author A of experience e_A. Iteratively the arguments holds for qualities $s_{n-2}, s_{n-3}, ..., s_1$.

Proof. Similarly the proof follows for the alternative case. ■

Proof of Theorem 3. Given the strategies of the authors the updated market belief is based on Baye's rule.

For a given experiences the author without the idea is always indifferent between accepting and rejecting the equilibrium offer of the author with the idea. Given the market beliefs there is no gainful deviation for the author without the idea.

Given any experience level e_B of author B, for $e_A \leq \widehat{e}_A^1(e_B)$, analogous to case (i) of Theorem 1 we can show that for any quality s_n, neither author has a gainful deviation when she has the the idea, $n = 1, 2, ..N$. Similarly for any experience level e_B of author B, for $e_A > \widehat{e}_A^N(e_B)$, analogous to case (ii) of Theorem 1 we can show that for any quality s_n, neither author has a gainful deviation when she has the the idea, $n = 1, 2, ..N$.

Now we consider the experiences level of author A in the intermediary range, $e_A \in (\widehat{e}_A^1(e_B), \widehat{e}_A^N(e_B)]$. Suppose author A has an idea of quality s_n. He can either deviate to the idea-based norm or the lexicographic norm. For all three norms the name order is AB, and thus market updates do not change, which further implies the gross payoff for the two authors remain unaltered. As in Theorem 1, there is no profitable deviation for author A.

Let author B have an idea of quality s_n. If $e_A \leq \widehat{e}_A^t(e_B)$, following strategy $\widehat{\sigma}_B(s_n, 0, 1)$, she offers the idea-based norm to author A. By definition for all such e_A ,

$$\begin{aligned} & C_n(E - E_A^{nI}) - C_n(E_A^{nI}) \\ \leq \ & (2\beta - 1)\left((1 - s_n)\widetilde{\mu}^l(e_A, e_B, |AB)V^l + s_n\widetilde{\mu}^h(e_A, e_B, |AB)V^h\right) \\ < \ & (2\beta - 1)\left((1 - s_n)\widehat{\mu}^l(e_A, e_B, |AB)V^l + s_n\widehat{\mu}^h(e_A, e_B, |AB)V^h\right) \end{aligned}$$

Consequently her net payoff will reduce with the updated lexicographic norm.

If $e_A > \widehat{e}_A^t(e_B)$, following strategy $\widehat{\sigma}_B(s_n, 0, 1)$, she offers the updated lexicographic norm to author A. By definition for all such e_A,

$$\begin{aligned} & C_n(E - E_A^{nI}) - C_n(E_A^{nI}) \\ > \ & (2\beta - 1)\left((1 - s_n)\widetilde{\mu}^l(e_A, e_B, |AB)V^l + s_n\widetilde{\mu}^h(e_A, e_B, |AB)V^h\right) \\ \geq \ & (2\beta - 1)\left((1 - s_n)\widehat{\mu}^l(e_A, e_B, |AB)V^l + s_n\widehat{\mu}^h(e_A, e_B, |AB)V^h\right). \end{aligned}$$

Resulting in a reduction in net payoff from offering the idea-based norm. ■

Proof of Remark 6. For simplicity we denote the updated exante gross payoff to author A with name order AB as,

$$V_n^{AU} = (1 - s_n)\widehat{\mu}^l(\widehat{e}_A^n, e_B|AB)V^l + s_n\widehat{\mu}^h(\widehat{e}_A^n, e_B|AB)V^h$$

with partial derivatives,

$$\begin{aligned} V_{n1}^{AU} &= (1 - s_n)\widehat{\mu}_1^l(\widehat{e}_A^n, e_B|AB)V^l + s_n\widehat{\mu}_1^h(\widehat{e}_A^n, e_B|AB)V^h \\ V_{n2}^{AU} &= (1 - s_n)\widehat{\mu}_2^l(\widehat{e}_A^n, e_B|AB)V^l + s_n\widehat{\mu}_2^h(\widehat{e}_A^n, e_B|AB)V^h \end{aligned}$$

Totally differentiating equations

$$(2\beta - 1)[(1 - s_n)\widehat{\mu}^l(\widehat{e}_A^n, e_B|AB)V^l + s_n\widehat{\mu}^h(\widehat{e}_A^n, e_B|AB)V^h] = C_n(E - E_A^{nI}) - C_n(E_A^{nI})$$
$$\text{and } (1 - \beta)V_n - C_n(E_A^{nI}) = \pi(\widehat{e}_A^n)$$

for quality $s_n, n = 1, 2, ..., N-1$, we get

$$(2\beta-1)V_{n1}^{AU}d\widehat{e}_A^n + \left(C'(E-E_A^{nI}) + C'(E_A^{nI})\right)dE_A^{nI} + (2\beta-1)V_{n2}^{AU}de_B + 2V_n^{AU}d\beta = 0$$
$$\pi'(\widehat{e}_A^n)d\widehat{e}_A^n + C'(E_A^{nI})dE_A^{nI} + V_n d\beta = 0.$$

