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Author/s:

Aharoni, G;Einhorn, E;Zeng, Q

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Under-Weighting of Private Information by Top Analysts *

Gil Aharoni

University of Melbourne

Eti Einhorn

Tel Aviv University

Qi Zeng

University of Melbourne

Abstract: It is conventionally perceived in the literature that weak analysts are likely to under-weight their private information and strategically bias their announcements in the direction of the public beliefs to avoid scenarios where their private information turns out to be wrong, whereas strong analysts tend to adopt an opposite strategy of over-weighting their private information and shifting their announcements away from the public beliefs in an attempt to stand out from the crowd. Analyzing a reporting game between two financial analysts, who are compensated based on their

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relative forecast accuracy, we demonstrate that it could be the other way around. An investigation of the equilibrium in our game suggests that, contrary to the common perception, analysts who benefit from information advantage may strategically choose to understate their exclusive private information and bias their announcements toward the public beliefs, while exhibiting the opposite behavior of overstating their private information when they estimate that their peers are likely to be equally informed.

Keywords: Security analysts; Earnings forecasts; Bias; Misreporting; Understatement of private information; Overstatement of private information; Relative ranking; Forecasting contests.

JEL classification: C72; D82; G17; G29; M41.

Introduction

The question whether public announcements of financial analysts truthfully reflect their private information has been at the center of academic debate in the last two decades.¹ The intuitive view that the dependence of analysts' careers on their forecasting accuracy should induce them to announce their true predictions (e.g., Keane and Runkle, 1998) has long been challenged on both theoretical and empirical grounds. A large body of literature indicates that career concerns may lead security analysts to strategically bias their publicly announced reports relative to their privately held information. Our study focuses on two countervailing misreporting patterns of financial analysts, which we refer to as understatement and overstatement. We define understatement as the tendency of analysts to under-weight their private information and bias their announcements in the direction of the public beliefs. We symmetrically define overstatement as the opposite predilection of analysts to over-weight their private information and bias their announcements away from the public expectations.² Understatement behavior is typically attributed to weak analysts, who suffer

¹ See Ramnath, Rock and Shane (2008) for an extensive review of this literature.

² Since the public beliefs are partially based on previously announced analysts' forecasts and consistent with prior literature (e.g., Welch, 2000; Zitzewitz, 2001; Bernhardt, Campello and Kutsoati, 2006), herding

from lack of information, ability or experience relative to their peers, and thus strategically choose to under-weight their private information in order to assimilate into the crowd and thereby avoid scenarios where their private information turns out to be wrong (e.g., Trueman, 1994; Graham, 1999; Hong, Kubick and Solomon, 2000). Similarly, overstatement behavior is conventionally ascribed to strong analysts, who enjoy a forecasting advantage due to their superior information, experience or ability, and thus prefer to stand out from the crowd and distinguish themselves from their peers (e.g., Laster, Bennett and Geoum, 1999; Bernhardt, Campello and Kutsoati, 2006; Chen and Jiang, 2006; Ottaviani and Sorensen, 2006; Beyer and Guttman, 2011; Pfeifer, Grushka-Cockayne and Lichtendahl, 2013). Our study demonstrates that it could be the other way around. We indicate circumstances where, contrary to the common wisdom, analysts with an information advantage understate their private information and push their announcements toward the publicly known beliefs, while adopting the opposite overstating strategy when they believe that their peers are likely to be equally informed.

We establish this argument within a reporting game between two risk-averse analysts, who follow the same publicly traded firm. Each of the two analysts might be endowed with private (noisy) information about the forthcoming earnings of the firm but may just as well be uninformed. The information status of each analyst is unobservable to his peer. On the basis of their available set of information, the two analysts simultaneously announce their strategic forecasts with respect to the expected earnings of the firm. When the earnings are subsequently realized and announced by the firm, the forecast errors of the analysts become commonly known and serve to estimate their performance and determine their compensation. In light of the importance of forecasting accuracy to analysts' professional careers (e.g., Mikhail, Walther and Willis, 1999; Stickel, 1992), the payoffs of the analysts are assumed to be dependent on their forecast errors. However, following Laster, Bennett and Geoum (1999) and Ottaviani and Sorensen (2006), we assume that the analysts are compensated based on their relative forecasting accuracy, rather than their absolute forecasting performance. This modeling assumption, which lies at the heart of our study, is motivated by the prevalent practice of ranking analysts' performance, and the conventional view that the professional

behavior of analysts (i.e., their tendency to follow their peers and bias their announcements in the direction of the consensus) can be viewed as a special case of the understatement behavior pattern. Similarly, anti-herding behavior (i.e., the opposite predilection of analysts for standing out from the crowd by biasing their announcements away from the consensus) can be considered as a special case of the overstatement behavior pattern. Our study is based on the analysis of simultaneous announcements of analysts, and thus focuses on other forms of understatement and overstatement.

reputation of individual analysts, their promotion opportunities and their potential wage largely depend upon such rankings (e.g., Hong, Kubick and Solomon, 2000; Hong and Kubik, 2003; Emery and Li, 2009; Groyberg, Healy and Maber, 2011; Aharoni, Shemesh and Zapatero, 2013).³ Unlike previous models of relative ranking that yield overstatement behavior of analysts in equilibrium (e.g., Laster, Bennett and Geom, 1999; Ottavianni and Sorensen, 2006), our model accommodates both understatement and overstatement behavior for a large set of parameter values.

Under the relative performance measurement, each analyst does not care about his absolute forecast accuracy, but rather only aspires to increase the probability of being more accurate than his rival. The uncertainty that each analyst faces with respect to the information status of the rival triggers a tradeoff between the wish of an analyst to increase his chances of winning against an informed rival and his countervailing desire to enhance his chances of winning against an uninformed rival. In particular, if the analyst receives favorable (unfavorable) information, then an unbiased reporting of his true earnings expectation conditional on his information may assist in contending with an equally informed analyst, but a biased report that is only slightly above (below) the prior earnings expectations better serves in contending with an uninformed analyst. In light of this tradeoff, risk aversion works to induce an informed analyst, who ascribes a relatively high probability to the scenario that his opponent is uninformed, to settle for a draw with an equally informed analyst and issue a report that understates his private information. The informed analyst is willing to do this in order to get closer to the forecast announced by an uninformed analyst and thereby increase his probability of winning against an uninformed opponent.

The understatement behavior that our model yields in equilibrium does not stem from the wish of weak analysts to minimize their probability of loss by avoiding scenarios where their private information turns out to be wrong, as commonly perceived in the literature. It rather serves to assist strong analysts to maximize their probability of winning by increasing their chances of being more accurate than an uninformed competitor. The understatement behavior that emerges from our model is therefore most salient in circumstances where it is highly probable that the private information possessed by the informed analyst is exclusive and unavailable to his rival. The tendency of an informed analyst to understate his private information however decreases as the probability that he is facing an equally informed analyst increases. In the extreme, when the analyst believes

³ The most influential ranking is the publicized forecasting contest of the Institutional Investors Magazine (I/I). Other media outlets, such as the Wall Street Journal, the Financial Times, and Forbes Magazine, also provide annual reports that rank the performance of financial analysts over the previous year, rewarding with a write-up the one with the most accurate analysis. Several other rankings of financial analysts are available online. Examples include Validea (www.validea.com), BigTipper (www.bigtipper.com) and BulldogResearch (www.bulldogresearch.com).

that his peer is very likely to be equally informed, he might even adopt an opposite reporting behavior of overstating his information. Overstatement by an informed analyst is the consequence of the strong motivation of an uninformed analyst to gamble on the information content and behave as if he is informed when he knows that his rival is most likely to be informed. To deter the gambling incentives of an uninformed rival, the informed analyst must overstate.

The paper proceeds as follows. The next section describes the model underlying the analysis. Sections 3 and 4 derive the equilibrium outcomes that the model yields and discuss their implications. The final section summarizes and offers concluding remarks. Proofs appear in the appendix.

Model

Our model depicts a reporting game between two risk-averse financial analysts, who follow the securities of the same publicly traded firm. For simplicity, we model the two analysts in a symmetric way, allowing them to vary only in the information set available to them. On the basis of their private information, and in light of their uncertainty about the information endowment of their opponent, the analysts exercise discretion over the forecasts they simultaneously report to the capital market investors with respect to the forthcoming earnings of the firm. The forecast errors of the two analysts become observable only at a subsequent date when the forecasted earnings are realized and announced by the firm. As the accuracy of analysts' forecasts is an important determinant of their professional reputation, promotion opportunities and compensation, we assume that the payoffs of the two analysts are a function of their forecast errors. However, unlike the widely employed assumption that analysts aim at minimizing their absolute forecast error, we rather assume that both analysts are only interested in their relative ranking (e.g., Laster, Bennett and Geom, 1999; Ottaviani and Sorensen, 2006; Kim and Zapatero, 2013). Accordingly, each analyst in our model wishes to exhibit a forecast error that is lower than that of the competitor. The rest of this section details the parameters and assumptions of the model, which are all assumed to be common knowledge unless otherwise indicated.

We represent the forthcoming uncertain earnings of the firm by the random variable \tilde{e} . For tractability, we assume that \tilde{e} is uniformly distributed with support $[\mu - \frac{1}{2}, \mu + \frac{1}{2}]$ one unit in length. The mean μ of the random variable \tilde{e} is initially unknown to the two analysts. According to the analysts' prior beliefs, μ can be either ρ or $-\rho$ with equal probabilities, implying that zero is their initial earnings expectations. We assume that ρ is a scalar satisfying $0 < \rho \leq \frac{1}{4}$. As graphically illustrated in Figure 1, the assumption $0 < \rho \leq \frac{1}{4}$ ensures that the support $[-\rho - \frac{1}{2}, -\rho + \frac{1}{2}]$ of the earnings distribution conditional on $\mu = -\rho$ differs from the support $[\rho - \frac{1}{2}, \rho + \frac{1}{2}]$ of the

earnings distribution conditional on $\mu = \rho$, but a sizable overlap between the two supports nevertheless exists, in which both ρ and $-\rho$ are included. As $1 - 2\rho$ is the size of the overlap between the two intervals $[-\rho - \frac{1}{2}, -\rho + \frac{1}{2}]$ and $[\rho - \frac{1}{2}, \rho + \frac{1}{2}]$, or alternatively 2ρ is the distance between their midpoints, the parameter ρ can serve in our analysis as a measure of the initial level of uncertainty about the forthcoming earnings $\tilde{\epsilon}$ of the firm.

[FIGURE 1]

Before providing their forecasts, both analysts invest resources in collecting private information about the firm's expected earnings μ . A priori, the information gathering activities of an analyst are fruitful with a probability $0 < \pi < 1$. More explicitly, π is the probability of an analyst becoming informed about μ , while $1 - \pi$ is the probability of remaining uninformed about μ . In the case that an analyst becomes informed, he privately observes the exact value of μ . We refer to the signal $\mu = \rho$ as a favorable signal about the forthcoming earnings and to the signal $\mu = -\rho$ as an unfavorable signal.⁴ Following Graham (1999), we assume that the endowment of each analyst with private information is unobservable by the other analyst and is independent of the information status of the other analyst. This assumption is rooted in the observation that individual analysts tend to differ in their talents and efforts, and these characteristics of analysts are normally invisible.⁵ Accordingly, regardless of his information status, each analyst ascribes a probability $1 - \pi$ to the scenario that the other analyst is uninformed and a probability π to the scenario that the other analyst is informed. The information content possessed by the competing analyst, if informed, is however known only to an informed analyst. That is, if an informed analyst possesses favorable (unfavorable) information about the firm's forthcoming earnings, indicating $\mu = \rho$ ($\mu = -\rho$), then he ascribes a probability $1 - \pi$ to the scenario that his rival is uninformed and a probability π to the scenario that the rival is equally informed and holds the same favorable (unfavorable) information. An uninformed analyst, on the other hand, ascribes a probability $1 - \pi$ to the scenario that his rival

⁴ Studies that analyze strategic earnings forecasts of analysts usually use either continuous setups (e.g., Laster, Bennett and Geoum, 1999; Ottaviani and Sorensen, 2006; Beyer and Guttman, 2011), or discrete setups, where the distribution of the earnings and the information about it is discrete (e.g., Trueman, 1994) or even binary (e.g., Graham, 1999). In our setup, the distribution of earnings is continuous, but the information about it takes a binary form. We adopt this modeling approach to keep the framework simple, but still rich enough to convey our idea.

⁵ We regard the parameter π as the ex-ante probability of an analyst becoming informed, irrespective of his specific talent and effort. The parameter π thus reflects the properties of the information environment of the firm and the amount of talent or effort required to gather information about its value. It may also reflect the proportion of smart analysts covering the firm, as in the model of Graham (1999).

is uninformed, a probability $\frac{1}{2}\pi$ to the scenario that the rival is informed and possesses the favorable information $\mu = \rho$, and a probability $\frac{1}{2}\pi$ to the scenario that the rival is informed and possesses the unfavorable information $\mu = -\rho$. The beliefs of each analyst with respect to the information status of his rival, conditional on his own information status, are summarized in Table 1.

[TABLE 1]

On the basis of their information, the two analysts simultaneously issue their earnings forecasts to the capital market. As they both exercise discretion in reporting, their publicly announced forecasts do not necessarily reflect their best estimate of the forthcoming earnings of the firm. In particular, there is no imposition on an uninformed analyst to report zero, while an informed analyst is not compelled to report his private signal, regardless of whether he has observed the favorable signal $\mu = \rho$ or the unfavorable signal $\mu = -\rho$. While biases in reporting the earnings forecasts are not associated with any direct costs, they are nevertheless limited due to the importance that the analysts attribute to their forecast accuracy, which is to be revealed subsequently when the earnings of the firm are realized and announced.

Our main assumption is that each analyst does not care about his absolute forecast error, but rather wishes to exhibit better forecast accuracy relative to the other analyst. This modeling assumption has been previously employed in the literature by Laster, Bennett and Geoum (1999), Ottaviani and Sorensen (2006) and Kim and Zapatero (2013). It is motivated by the common practice of ranking analysts' performance (e.g., rankings published by the Institutional Investors Magazine, Wall Street Journal, Financial Times, Forbes Magazine, and several internet websites) and the importance of such rankings in determining the professional reputation of individual analysts, their promotion opportunities and their potential wage (e.g., Hong, Kubick and Solomon, 2000; Hong and Kubik, 2003; Emery and Li, 2009; Groysberg, Healy and Maber, 2011; Aharoni, Shemesh and Zapatero, 2013). We use the notation $W(f_1, f_2, e)$ to denote the payoff of each analyst, given that f_1 is his own forecast, f_2 is the forecast of his peer, and e is the earnings realization. The payoff $W(f_1, f_2, e)$ of an analyst equals H if his forecast error $|e - f_1|$ is strictly lower than the forecast error $|e - f_2|$ of his competitor, it equals L if $|e - f_1|$ is strictly higher than $|e - f_2|$, and it equals $\frac{1}{2}(L + H)$ if the forecast errors $|e - f_1|$ and $|e - f_2|$ are identical, where L and H are scalars satisfying $0 \leq L < H$.⁶ The high payoff H can be viewed as a promotion of the analyst within the

⁶ The mid-point $(f_1 + f_2)/2$ of the two forecasts f_1 and f_2 plays an important role in determining the payoff $W(f_1, f_2, e)$. When $f_1 < f_2$, $W(f_1, f_2, e) = H$ if $e < (f_1 + f_2)/2$, $W(f_1, f_2, e) = L$ if

same brokerage house or a movement to a larger brokerage house, the low payoff L can be similarly considered as a demotion, and the tie payoff $\frac{1}{2}(L+H)$ may capture the scenario of staying in the same position. We assume that the analysts are (weakly) risk averse and thus gain less utility from promotion than the utility they lose from demotion. The utility of each analyst from a payoff w is accordingly described by $U(w)$, where $U : \mathfrak{R} \rightarrow \mathfrak{R}$ is a strictly increasing and weakly concave function. The measure $\frac{U(\frac{1}{2}(L+H)) - \frac{1}{2}(U(L) + U(H))}{U(H) - U(L)}$, denoted λ , captures the

extent to which the utility function $U : \mathfrak{R} \rightarrow \mathfrak{R}$ is concave, thus reflecting the risk preferences of the analysts. Since $L < \frac{1}{2}(L+H) < H$ and the function U is strictly increasing and weakly concave, it follows that $0 \leq \lambda < \frac{1}{2}$. The special case of $\lambda = 0$ (where the utility function U is linear) depicts risk neutrality on the part of the analysts. In all other cases where λ is positive, the analysts are risk averse and the measure λ represents their degree of risk aversion. When λ approaches the upper bound of $\frac{1}{2}$, the analysts become highly risk averse so that their utility $U(\frac{1}{2}(L+H))$ from a tie outcome converges to their utility $U(H)$ from a winning outcome.

We look for symmetric Bayesian equilibria in the model. Any such equilibrium can be represented by a triple (r_1, r_2, r_3) , where r_1 is the reporting strategy of an uninformed analyst, r_2 is the reporting strategy of an informed analyst with unfavorable information, and r_3 is the reporting strategy of an informed analyst with favorable information. We focus on equilibria of the form $(\pm b, -a, a)$, where an uninformed analyst (who estimates that μ is either ρ or $-\rho$ with equal probabilities) adopts a mixed strategy of reporting an earnings forecast of b or $-b$ with equal probabilities for some non-negative scalar $b \geq 0$, an informed analyst who possesses a favorable signal (indicating that $\mu = \rho$) adopts a pure strategy of reporting an earnings forecast of a for some non-negative scalar $a \geq 0$, and an informed analyst who possesses an unfavorable signal (indicating that $\mu = -\rho$) adopts a pure strategy of reporting the inverse earnings forecast of $-a$. In equilibrium, each analyst makes an optimal reporting decision based on his available information and utilizing his rational expectations about the reporting strategy of the other analyst. A symmetric

$e > (f_1 + f_2)/2$, and $W(f_1, f_2, e) = \frac{1}{2}(L+H)$ if $e = (f_1 + f_2)/2$. Similarly, when $f_1 > f_2$, $W(f_1, f_2, e) = H$ if $e > (f_1 + f_2)/2$, $W(f_1, f_2, e) = L$ if $e < (f_1 + f_2)/2$, and $W(f_1, f_2, e) = \frac{1}{2}(L+H)$ if $e = (f_1 + f_2)/2$. When $f_1 = f_2$, $W(f_1, f_2, e) = \frac{1}{2}(L+H)$ for any earnings realization e .

Bayesian equilibrium of the form $(\pm b, -a, a)$, where $a, b \geq 0$, thus prevails if and only if the following three conditions hold:

(i) $F^{a,b}(a) \geq F^{a,b}(f)$ for any $f \in \mathfrak{R}$, where

$$F^{a,b}(f) = \frac{1}{2}(1-\pi)E[U(W(f,b,\tilde{e})) | \mu = \rho] + \frac{1}{2}(1-\pi)E[U(W(f,-b,\tilde{e})) | \mu = \rho] + \pi E[U(W(f,a,\tilde{e})) | \mu = \rho];$$

(ii) $G^{a,b}(-a) \geq G^{a,b}(f)$ for any $f \in \mathfrak{R}$, where

$$G^{a,b}(f) = \frac{1}{2}(1-\pi)E[U(W(f,b,\tilde{e})) | \mu = -\rho] + \frac{1}{2}(1-\pi)E[U(W(f,-b,\tilde{e})) | \mu = -\rho] + \pi E[U(W(f,-a,\tilde{e})) | \mu = -\rho];$$

(iii) $\frac{1}{2}H^{a,b}(b) + \frac{1}{2}H^{a,b}(-b) \geq \frac{1}{2}H^{a,b}(f) + \frac{1}{2}H^{a,b}(-f)$ for any $f \in \mathfrak{R}$, where

$$H^{a,b}(f) = \frac{1}{2}(1-\pi)E[U(W(f,b,\tilde{e}))] + \frac{1}{2}(1-\pi)E[U(W(f,-b,\tilde{e}))] + \frac{1}{2}\pi E[U(W(f,a,\tilde{e})) | \mu = \rho] + \frac{1}{2}\pi E[U(W(f,-a,\tilde{e})) | \mu = -\rho]$$

The first condition pertains to the reporting strategy of an informed analyst with a favorable signal, the second condition pertains to the reporting strategy of an informed analyst with an unfavorable signal, and the third condition relates to the reporting strategy of an uninformed analyst. Each condition requires the analyst to make the reporting decision that maximizes his expected utility, based on his available information and utilizing his rational expectations about the information available to his opponent and the corresponding reporting strategy of the opponent.