For a given β, for quality s_n, $n = 1, 2, ...N-1$ we have,

$$\begin{aligned}
(2\beta-1)V_{n1}^{AU}\frac{d\widehat{e}_A^n}{de_B} + \left(C'(E-E_A^{nI}) + C'(E_A^{nI})\right)\frac{dE_A^{nI}}{de_B} &= -(2\beta-1)V_{n2}^{AU} \\
\pi'(\widehat{e}_A^n)\frac{d\widehat{e}_A^n}{de_B} + C'(E_A^{nI})\frac{dE_A^{nI}}{de_B} &= 0.
\end{aligned}$$

Cramer's rule gives us

$$\frac{dE_A^{nI}}{de_B} = \frac{(2\beta-1)V_{n2}^{AU}\pi'(\widehat{e}_A^n)}{(2\beta-1)V_{n1}^{AU}C'(E_A^{nI}) - \left(C'(E-E_A^{nI}) + C'(E_A^{nI})\right)\pi'(\widehat{e}_A^n)} > 0$$

$$\frac{d\widehat{e}_A^n}{de_B} = \frac{-(2\beta-1)V_{n2}^{AU}C'(E_A^{nI})}{(2\beta-1)V_{n1}^{AU}C'(E_A^{nI}) - \left(C'(E-E_A^{nI}) + C'(E_A^{nI})\right)\pi'(\widehat{e}_A^n)} < 0$$

We define the function

$$\begin{aligned}
h^n(e_A, e_B) &= (2\beta-1)\left[(1-s_n)\widehat{\mu}^l(e_A^n, e_B, n|AB)V^l + s_n\widehat{\mu}^h(e_A^n, e_B, n|AB)V^h\right] \\
&\quad - C_n(E-E_A^{nI}) - C_n(E_A^{nI}).
\end{aligned}$$

By adapting Proposition 2 to the unobservable case, $\widehat{e}_A^n$ satisfies $h^{n\prime}(\widehat{e}_A^n) < 0$ such that

$$\left(C'(E-E_A^{nI}) + C'(E_A^{nI})\right)\frac{\pi'(\widehat{e}_A^n)}{C'(E_A^{nI})} > V_n(2\beta-1)V_{n1}^{AU} \tag{36}$$

Hence the above inequalities follow. Finally, note $\frac{de_A^{N*}}{de_B} < 0$ from Remark 1 of the observable section. The actual threshold for quality s_n is given by,

$$\min\{\widehat{e}_A^n, \widehat{e}_A^{n+1}, ...\widehat{e}_A^{N-1}, e_A^{N*}\}$$

where each threshold $\widehat{e}_A^p$, $p = n, n+1, ..N-1$ and e_A^{N*} is decreasing in e_B, therefore the actual threshold is also decreasing in e_B.

Likewise for a given e_B, we have for quality s_n, $n = 1, 2, ...N-1$,

$$(2\beta - 1)V_{n1}^{AU}\frac{d\widehat{e}_A^n}{d\beta} + \left(C'(E - E_A^{nI}) + C'(E_A^{nI})\right)\frac{dE_A^{nI}}{d\beta} = -2V_n^{AU}$$

$$\pi'(\widehat{e}_A^n)\frac{d\widehat{e}_A^n}{d\beta} + C'(\widehat{E}_A^n)\frac{dE_A^{nI}}{d\beta} = -V_n$$

Cramer's rule gives us

$$\frac{d\widehat{E}_A^n}{d\beta} = \frac{2V_n^{AU}\pi'(\widehat{e}_A^n) - V_n(2\beta-1)V_{n1}^{AU}}{(2\beta-1)V_{n1}^{AU}C'(E_A^{nI}) - (C'(E - E_A^{nI}) + C'(E_A^{nI}))\,\pi'(\widehat{e}_A^n)}$$

$$\frac{d\widehat{e}_A^n}{d\beta} = \frac{V_n\left(C'(E - E_A^{nI}) + C'(E_A^{nI})\right) - 2V_n^{AU}C'(E_A^{nI})}{(2\beta-1)V_{n1}^{AU}C'(E_A^{nI}) - (C'(E - E_A^{nI}) + C'(E_A^{nI}))\,\pi'(\widehat{e}_A^n)} < 0$$

since the cost function is convex, and $E_A^{nI} < E/2$, $C'(E - E_A^{nI}) > C'(E_A^{nI})$ the numerator of the comparative statics with respect to the threshold experience is positive while the denominator is negative from condition (36). ■

Finally, note $\frac{de_A^{N*}}{d\beta} < 0$ from Remark 5 of the observable section. The actual threshold for quality s_n is given by,

$$\min\{\widehat{e}_A^n, \widehat{e}_A^{n+1}, ...\widehat{e}_A^{N-1}, e_A^{N*}\}$$

where each threshold $\widehat{e}_A^p$, $p = n, n+1, ..N-1$ and e_A^{N*} is decreasing in e_B, therefore the actual threshold is also decreasing in e_B. ■