In furthering our main research interest of exploring biases in reporting made by informed analysts, we first focus in Section 3 on symmetric Bayesian equilibria of the form $(0, -a, a)$, in which it is optimal for an uninformed analyst to truthfully report his earnings prediction of zero. For completeness, we then analyze in Section 4 all other symmetric Bayesian equilibria of the form $(\pm b, -a, a)$, where $b > 0$, showing that the strategic behavior of informed analysts, as explored in Section 3, qualitatively holds even when it is optimal for an uninformed analyst to adopt a gambling strategy of announcing either a positive forecast of $+b$ or a negative forecast of $-b$ with equal probabilities. It should be noted that, even though the analysis in Section 3 is limited to situations where an uninformed analyst truthfully announces his best earnings estimate of zero, and the analysis in Section 4 is limited to situations where an uninformed analyst biases his report away from his best estimate of zero and gambles on two inverse reports with equal probabilities, no restrictions

are nevertheless made upfront with respect to the reporting choice of the uninformed analyst. Hence, the analysis in Section 3 explores situations where truthful reporting is indeed optimal for an uninformed analyst and the analysis in Section 4 similarly explores situations where an uninformed analyst indeed finds it optimal to gamble.

Symmetric Bayesian equilibria with truthful reporting by uninformed analysts

In this section we derive the symmetric Bayesian equilibria of the form $(0, -a, a)$, where $a \geq 0$, in which it is optimal for an uninformed analyst to truthfully report his earnings prediction of zero. By limiting the analysis in this section to circumstances where an uninformed analyst chooses in equilibrium to truthfully report, we highlight our focus on biases in reporting made by informed analysts. To understand how misreporting by informed analysts may occur in equilibrium, it should be noted that, under a relative performance measurement, neither analyst cares about his absolute forecast accuracy, but rather only aims at increasing the probability of being more accurate than his rival. The uncertainty that each analyst faces with respect to the information status of his rival triggers a tradeoff between his wish to increase his chances of winning against an informed analyst and his countervailing desire to enhance his chances of winning against an uninformed analyst. In particular, if the analyst possesses favorable (unfavorable) information, then an unbiased reporting of his true earnings expectation conditional on his information may help him to contend with another equally informed analyst. However, a biased report that is only slightly above (below) the prior earnings expectations of zero better serves him in contending with an uninformed analyst, similarly to the best strategy of the second guesser in the sequential guessing model of Steele and Zidek (1980). This inevitable tradeoff may trigger the incentives of the informed analyst to bias his report relative to his private information. It appears, however, that such misreporting incentives are precluded under risk neutrality on the part of the analysts. The case of $\lambda = 0$, where the analysts are risk neutral, therefore provides a natural point of reference to our analysis. Proposition 1 presents the equilibrium outcomes in the case of $\lambda = 0$, which serves as a benchmark case in the analysis.

Proposition 1. *In the benchmark case of $\lambda = 0$ (risk neutrality), no symmetric Bayesian equilibrium of the form $(0, -a, a)$ exists when $0 < \pi < \frac{1}{2}$, and the truthful reporting strategy $(0, -\rho, \rho)$ is the unique equilibrium of this form when $\frac{1}{2} \leq \pi < 1$.*

Proposition 1 indicates that biases in reporting cannot appear in a symmetric Bayesian equilibrium of the form $(0, -a, a)$ when both analysts are risk neutral. The only equilibrium of this form that can exist in the benchmark case of risk neutrality is the truthful reporting equilibrium

$(0, -\rho, \rho)$.⁷ When the analysts are risk neutral, and provided that each of them is more likely than not to be informed (i.e., $\frac{1}{2} \leq \pi < 1$), both of them issue unbiased forecasts in equilibrium, which truthfully reflect their earnings expectations, regardless of their information status and regardless of their beliefs about the information status of the other analyst. That is, an uninformed analyst reports an earnings forecast of zero, an informed analyst with unfavorable information reports an earnings forecast of $-\rho$, and an informed analyst with favorable information reports ρ . The risk neutrality of the analysts precludes all other solutions $(0, -a, a)$, where $a \neq \rho$. When the analysts are risk neutral, they are so eager to win that they cannot resist the temptation to slightly deviate from a biased announcement toward their true earnings prediction. Knowing that his competitor reports a ($-a$) upon receiving favorable (unfavorable) information, where $a \neq \rho$, it is worthwhile for a risk-neutral analyst with favorable (unfavorable) information to slightly deviate from a report of a ($-a$) in the direction of his true earnings expectation ρ ($-\rho$). Such a deviation ensures him a winning outcome with a probability that exceeds $\frac{1}{2}$ over an informed competitor, instead of the riskless tie outcome, without significantly altering his chances against an uninformed competitor. Only risk aversion, which leads the analyst to prefer a riskless outcome over an uncertain outcome that is on average more profitable, can suppress his incentive to deviate from a biased announcement and may lead him to settle for a draw with an equally informed rival.

Misreporting by informed analysts can thus appear in an equilibrium of the form $(0, -a, a)$ only when the analysts are risk averse. We thus continue by analyzing the case where the parameter λ is positive and the utility function of the analysts exhibits risk aversion. It should be noted, however, that while a moderate level of risk aversion induces the informed analyst to draw with an equally informed rival, but still retains his motivation to win over an uninformed rival, an extremely high degree of risk aversion leads the informed analyst to seek the riskless tie outcome in any case. It is thus useful to consider the case of a low degree of risk aversion, where $0 < \lambda < \rho$, separately from the case of a high degree of risk aversion, where $\rho \leq \lambda < \frac{1}{2}$. We start with the analysis of the case $0 < \lambda < \rho$, where the analysts are risk averse but their degree λ of risk aversion is low relative to the level of their prior uncertainty about the earnings \tilde{e} , as captured by the parameter ρ . Proposition 2 provides the equilibrium outcomes that the model yields in this case.

⁷ Later on, in Section 4, it is further shown that, under risk neutrality on the part of the analysts, the truthful reporting equilibrium $(0, -\rho, \rho)$ is the unique symmetric Bayesian equilibrium of the form $(\pm b, -a, +a)$, where $a, b \geq 0$.

Proposition 2. *In the case of $0 < \lambda < \rho$ (low risk aversion), no symmetric Bayesian equilibrium of the form $(0, -a, a)$ exists when $0 < \pi < \frac{1}{2} - \frac{\lambda}{\rho + \lambda}$. However, when $\frac{1}{2} - \frac{\lambda}{\rho + \lambda} \leq \pi < 1$, any scalar a , such that $a_{\min} \leq a \leq a_{\max}$, characterizes an equilibrium of the form $(0, -a, a)$, where*

$$a_{\min} = \begin{cases} \rho - \lambda & \text{if } \frac{1}{2} - \frac{\lambda}{\rho + \lambda} \leq \pi \leq \frac{1}{2} + \frac{\rho - \lambda}{2(\rho + 3\lambda)} \\ (\rho + 3\lambda)\pi - 2\lambda & \text{if } \frac{1}{2} + \frac{\rho - \lambda}{2(\rho + 3\lambda)} \leq \pi < 1 \end{cases} \quad \text{and}$$

$$a_{\max} = \begin{cases} 2(\rho + \lambda)\pi & \text{if } \frac{1}{2} - \frac{\lambda}{\rho + \lambda} \leq \pi \leq \frac{1}{2} \\ \rho + \lambda & \text{if } \frac{1}{2} \leq \pi < 1 \end{cases} .$$

It follows from Proposition 2 that, in the case of $0 < \lambda < \rho$, as long as the probability π is sufficiently high, exceeding $\frac{1}{2} - \frac{\lambda}{\rho + \lambda}$, multiple symmetric equilibria of the form $(0, -a, a)$ exist, where a does not necessarily equal ρ . By reducing the desire of an informed analyst to win, risk aversion causes him to be content with the riskless tie outcome in the case that his rival is equally informed. Yet, his motivation to win over an inferior, uninformed, rival still exists under a limited degree λ of risk aversion, which does not exceed ρ . He is thus willing to settle for a draw with an equally informed analyst on some biased announcement in an attempt to increase his probability of winning against an uninformed analyst. Here, a risk-averse analyst with favorable (unfavorable) information finds it unprofitable to slightly deviate from a biased equilibrium report of a ($-a$) in the direction of his true earnings expectation ρ ($-\rho$), even if he knows that his competitor reports a ($-a$) upon receiving the same information. Such a deviation indeed ensures the informed analyst a winning outcome with a probability that exceeds $\frac{1}{2}$ and a loss outcome with a probability below $\frac{1}{2}$ over an informed competitor, instead of the riskless tie outcome, without significantly altering his chances against an uninformed competitor. Due to his risk aversion, however, the informed analyst prefers the riskless tie outcome, in case his rival is also informed, over the alternative outcome that is on average more profitable but riskier.

[FIGURES 2a and 2b]

The equilibrium outcomes for the case of $0 < \lambda < \rho$, as formally presented in Proposition 2, are graphically illustrated in Figures 2a and 2b. As the equilibrium representation $(0, -a, a)$ can be condensed into the scalar a , Figure 2a illustrates only the equilibrium announcement a of an informed analyst with favorable information. Though not explicitly described in Figure 2a, the

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equilibrium announcement of an informed analyst with unfavorable information can be immediately determined from the figure, because it is the additive inverse $-a$ of the announcement of an informed analyst with favorable information, whereas the equilibrium announcement of an uninformed analyst is simply zero. The horizontal axis in the figure represents all the possible values of the probability π of the analysts being informed. The vertical axis represents all the possible reporting choices of an informed analyst with favorable information, where ρ is the truthful reporting choice. The broken red line describes the lower bound a_{\min} of the equilibrium earnings forecast a reported by an informed analyst with favorable information as a function of π , while the broken blue line describes the upper bound a_{\max} of his equilibrium report a as a function of π . Given the probability π of being informed, any scalar a that lies between the two corresponding bounds characterizes a symmetric equilibrium of the form $(0, -a, a)$.

The equilibria space of Proposition 2, as depicted by the trapezium in Figure 2a, is bounded by four lines: the lower horizontal red line, the lower sloping red line, the upper sloping blue line and the upper horizontal blue line. These four boundaries of the trapezium represent the binding constraints that arise from the three equilibrium conditions: $F^{a,0}(a) \geq F^{a,0}(f)$, $G^{a,0}(-a) \geq G^{a,0}(f)$ and $H^{a,0}(0) \geq \frac{1}{2}H^{a,0}(f) + \frac{1}{2}H^{a,0}(-f)$ for any $f \in \mathfrak{R}$. The first equilibrium condition, $F^{a,0}(a) \geq F^{a,0}(f)$ for any $f \in \mathfrak{R}$, limits the equilibria space to the subset of the announcements a , for which an informed analyst with a favorable signal has no incentive to deviate from the equilibrium announcement of a . The second equilibrium condition, $G^{a,0}(-a) \geq G^{a,0}(f)$ for any $f \in \mathfrak{R}$, similarly limits the equilibria space to the subset of the announcements a , for which an informed analyst with an unfavorable signal has no incentive to deviate from the equilibrium announcement of $-a$. The third equilibrium condition, $H^{a,0}(0) \geq \frac{1}{2}H^{a,0}(f) + \frac{1}{2}H^{a,0}(-f)$ for any $f \in \mathfrak{R}$, further restricts the equilibria space to the subset of the announcements a , for which an uninformed analyst has no incentive to deviate from the equilibrium announcement of zero. The intersection of the subsets that emerge from the three equilibrium conditions, which is graphically illustrated by the trapezium in Figure 2a, constitutes the set of all the announcements a that prevail in equilibrium. As shown in the appendix, the three equilibrium conditions yield many constraints, which collapse into only four binding constraints. These binding constraints are depicted by the four boundaries of the trapezium in Figure 2a.

The horizontal red (lower) boundary and the horizontal blue (upper) boundary of the trapezium in Figure 2a indicate that the strategic announcement of an informed analyst cannot be below $\rho - \lambda$ or above $\rho + \lambda$. So, while informed analysts may bias their announcement in both directions relative to their true estimate of the underlying value, the magnitude of their bias cannot

exceed λ . The horizontal red and blue boundaries serve to suppress the incentives of an informed analyst with favorable (unfavorable) information to slightly deviate from the equilibrium report of a ($-a$) in the direction of his true earnings expectation ρ ($-\rho$) in order to improve his position against an equally informed rival without changing his chances against an uninformed rival. Such a slight deviation becomes more and more tempting to an informed analyst with favorable (unfavorable) information as the distance between the equilibrium report a ($-a$) and his private signal ρ ($-\rho$) increases. The risk aversion of analysts can thus prevent them from such a deviation, and induce them to agree to tie on a report of a ($-a$), only when the distance between their report a ($-a$) and their private signal ρ ($-\rho$) is limited. The horizontal red (blue) boundary of the trapezium depicts the minimal (maximal) value of a that deters an informed analyst from slightly deviating in the direction of his private information. It should be noted that the horizontal red and blue boundaries are parallel to the horizontal axis and do not at all depend on the probability π of confronting an informed rival. This is because a slight deviation of an informed analyst from the equilibrium announcement toward his private information changes only his position against an equally informed rival, but does not change his position against an uninformed rival. Both these boundaries are, however, dependent on the degree λ of the analysts' risk aversion. As λ increases and the analysts become more risk averse, their willingness to settle for a draw with an equally informed rival increases, and the horizontal red and blue boundaries accordingly become less restrictive.

While the horizontal red and blue boundaries of the trapezium in Figure 2a work to suppress the incentive of an informed analyst to deviate from equilibrium in order to improve his position against an equally informed rival, the sloping blue (upper) boundary works to diminish the motivation of an informed analyst to deviate from equilibrium in order to improve his position against an uninformed rival. Specifically, the sloping blue line diminishes the incentive of an informed analyst with favorable (unfavorable) information to deviate from the equilibrium announcement of a ($-a$) and announce slightly above (below) zero in order to increase his chances against an uninformed rival even at the cost of decreasing his chances against an equally informed rival. Such a deviation is especially attractive to an informed analyst when π is low and when there is a great distance between a and zero. An informed analyst, who attributes a low probability π to the scenario that his rival is equally informed, has a strong motivation to deviate from equilibrium toward zero, unless the equilibrium announcement is already sufficiently close to zero. This motivation decreases as the likelihood of confronting an informed rival increases. The sloping blue (upper) boundary, which depicts the maximal value of a that deters the informed analyst from deviating toward zero, is thus very restrictive when π is low but becomes less restrictive as π increases.

For very low values of π , satisfying $0 < \pi < \frac{1}{2} - \frac{\lambda}{\rho + \lambda}$, the (upper) sloping blue boundary of the trapezium is so restrictive that it is located below the (lower) horizontal red boundary. This explains a non-empty range of sufficiently low values of π , for which no symmetric equilibrium of the form $(0, -a, a)$ exists. When π is very low, any announcement a must be either above the sloping blue line or below the horizontal red line. When a is above the sloping blue line (which depicts the maximal value of a that deters the informed analyst from deviating toward zero), it is worthwhile to an informed analyst with favorable (unfavorable) information to deviate from a report of a ($-a$) to a report that is slightly above (below) zero. When a is below the horizontal red line (which depicts the minimal value of a that deters an informed analyst from slightly deviating in the direction of his private information), it is beneficial to an informed analyst to slightly deviate in the opposite direction toward his true earnings prediction. Hence, an informed analyst, who ascribes a very low probability π to the scenario of confronting an equally informed rival, is always better off deviating from any equilibrium of the form $(0, -a, a)$. Consequently, symmetric equilibrium of the form $(0, -a, a)$, where $a \geq 0$, cannot survive in equilibrium when π is very low.

The fourth, and last, boundary that determines the shape of the trapezium in Figure 2a is the sloping red (lower) boundary. This boundary works to suppress the motivation of an uninformed analyst to deviate from the equilibrium announcement of zero in an attempt to mimic an informed analyst. An uninformed analyst becomes motivated to gamble on the information content and announce as if he is informed when he ascribes a high probability π to the scenario that he is confronting an informed analyst. The profit to the uninformed analyst if the gamble succeeds is the tie outcome, independently of a , but his loss if the gamble fails is increasing in a . The gambling behavior is thus worthwhile to the uninformed analyst for relatively low values of a . By restricting the equilibrium announcements of informed analysts to be sufficiently far from zero, the sloping red boundary prevents gambling on the part of the uninformed analyst. The sloping red (lower) boundary depicts the minimal value of a that inhibits the gambling incentives of an uninformed analyst. As the probability π of confronting an informed rival increases, the motivation of the uninformed analyst to gamble increases as well. The sloping red boundary is thus effective in preventing a deviation from the equilibrium zero announcement of an uninformed analyst only for sufficiently high values of π and it becomes more and more restrictive as π further increases.

The dependence of the equilibria space of Proposition 2 on the degree λ of the analysts' risk aversion is graphically illustrated in Figure 2b by the shift of the lower (upper) bound a_{\min} (a_{\max}) of the trapezium from the solid red (blue) plot toward the dotted red (blue) plot when λ increases. As the degree λ of the analysts' risk aversion increases from zero toward ρ , there are more announcements on which two informed analysts agree to tie, so the equilibria space depicted by the

trapezium becomes wider, the range where no equilibrium exists diminishes (and even becomes empty at the limit as λ converges to ρ), and the magnitude of the potential biases in reporting grows larger. For very high levels of π , however, an increase in the analysts' risk aversion has the additional effect of making the sloping red boundary of the trapezium steeper and thereby shifting the equilibria space toward more extreme announcements. This is because of the role of the sloping red (lower) boundary of the trapezium in deterring gambling by uninformed analysts, whose incentives to gamble on a draw with an informed rival increase with their risk aversion.

The equilibria space in the benchmark case of risk neutrality, as presented in Proposition 1, is obtained at the limit as λ converges to zero and the trapezium in Figure 2b becomes so thin that eventually its upper and lower parallel sides conjoin into the horizontal green segment that reflects truthful reporting of $a = \rho$. In the benchmark case of $\lambda = 0$, both the horizontal (lower) red boundary and the horizontal blue (upper) boundary converge to the horizontal line $a = \rho$, but this line is located below the sloping blue (upper) boundary only when $\pi \geq \frac{1}{2}$. Hence, when π is below $\frac{1}{2}$, a truthful reporting of ρ ($-\rho$) by an informed analyst with favorable (unfavorable) information cannot prevail in equilibrium, because of the strong incentive of the informed analyst to deviate and announce slightly above (below) the zero announcement of an uninformed rival.⁸ This motivation, which shifts the sloping blue (upper) boundary below the horizontal line $a = \rho$ when $\pi < \frac{1}{2}$, explains the absence of symmetric equilibria in the benchmark case of $\lambda = 0$ when the probability

⁸ Consider, for instance, the case of $\mu = \rho$ (favorable signal), where the earnings variable \tilde{e} is uniformly distributed over the support $[\rho - \frac{1}{2}, \rho + \frac{1}{2}]$. An informed analyst, who announces his true earnings prediction of ρ , wins against a zero announcement of an uninformed rival if and only if the earnings realization is above $\frac{1}{2}\rho$ and his winning probability is thus only $\rho + \frac{1}{2} - \frac{1}{2}\rho = \frac{1}{2}\rho + \frac{1}{2}$. In comparison, an informed analyst, who deviates from the equilibrium announcement of ρ and announces slightly above the zero announcement of an uninformed rival, beats the uninformed rival if and only if the earnings realization is above zero and his winning probability is thus $\rho + \frac{1}{2}$. Such a deviation by an informed analyst increases the probability of winning against an uninformed rival from $\frac{1}{2}\rho + \frac{1}{2}$ to $\rho + \frac{1}{2}$. It is, however, associated with the cost of replacing the tie outcome (which is equivalent to a winning probability of $\frac{1}{2}$ under risk neutrality) in the case of confronting an equally informed rival with a low winning probability of $\frac{1}{2} - \frac{1}{2}\rho$ (which reflects a winning outcome if and only if the earnings realization is below $\frac{1}{2}\rho$). To sum, a deviation of an informed analyst toward zero increases his winning probability against an uninformed rival by $\frac{1}{2}\rho$ (from $\frac{1}{2}\rho + \frac{1}{2}$ to $\rho + \frac{1}{2}$) while decreasing his winning probability against an equally informed rival by the same amount of $\frac{1}{2}\rho$ (from $\frac{1}{2}$ to $\frac{1}{2} - \frac{1}{2}\rho$). It is thus beneficial only when the probability π of confronting an informed rival is below $\frac{1}{2}$.

π of being informed is below $\frac{1}{2}$. Unlike the benchmark case $\lambda = 0$ of risk neutrality that gives rise only to the truthful reporting equilibrium provided that $\pi \geq \frac{1}{2}$, any degree λ of risk aversion, such that $0 < \lambda < \rho$, yields a multitude of symmetric equilibria of the form $(0, -a, a)$ for a wide range of probabilities π . Moreover, the truthful reporting strategy $(0, -\rho, \rho)$ does not necessarily belong to the equilibria space, as clarified by the following corollary.

Corollary to Proposition 2. *In the case of $0 < \lambda < \rho$ (low risk aversion), the truthful reporting*

strategy $(0, -\rho, \rho)$ constitutes an equilibrium if and only if $\frac{1}{2} - \frac{\lambda}{2(\rho+\lambda)} \leq \pi \leq \frac{1}{2} + \frac{\rho+\lambda}{2(\rho+3\lambda)}$. When

$\frac{1}{2} - \frac{\lambda}{\rho+\lambda} \leq \pi < \frac{1}{2} - \frac{\lambda}{2(\rho+\lambda)}$, any equilibrium of the form $(0, -a, a)$ satisfies $a < \rho$. When

$\frac{1}{2} + \frac{\rho+\lambda}{2(\rho+3\lambda)} < \pi < 1$, any equilibrium of the form $(0, -a, a)$ satisfies $a > \rho$.

When the probability π of the analysts being informed is relatively low, satisfying

$\frac{1}{2} - \frac{\lambda}{\rho+\lambda} \leq \pi < \frac{1}{2} - \frac{\lambda}{2(\rho+\lambda)}$, the upper bound a_{\max} of the earnings forecast provided by an informed analyst with favorable information, as depicted by the sloping blue line in Figure 2a, is strictly below his true earnings expectation ρ . This result surprisingly suggests that the informed analyst is willing to under-weight his private information and shift his earnings forecast toward the prior earnings expectations of zero. Furthermore, the informed analyst adopts such a strategy even though he is fully aware of his information advantage and knows that the probability that his competitor is also informed is relatively low. Unlike previous models, in which under-weighting of private information helps the analyst to avoid negative consequences if his private information turns out to be wrong, understatement behavior here helps the analyst to win by increasing his probability of being more accurate than an uninformed competitor. Therefore, the analyst in our model does not perfectly mimic the announcement of his rival, as is typically the case in herding models (e.g., Scharfstein and Stein, 1990; Trueman, 1994; Avery and Chevalier, 1999; Graham, 1999). He rather under-weights his private information to bring his announcement close to that of an uninformed rival.

The understatement behavior that our model yields in equilibrium is opposite to the equilibrium outcomes of previous models, which suggest that relative ranking of analysts induces them to overstate their private information (e.g., Laster, Bennett and Geoum, 1999; Ottaviani and Sorensen, 2006). It is also different from the understatement behavior that arises in models that assume other utility functions of analysts (e.g., Trueman, 1994; Graham, 1999). In particular, the understatement behavior that arises in our model is not driven by the tendency of a weak analyst to assimilate into the crowd, as conventionally presumed in the literature. It is rather caused by a strong analyst, who has a clear information advantage over his competitor, nevertheless choosing in equilibrium to bias his report toward that of an uninformed rival. This understatement behavior by a

strong analyst can exist in a symmetric equilibrium due to his risk aversion, which induces him to be content with a tie outcome in the scenario that his competitor is equally informed and to design his strategic report such that it increases his chances of winning in the case that his rival is uninformed. The understatement behavior of the informed analyst is thus more likely to occur when his information is more exclusive. When the probability π of being informed increases, the informed analyst becomes more worried that the other analyst is equally informed, and his announcement is thus pushed toward his true estimate of the expected earnings, as graphically demonstrated by the sloping blue line in Figure 2a.

Moreover, it is not only that the understatement behavior of an informed analyst tends to diminish as π increases. The opposite outcome of overstating behavior even emerges in equilibrium for relatively high values of π . When the probability π of being informed is sufficiently high, exceeding $\frac{1}{2} + \frac{\rho+\lambda}{2(\rho+3\lambda)}$, the lower bound a_{\min} of the report provided by an informed analyst with favorable information, as depicted by the sloping red line in Figure 2a, is strictly above his true earnings expectation ρ . This result interestingly implies that an informed analyst, who ascribes a high probability to the scenario that he is confronting an equally informed rival, chooses in equilibrium to issue an earnings forecast that over-weights his private information. In the case of $\frac{1}{2} + \frac{\rho+\lambda}{2(\rho+3\lambda)} < \pi < 1$, a reporting strategy of the form $(0, -a, a)$, where $a \leq \rho$, cannot prevail in equilibrium due to the incentives of an uninformed analyst to deviate from reporting zero. Here, the relatively high probability π , which an uninformed analyst ascribes to the scenario that he is confronting an informed analyst, motivates him to gamble on the information content and announce as if he is informed, deviating from a report of zero to a report of either a or $-a$. The profit to the uninformed analyst if the gamble succeeds is the tie outcome, independently of a , but his loss if the gamble fails is increasing in a . The gambling behavior is thus worthwhile to the uninformed analyst for relatively low values of a . So, to prevent gambling by the uninformed analyst, the informed analyst must overstate. As the probability π of being informed increases, the motivation of the uninformed analyst to gamble increases as well, inducing the informed analyst to announce an even higher forecast a in order to deter the uninformed analyst from gambling, as captured in Figure 2a by the sloping red line.

Particular attention should be paid to the fact that a pooling of analysts' earnings forecasts, which typically arises in herding models, cannot appear in equilibrium in our model when the degree λ of the analysts' risk aversion is relatively low, satisfying $0 < \lambda < \rho$. In the case of low risk aversion, the lower bound a_{\min} of the equilibrium report provided by an informed analyst with favorable information is strictly positive for any probability π . This implies that the informed analyst might sometimes bias his report toward the zero report of an uninformed analyst, so that the two

reports get closer, but as long as $0 < \lambda < \rho$ they never exactly coincide. Hence, when the analysts are risk averse but their degree λ of risk aversion is lower than ρ , any equilibrium of the form $(0, -a, a)$ must be a separating equilibrium, where each type of analyst reports a different earnings forecast.⁹ The existence of a pooling equilibrium $(0, 0, 0)$, where zero is reported by all three types of analysts, requires a higher degree of risk aversion on the part of the analysts. This is because, when the competing analyst is known to issue a zero report, a slight deviation by an informed analyst from the zero report, in the direction of his true earnings expectations, is very tempting. Such a deviation provides the informed analyst with an extremely high probability of winning over the other analyst, instead of having to settle for the riskless tie outcome. Only a sufficiently high degree of risk aversion can prevent this deviation. The pooling equilibrium $(0, 0, 0)$ exists if and only if the degree λ of the analysts' risk aversion is at least ρ . This leads us to the analysis of the case $\rho \leq \lambda < \frac{1}{2}$, which yields the equilibrium outcomes presented in Proposition 3.

Proposition 3. *In the case of $\rho \leq \lambda < \frac{1}{2}$ (high risk aversion), the pooling equilibrium $(0, 0, 0)$ is the unique symmetric Bayesian equilibrium of the form $(0, -a, a)$ when $0 < \pi \leq \frac{1}{2} - \frac{\rho}{2\lambda}$. However, when $\frac{1}{2} - \frac{\rho}{2\lambda} < \pi < 1$, in addition to the pooling equilibrium $(0, 0, 0)$, any scalar a , such that $a_{\min} \leq a \leq a_{\max}$, characterizes an equilibrium of the form $(0, -a, a)$, where*

⁹ Under the separating equilibria presented in Proposition 2, the announcements of the analysts fully reveal their private information. This raises the question why doesn't the capital market adjust the payoffs of the analysts accordingly. Later on, in Propositions 3 and 4, we partially mitigate this problem by presenting multiple equilibria of the form $(\pm a, -a, a)$ that are not fully revealing. Moreover, we note that in circumstances where the capital market investors (who do not participate as players in our reporting game) face some uncertainty about the utility function of the analysts or about the probability of the analysts being informed, they cannot perfectly infer the analysts' private information from observing their reports, even under separating equilibria.

$$a_{\min} = \begin{cases} 0 & \text{if } \frac{1}{2} - \frac{\rho}{2\lambda} < \pi \leq \frac{1}{2} + \frac{\lambda - \rho}{2(\rho + 3\lambda)} \\ (\rho + 3\lambda)\pi - 2\lambda & \text{if } \frac{1}{2} + \frac{\lambda - \rho}{2(\rho + 3\lambda)} \leq \pi < \min\left(\frac{1}{2} + \frac{2 + \lambda - 5\rho}{2(\rho + 3\lambda)}, 1\right) \text{ and} \\ \frac{(1 + 6\lambda)\pi - 4\lambda + 2\rho - 1}{1 + \pi} & \text{if } \min\left(\frac{1}{2} + \frac{2 + \lambda - 5\rho}{2(\rho + 3\lambda)}, 1\right) \leq \pi < 1 \end{cases}$$

$$a_{\max} = \begin{cases} 4\lambda\pi - 2(\lambda - \rho) & \text{if } \frac{1}{2} - \frac{\rho}{2\lambda} < \pi \leq \frac{1}{2} + \frac{\lambda - \rho}{4\lambda} \\ \rho + \lambda & \text{if } \frac{1}{2} + \frac{\lambda - \rho}{4\lambda} \leq \pi < 1 \end{cases}$$

When his degree λ of risk aversion is sufficiently high, exceeding ρ , the analyst seeks a tie with his rival, regardless of his information status and regardless of the information status of the rival. The value of the riskless tie outcome to the analysts is so high when $\rho \leq \lambda < \frac{1}{2}$, that it suppresses any incentive to deviate from the pooling equilibrium of $(0,0,0)$, in which all types of analysts issue the same report of zero. Indeed, according to Proposition 3, in the case of $\rho \leq \lambda < \frac{1}{2}$, the equilibria space contains the pooling equilibrium $(0,0,0)$ for any value of π . Hence, under a high degree of risk aversion, it could even be that an informed analyst finds it optimal to completely ignore his private information in equilibrium and perfectly tie with the zero announcement of an uninformed analyst. Moreover, the pooling equilibrium $(0,0,0)$ is the unique equilibrium that exists for extremely low values of π .¹⁰ This implies that an informed analyst totally ignores his information advantage, even though he knows that the other analyst is most likely to be uninformed. This type of behavior may be adopted, for example, by a young talented analyst, who first wants to ensure his current place in the work hierarchy before aspiring to move up the ranks.

When $\rho \leq \lambda < \frac{1}{2}$, the informed analyst seeks a tie with both an informed rival and an uninformed rival, as is the case in the pooling equilibrium. However, provided that the probability π of the other analyst being informed is sufficiently high, a tie outcome with an equally informed rival is more important for him than a tie with an inferior, uninformed, rival. He is thus willing sometimes

¹⁰ Recall that, for very low values of π , a separating equilibrium does not exist because of the strong motivation of an informed analyst to deviate toward zero. This motivation, which shifts the sloping blue (upper) boundary of the trapezium in Figure 2a below the horizontal red (lower) boundary when π is very low, is absent in the context of the pooling equilibrium $(0,0,0)$, where zero is the equilibrium announcement of both informed and uninformed analysts. Hence, the pooling equilibrium $(0,0,0)$ prevails for any value of π when $\rho \leq \lambda < \frac{1}{2}$.

to draw with an informed rival, even at the expense of deviating from the zero report of an uninformed rival. This allows for the existence of separating equilibria when $\rho \leq \lambda < \frac{1}{2}$, in addition to the pooling equilibrium, as graphically illustrated in Figures 3a and 3b. In providing the graphic illustration, it is useful to divide the range $[\rho, \frac{1}{2})$ to which the degree λ of the analysts' risk aversion belongs into two sub-ranges, where Figure 3a pertains to the sub-range $[\rho, 1 - 3\rho]$ and Figure 3b relates to the sub-range $(1 - 3\rho, \frac{1}{2})$.¹¹ In essence, the results illustrated in Figure 3b (when it is relevant) are very similar to those illustrated in Figure 3a. The difference between the two figures is rather technical. It stems from the bounded support of the earnings distribution, which triggers a change in the strategic behavior of the analysts when they are extremely risk averse, so that $\lambda \in (1 - 3\rho, \frac{1}{2})$, and their probability π of being informed is very high. We thus henceforth focus in our discussion on the illustration in Figure 3a.

[FIGURES 3a and 3b]

In spite of the different underlying forces, the space of separating equilibria that the model yields in the case of $\rho \leq \lambda < \frac{1}{2}$ is similar in its graphical shape to that obtained in the case of $0 < \lambda < \rho$. There are only two differences between the trapezium in Figure 2a that illustrates the equilibria space under $0 < \lambda < \rho$, and the trapezium in Figure 3a that illustrates the equilibria space under $\rho \leq \lambda < \frac{1}{2}$. The first difference is the horizontal red boundary, which moves from the positive value of $\rho - \lambda$ under $0 < \lambda < \rho$ to zero under $\rho \leq \lambda < \frac{1}{2}$. The second difference is the role of the sloping blue boundary, which under $0 < \lambda < \rho$ works to impede the incentive of an informed analyst with favorable (unfavorable) information to deviate from equilibrium and announce slightly above (below) zero in order to improve his chances of winning against an uninformed rival, but under $\rho \leq \lambda < \frac{1}{2}$ it rather works to suppress the incentive of an informed analyst to deviate from equilibrium and announce exactly zero in order to draw with an uninformed rival. The general shape of the equilibria space, however, remains the same in all qualitative aspects. Again, no symmetric separating equilibrium exists when the probability of the analysts being informed is very low, with the single exception of the case where $\lambda = \rho$. Also, as long as π is sufficiently high, multiple symmetric equilibria of the form $(0, -a, a)$ exist, though the truthful

¹¹ Our assumption $0 < \rho \leq \frac{1}{4}$ implies that the first interval $[\rho, 1 - 3\rho]$ is always non-empty and Figure 3a is thus always relevant. However, the second interval $(1 - 3\rho, \frac{1}{2})$ is non-empty and Figure 3b is relevant only when the initial uncertainty about the forthcoming earnings is sufficiently high, satisfying $\frac{1}{6} < \rho \leq \frac{1}{4}$.

reporting strategy $(0, -\rho, \rho)$ is not necessarily one of them, as formally clarified by the following corollary.

Corollary to Proposition 3. *In the case of $\rho \leq \lambda < \frac{1}{2}$ (high risk aversion), the truthful reporting strategy $(0, -\rho, \rho)$ constitutes an equilibrium if and only if $\frac{1}{2} - \frac{\rho}{4\lambda} \leq \pi \leq \frac{1}{2} + \frac{\rho+\lambda}{2(\rho+3\lambda)}$. When*

$\frac{1}{2} - \frac{\rho}{2\lambda} < \pi < \frac{1}{2} - \frac{\rho}{4\lambda}$, any separating equilibrium of the form $(0, -a, a)$ satisfies $a < \rho$. When $\frac{1}{2} + \frac{\rho+\lambda}{2(\rho+3\lambda)} < \pi < 1$, any separating equilibrium of the form $(0, -a, a)$ satisfies $a > \rho$.

In the case $\rho \leq \lambda < \frac{1}{2}$, when the probability π of the analysts being informed is relatively low, satisfying $\frac{1}{2} - \frac{\rho}{2\lambda} < \pi < \frac{1}{2} - \frac{\rho}{4\lambda}$, the upper bound a_{\max} of the report provided by an informed analyst with favorable information, as depicted by the sloping blue line in Figure 3a, is strictly below his true earnings expectation ρ . On the other hand, when the probability π of the analysts being informed is relatively high, satisfying $\frac{1}{2} + \frac{\rho+\lambda}{2(\rho+3\lambda)} < \pi < 1$, the lower bound a_{\min} of the report provided by an informed analyst with favorable information, as depicted by the sloping red line in Figure 3a, is strictly above his true earnings expectation ρ . These results, though driven by different considerations and motivations, are similar to those obtained in the case of $0 < \lambda < \rho$. It thus appears that, as long as the analysts are risk averse, and regardless of their exact degree of risk aversion, an informed analyst tends to under-weight his private information and bias his report toward the prior earnings expectations of zero when his rival is likely to be uninformed, but may over-weight his information and bias his report in the opposite direction when his rival is likely to be equally informed. In both cases, the magnitude of the potential reporting bias is increasing in the degree λ of the analysts' risk aversion.

Symmetric Bayesian equilibria with gambling by uninformed analysts

In this section we focus on equilibria of the form $(\pm b, -a, a)$, where $a \geq 0$ and $b > 0$. We thereby show that the strategic behavior of informed analysts, as explored in Section 3, qualitatively holds even when the uninformed analyst does not choose in equilibrium to truthfully report his earnings prediction of zero but rather finds it optimal to gamble on the direction of the private information and announce either a positive forecast of $+b$ or a negative forecast of $-b$ with equal probabilities. For simplicity, we restrict the analysis in this section to equilibria of the form $(\pm b, -a, a)$, where a and b do not exceed the value of $-\rho + \frac{1}{2}$. This restriction delimits the equilibrium announcements to the overlap range $[\rho - \frac{1}{2}, -\rho + \frac{1}{2}]$ between the support of the

earnings distribution conditional on $\mu = -\rho$ and the support of the earnings distribution conditional on $\mu = \rho$, and thereby eliminates corner solutions that may emerge due the bounded support of the earnings distribution. We accordingly present in Proposition 4 the set of equilibria of the form $(\pm b, -a, a)$, where $0 \leq a \leq -\rho + \frac{1}{2}$ and $0 < b \leq -\rho + \frac{1}{2}$.

Proposition 4. *In the benchmark case of $\lambda = 0$ (risk neutrality), there exists no symmetric Bayesian equilibrium of the form $(\pm b, -a, a)$, where $0 \leq a \leq -\rho + \frac{1}{2}$ and $0 < b \leq -\rho + \frac{1}{2}$. The space of equilibria of the form $(\pm b, -a, a)$, where $0 \leq a \leq -\rho + \frac{1}{2}$ and $0 < b \leq -\rho + \frac{1}{2}$, consists of the sets S_1 and S_3 when $0 < \lambda < \frac{1}{2}\rho$, the sets S_1 , S_2 and S_3 when $\frac{1}{2}\rho \leq \lambda < \rho$, and the sets S_2 , S_3 and S_4 when $\rho \leq \lambda < \frac{1}{2}$, where*

$$S_1 = \left\{ (\pm b, -a, a) \mid \begin{array}{l} \max\{\rho - \lambda, (\rho + 2\lambda)\pi - \lambda\} \leq a \leq \min\{b + 2(-b + \rho + \lambda)\pi, \rho + \lambda, -\rho + \frac{1}{2}\} \\ \text{and } 0 < b \leq \min\{\lambda, \rho - \lambda\} \end{array} \right\},$$

$$S_2 = \left\{ (\pm b, -a, a) \mid \begin{array}{l} \max\{b, (\rho + 2\lambda)\pi - \lambda\} \leq a \leq \min\{\rho - \lambda + (-b + \rho + 3\lambda)\pi, \rho + \lambda, -\rho + \frac{1}{2}\} \\ \text{and } \max\{0, \rho - \lambda\} < b \leq \lambda \end{array} \right\},$$

$$S_3 = \left\{ (\pm a, -a, a) \mid \max\{0, \rho - \lambda\} \leq a \leq \min\{\pi\rho + \lambda, -\rho + \frac{1}{2}\} \right\}, \text{ and}$$

$$S_4 = \left\{ (\pm b, -a, a) \mid \begin{array}{l} \max\{0, \rho - 3\lambda + (\lambda + \rho - b)/\pi\} \leq a \leq \min\{\rho + 3\lambda - (\lambda - \rho - b)/\pi, b\} \\ \text{and } 0 < b \leq \min\{\lambda + \pi(\rho - 2\lambda), -\rho + \frac{1}{2}\} \end{array} \right\}.$$

The set S_1 is not empty if and only if $\left((0 < \lambda < \frac{1}{2}\rho) \text{ and } \left(\frac{1}{2} - \frac{\lambda}{\rho} \leq \pi < 1 \right) \right) \text{ or } (\frac{1}{2}\rho \leq \lambda < \rho)$. The set S_2 is not empty if and only if $(\frac{1}{2}\rho \leq \lambda < \rho) \text{ or } \left((\rho \leq \lambda < \frac{1}{2}) \text{ and } \left(\frac{1}{2} - \frac{3\rho + \lambda}{2(\rho + 3\lambda)} \leq \pi < 1 \right) \right)$. The set S_3 is not empty if and only if $\left((0 < \lambda < \frac{1}{2}\rho) \text{ and } \left(\frac{1}{2} - \frac{4\lambda - \rho}{2\rho} \leq \pi < 1 \right) \right) \text{ or } (\frac{1}{2}\rho \leq \lambda < \frac{1}{2})$. The set S_4 is not empty if and only if $(\rho \leq \lambda < \frac{1}{2}) \text{ and } \left(0 < \pi < \frac{1}{2} + \frac{\rho}{2(2\lambda - \rho)} \right)$.

Proposition 4 indicates that equilibria of the form $(\pm b, -a, a)$, where $0 \leq a \leq -\rho + \frac{1}{2}$ and $0 < b \leq -\rho + \frac{1}{2}$, cannot prevail when the analysts are risk neutral. Knowing that an uninformed competitor reports b or $-b$ with equal probabilities, where $b \neq 0$, it is worthwhile for a risk-neutral analyst without information to deviate from this equilibrium strategy and announce zero. A zero announcement, which is the mean of announcing b or $-b$ with equal probabilities, does not change the utility of the uninformed analyst when facing an informed rival. However, being the best earnings estimate in the absence of private information, a zero announcement does increase the utility of a risk-neutral uninformed analyst in the case of confronting another uninformed analyst.

Only risk aversion on the part of the analysts, which leads them to prefer a riskless outcome over an uncertain outcome that is on average more profitable, can suppress the incentive of an uninformed analyst to deviate from a biased announcement toward the truthful announcement of zero and may lead him to settle for a draw with another uninformed analyst on some common gambling strategy.

Proposition 4 indeed establishes the existence of four sets of equilibria of the form $(\pm b, -a, a)$, where $0 \leq a \leq -\rho + \frac{1}{2}$ and $0 < b \leq -\rho + \frac{1}{2}$, under risk aversion on part of the analysts. Set S_1 includes equilibria with $b < a$, which prevail only when $\frac{1}{2}\rho \leq \lambda < \rho$ or when $0 < \lambda < \frac{1}{2}\rho$ and $\frac{1}{2} - \frac{\lambda}{\rho} \leq \pi < 1$. Set S_2 includes another type of equilibria with $b < a$, but those equilibria prevail only when $\frac{1}{2}\rho \leq \lambda < \rho$ or when $\rho \leq \lambda < \frac{1}{2}$ and $\frac{1}{2} - \frac{3\rho + \lambda}{2(\rho + 3\lambda)} \leq \pi < 1$. It should be noted that although the announcement of the uninformed analyst is lower in magnitude than that of the informed analyst (i.e., $b < a$) in both equilibria sets S_1 and S_2 , set S_1 contains equilibria with relatively low values of b (below $\rho - \lambda$) and set S_2 contains equilibria with relatively high values of b (above $\rho - \lambda$). Set S_3 includes equilibria with $b = a$, which exist when $\frac{1}{2}\rho \leq \lambda < \frac{1}{2}$ or when $0 < \lambda < \frac{1}{2}\rho$ and $\frac{1}{2} - \frac{4\lambda - \rho}{2\rho} \leq \pi < 1$. Set S_4 includes equilibria with $b > a$, which exist only when $\rho \leq \lambda < \frac{1}{2}$ and $0 < \pi < \frac{1}{2} + \frac{\rho}{2(2\lambda - \rho)}$. As the equilibria in set S_4 prevail only for a small range of parameter values, we focus in our discussion on the equilibria sets S_1 , S_2 and S_3 . Figure 4 accordingly pertains to the case of $\frac{1}{2}\rho \leq \lambda < \rho$, for which all equilibria that belong to the sets S_1 , S_2 and S_3 co-exist. A graphical illustration of some of the equilibria that belong to the set S_1 appears in Figure 4a, a graphical illustration of some of the equilibria that belong to the set S_2 appears in Figure 4b, and a graphical illustration of all the equilibria that belong to set S_3 appears in Figure 4c.

[FIGURES 4a, 4b and 4c]

Figure 4a illustrates a subset of equilibria of the form $(\pm b, -a, a) \in S_1$ for a fixed value of b , such that $0 < b < \rho - \lambda$. Figure 4b similarly illustrates a subset of equilibria of the form $(\pm b, -a, a) \in S_2$ for a fixed value of b , such that $b > \rho - \lambda$. The horizontal green line in both figures depicts the fixed value of b , whereas the corresponding equilibrium values of a are contained in

the trapezium that is bounded by the solid red lines and the solid blue lines.¹² For comparison, the space of all equilibria of the form $(0, -a, a)$ for the same parameters values is illustrated in both figures by the dotted trapezium. The illustration suggests that, regardless of whether an uninformed analyst truthfully reports his earnings prediction of zero in equilibrium or alternatively gambles on the direction of the private information and announces either a positive forecast of $+b$ or a negative forecast of $-b$ with equal probabilities, the set of the corresponding equilibrium announcements of an informed analyst is contained within a trapezium of similar structure. The trapezium shape of the equilibria space reinforces our results regarding the tendency of an informed analyst to understate (overstate) when he believes that his rival is likely to be uninformed (informed), indicating that this strategic behavior of the informed analyst is qualitatively robust to the strategic behavior of the uninformed analyst.

The economic forces that explain the four bounds of the solid trapezium in Figure 4a (Figure 4b) are similar to the forces underlying the bounds of the dotted trapezium. The horizontal red and blue boundaries of the equilibria space in both figures work to suppress the incentive of an informed analyst with favorable (unfavorable) information to improve his chances against an equally informed rival by slightly deviating from the equilibrium announcement of a ($-a$) in the direction of his information. The sloping blue boundary, which now depends on b , works to diminish the motivation of an informed analyst with favorable (unfavorable) information to increase his chances against an uninformed rival. The binding condition depicted by the sloping blue boundary in Figure 4a is different than that depicted by the sloping blue boundary in Figure 4b. In Figure 4a, the sloping blue boundary suppresses the incentive of the informed analyst with favorable (unfavorable) information to win against an uninformed rival by deviating from the equilibrium announcement of a ($-a$) and announcing slightly above b (below $-b$). In Figure 4b, however, the sloping blue boundary suppresses the incentive of the informed analyst to draw with an uninformed rival by deviating from the equilibrium announcement of a ($-a$) and announcing exactly b ($-b$). The sloping red

¹² Proposition 4 indicates that, as long as $\frac{1}{2}\rho \leq \lambda < \rho$ and regardless of the value of π , there must exist at least one pair of scalars a and b such that $(\pm b, -a, a) \in S_1$, and there must exist another pair of scalars a and b such that $(\pm b, -a, a) \in S_2$. In other words, when the value of b is unrestricted, equilibria of the form $(\pm b, -a, a) \in S_1$, as well as equilibria of the form $(\pm b, -a, a) \in S_2$, exist for any π in the case of $\frac{1}{2}\rho \leq \lambda < \rho$. However, for a fixed value of b , equilibria of the form $(\pm b, -a, a) \in S_1$, as well as equilibria of the form $(\pm b, -a, a) \in S_2$, exist only when the value of π is not too low, as illustrated by the trapeziums in Figures 4a and 4b. As the value of b moves toward $\rho - \lambda$ from below (above), the trapezium in Figures 4a (4b) spreads over a larger range of values of π , so the range where no equilibrium exists diminishes and eventually becomes empty at the limit when b converges to $\rho - \lambda$.

boundary works to suppress the motivation of an uninformed analyst to deviate from the equilibrium announcement of $\pm b$ toward the announcement $\pm a$ of an informed analyst. This boundary is independent of b as long as b is strictly positive, but it is more restrictive for $b > 0$ as compared to the case of $b = 0$. This is because the temptation of an uninformed analyst to deviate from the equilibrium announcement of $\pm b$ toward $\pm a$ is stronger under a positive $b > 0$, where such a deviation is associated with the cost of giving up the tie outcome against another uninformed analyst only in half the cases when they gamble on the same direction, as compared to the case of $b = 0$, where the deviation is associated with the higher cost of always waiving the tie outcome against another uninformed analyst.

The equilibria of the form $(\pm b, -a, a)$ for $0 < b < a \leq -\rho + \frac{1}{2}$, as described in Figures 4a and 4b, reflect situations where the uninformed analyst finds it optimal to gamble on the direction of the private information and announce either a positive forecast of $+b$ or a negative forecast of $-b$ with equal probabilities. In all these equilibria, however, the announcement of the uninformed analyst is lower in magnitude than that of the informed analyst (i.e., $b < a$). In addition to these multiple equilibria with $b < a$, there also exist multiple equilibria with $b = a$, in which the announcement of the uninformed analyst exactly coincides with that of the informed analyst in the case of a successful gamble. This set of equilibria (set S_3) is graphically illustrated in Figure 4c by the solid trapezium. For convenience of comparison, the space of all equilibria of the form $(0, -a, a)$ for the same parameter values is illustrated again by the dotted trapezium.

The solid trapezium in Figure 4c differs in its structure from the dotted trapezium. Here, only two binding conditions determine the shape of the solid trapezium – the lower bound depicted by the horizontal red line and the upper bound depicted by the sloping blue line. The horizontal red boundary of the equilibria space works to suppress the incentive of an informed analyst with favorable (unfavorable) information to improve his chances against an equally informed rival by slightly deviating from the equilibrium announcement of a ($-a$) in the direction of his information. Here, unlike Figure 4a, only the lower horizontal bound at $\rho - \lambda$ is sufficient to deter such deviation, because the upper horizontal bound at $\rho + \lambda$ is subsumed by the sloping blue boundary and is thus not binding. The upper bound depicted by the sloping blue boundary of the equilibria space works to suppress the incentive of an uninformed analyst to deviate from the equilibrium mixed announcements of $\pm a$ toward mixed announcements that are closer to zero. Such a deviation improves the position of an uninformed analyst against an uninformed rival at the cost of detracting from his chances against an informed rival. Therefore, the blue boundary becomes less restrictive as the probability π of confronting an informed analyst increases. Most importantly, due to the sloping blue boundary, the understatement behavior by an informed analyst with exclusive information prevails even when the uninformed analyst aims at exactly mimicking the

announcement of an informed analyst. As the uninformed analyst announces as if he is informed in any equilibrium of the form $(\pm a, -a, a)$, two binding conditions that play an important role in sets S_1 and S_2 of equilibria are not relevant here – the one that deters the tendency of an informed analyst to deviate from equilibrium toward the announcement of an uninformed analyst and the one that suppresses the tendency of an uninformed analyst to deviate from equilibrium toward the announcement of an informed analyst. The smaller number of binding conditions explains why pooling equilibria of the form $(\pm a, -a, a)$ exist for a wide range of parameter values and sometimes emerge even in circumstances where separating equilibria of the form $(\pm b, -a, a)$, where $a \neq b$, are absent. In the case of $\frac{1}{2}\rho \leq \lambda < \frac{1}{2}$, where the degree of risk aversion of the analysts is sufficiently high to make the tie outcome desirable for them, the sloping blue boundary is above the horizontal red boundary for any $0 < \pi < 1$, so equilibria of the form $(\pm a, -a, a)$ exist for any value of the parameter π (as depicted in Figure 4c). In the case of $0 < \lambda < \frac{1}{2}\rho$, however, the sloping blue boundary and the horizontal red boundary intersect at $\pi = \frac{1}{2} - \frac{4\lambda - \rho}{2\rho}$, so equilibria of the form $(\pm a, -a, a)$ exist only for sufficiently high values of the parameter π that satisfy $\frac{1}{2} - \frac{4\lambda - \rho}{2\rho} \leq \pi < 1$.

The analysis of the symmetric equilibria of the form $(\pm b, -a, a)$ with $b > 0$, as given in this section, reinforces the robustness of the insights that emerge from the analysis of the symmetric equilibria of the form $(0, -a, a)$ in Section 3. It is also important in establishing the existence of symmetric equilibria for a larger range of parameter values. Table 2 presents the range of parameter values, for which symmetric equilibria of the form $(\pm b, -a, a)$ exist, with a separation to five classes of equilibria - $a > b = 0$, $a = b = 0$, $a > b > 0$, $a = b > 0$, and $b > a \geq 0$. As reflected in the table, separating equilibria with $a > b \geq 0$ always exist when $\frac{1}{2}\rho \leq \lambda < \rho$, regardless of the value of π , but in the cases of $0 \leq \lambda < \frac{1}{2}\rho$ and $\rho \leq \lambda < \frac{1}{2}$ they can only exist when the value of π is not too low. Also, pooling equilibria with $a = b \geq 0$ always exist when $\frac{1}{2}\rho \leq \lambda < \frac{1}{2}$, regardless of the value of π , but they cannot prevail under $\lambda = 0$ and in the case of $0 < \lambda < \frac{1}{2}\rho$ they can only exist when the value of π is sufficiently high.

[TABLE 2]

It follows from Table 2 that pooling equilibria are more prevalent than separating equilibria when the degree λ of risk aversion of the analysts is at least ρ . For $\rho \leq \lambda < \frac{1}{2}$, pooling equilibria always exist, regardless of the value of π , but separating equilibria exist only if the probability π is not too low. The opposite is however true when the degree λ of risk aversion of the analysts is below $\frac{1}{2}\rho$. For $0 \leq \lambda < \frac{1}{2}\rho$, the range of probabilities π for which separating equilibria exist is

larger than the range of probabilities π for which pooling equilibria exist (because $0 \leq \lambda < \frac{1}{2}\rho$ implies $\frac{1}{2} - \frac{\lambda}{\rho} < \frac{1}{2} - \frac{4\lambda - \rho}{2\rho}$).¹³ For intermediate degrees λ of risk-aversion, which satisfy

$\frac{1}{2}\rho \leq \lambda < \rho$, both pooling and separating equilibria always exist, regardless of the value of π .

Intuitively, the more (less) risk averse are the analysts, the more (less) valuable is the tie outcome for them, and thus the more (less) prevalent are pooling equilibria and the less (more) prevalent are separating equilibria.

Concluding remarks

It has been well established in the literature that, in spite of the fact that the professional careers of financial analysts largely depend on the accuracy of their forecasting, their public forecasts do not necessarily reflect the best prediction suggested by their private information. Many studies, both empirical and theoretical, indicate the propensity of financial analysts to bias their publicly reported forecasts relative to their privately held information. The literature posits that weak analysts are likely to understate their private information and strategically bias their announcements in the direction of the public expectations, whilst strong analysts tend to adopt an opposite strategy of biasing their report away from the public beliefs in order to stand out from the herd. Contrary to this common perception, our study points to circumstances where analysts strategically choose to understate their private information and shift their announcement toward the public expectations when they possess exclusive information, which is not likely to be available to their peers, but exhibit the opposite behavior of overstating their information when they estimate that their peers are likely to be equally informed. The counter-intuitive understatement behavior of top analysts, as well as the opposite overstatement behavior of ordinary analysts, is established within a reporting game between two risk-averse analysts, who compete on their relative forecasting accuracy, and whose endowment with information is uncertain and unobservable to their peers. Our results can be interpreted as implying that forecasts of analysts are likely to understate (overstate) their private information in environments where information is difficult to obtain (easily obtainable) and in environments with limited (extensive) coverage of analysts. This interpretation is based on the notion that the skills of top analysts are more likely to assist them in obtaining exclusive information in environments where information is not very accessible (e.g., information on small firms, highly volatile firms, firms with a less transparent information

¹³At the extreme, when $\lambda = 0$, pooling equilibria cannot survive regardless of the value of π , while a separating equilibrium (the truthful reporting equilibrium) exists for $\pi \geq \frac{1}{2}$.

environment, firms intensively involved in earnings management) and where analyst coverage is scanty.

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Appendix– Proofs

The proofs of Propositions 1-4 are based on Lemmata 5-11, which are stated and proved below. To streamline the presentation, we take away from proofs of the Lemmata technical details that can be derived by applying simple arithmetic calculations and are available from the authors upon request.

Lemma 5. A scalar $a \geq 0$ satisfies $F^{a,0}(a) \geq F^{a,0}(f)$ for any $f \in \mathfrak{R}$ if and only if

$(a > 0$ and $\rho - \lambda \leq a \leq \min\{2(\rho + \lambda)\pi, -2(\lambda - \rho) + 4\lambda\pi, \rho + \lambda\})$ or $(a = 0$ and $\lambda \geq \rho)$.

Proof of the Lemma 5. The condition $F^{a,0}(a) \geq F^{a,0}(f)$ for any $f \in \mathfrak{R}$ is equivalent to intersection of the following conditions, which are derived under two cases: $a > 0$ and $a = 0$.

The case $a > 0$ yields the following conditions:

$$\forall a > 0, f > a: F^{a,0}(a) \geq F^{a,0}(f) \Leftrightarrow a \geq \rho - \lambda \quad (1)$$

$$\forall a > 0, 0 < f < a: F^{a,0}(a) \geq F^{a,0}(f) \Leftrightarrow a \leq \min\{2(\rho + \lambda)\pi, \rho + \lambda\} \quad (2)$$

$$\forall a > 0: F^{a,0}(a) \geq F^{a,0}(0) \Leftrightarrow a \leq -2(\lambda - \rho) + 4\lambda\pi \quad (3)$$

$$\forall a > 0, 0 < f < a: F^{a,0}(a) \geq F^{a,0}(f) \Rightarrow \forall a > 0, f < 0: F^{a,0}(a) \geq F^{a,0}(f) \quad (4)$$

The case $a = 0$ yields the following condition:

$$F^{0,0}(0) \geq F^{0,0}(f) \text{ for any } f \neq 0 \Leftrightarrow \lambda \geq \rho \quad (5)$$

The proof of the lemma now follows from (1)-(5). \square

Lemma 6. A scalar $a \geq 0$ satisfies $G^{a,0}(-a) \geq G^{a,0}(f)$ for any $f \in \mathfrak{R}$ if and only if

$(a > 0$ and $\rho - \lambda \leq a \leq \min\{2(\rho + \lambda)\pi, -2(\lambda - \rho) + 4\lambda\pi, \rho + \lambda\})$ or $(a = 0$ and $\lambda \geq \rho)$.

Proof of the Lemma 6. Using symmetry considerations, the proof of Lemma 6 immediately follows from Lemma 5. \square

Lemma 7. A scalar $a \geq 0$ satisfies $H^{a,0}(0) \geq \frac{1}{2}H^{a,0}(f) + \frac{1}{2}H^{a,0}(-f)$ for any $f \in \mathfrak{R}$ if and only if $(0 < a \leq 1 - 2\rho$ and $a \geq \max\{-2\lambda + (\rho + 3\lambda)\pi, \frac{2\rho\pi}{1+\pi} - \frac{2(1-\pi)}{1+\pi}\lambda\})$ or $(a > 1 - 2\rho$ and $a \geq \frac{(1+6\lambda)\pi - 4\lambda + 2\rho - 1}{1+\pi})$ or $a = 0$.

Proof of the Lemma 7. Using symmetry considerations, we can restrict the proof to non-negative values of f . The condition $H^{a,0}(0) \geq \frac{1}{2}H^{a,0}(f) + \frac{1}{2}H^{a,0}(-f)$ for any $f \in \mathfrak{R}$ is thus equivalent to intersection of the following conditions, which are derived under two cases: $a > 0$ and $a = 0$.

The case $a > 0$ yields the following conditions:

$$\forall a > 0, 0 < f < a: H^{a,0}(0) \geq H^{a,0}(f) \quad (6)$$

$$\forall 0 < a \leq 1 - 2\rho: H^{a,0}(0) \geq H^{a,0}(a) \Leftrightarrow a \geq -2\lambda + (\rho + 3\lambda)\pi \quad (7)$$

$$\forall a > 1 - 2\rho: H^{a,0}(0) \geq H^{a,0}(a) \Leftrightarrow a \geq \frac{(1+6\lambda)\pi - 4\lambda + 2\rho - 1}{1+\pi} \quad (8)$$

$$\forall 0 < a \leq 1 - 2\rho, f > a: H^{a,0}(0) \geq H^{a,0}(f) \Leftrightarrow a \geq \frac{2\rho\pi}{1+\pi} - \frac{2(1-\pi)}{1+\pi}\lambda \quad (9)$$

$$\forall a > 1 - 2\rho, f > a: H^{a,0}(0) \geq H^{a,0}(f) \quad (10)$$

The case $a = 0$ yields the following condition:

$$H^{0,0}(0) \geq H^{0,0}(f) \text{ for any } f \neq 0 \quad (11)$$

The proof of the Lemma now follows from (6)-(11). \square

Lemma 8. A scalar $a \geq 0$ characterizes an equilibrium of the form $(0, -a, a)$ if and only if $(0 < a \leq 1 - 2\rho$ and $\max\{\rho - \lambda, -2\lambda + (\rho + 3\lambda)\pi\} \leq a \leq \min\{2(\rho + \lambda)\pi, -2(\lambda - \rho) + 4\lambda\pi, \rho + \lambda\})$ or $(a > 1 - 2\rho$ and $\max\{\rho - \lambda, \frac{(1+6\lambda)\pi - 4\lambda + 2\rho - 1}{1+\pi}\} \leq a \leq \min\{2(\rho + \lambda)\pi, -2(\lambda - \rho) + 4\lambda\pi, \rho + \lambda\})$ or $(a = 0$ and $\lambda \geq \rho)$.

Proof of the Lemma 8. A scalar $a \geq 0$ characterizes a symmetric equilibrium of the form $(0, -a, a)$ if and only if the following three conditions hold: (i) $F^{a,0}(a) \geq F^{a,0}(f)$; (ii) $G^{a,0}(-a) \geq G^{a,0}(f)$; and (iii) $H^{a,0}(0) \geq \frac{1}{2}H^{a,0}(f) + \frac{1}{2}H^{a,0}(-f)$ for any $f \in \mathfrak{R}$. By Lemmata 5-7, these conditions hold if and only if $(0 < a \leq 1 - 2\rho$ and

$\max\{\rho - \lambda, -2\lambda + (\rho + 3\lambda)\pi, \frac{2\rho\pi}{1+\pi} - \frac{2(1-\pi)}{1+\pi}\lambda\} \leq a \leq \min\{2(\rho + \lambda)\pi, -2(\lambda - \rho) + 4\lambda\pi, \rho + \lambda\}$ or $(a > 1 - 2\rho$
 and $\max\{\rho - \lambda, \frac{(1+6\lambda)\pi - 4\lambda + 2\rho - 1}{1+\pi}\} \leq a \leq \min\{2(\rho + \lambda)\pi, -2(\lambda - \rho) + 4\lambda\pi, \rho + \lambda\}$) or $(a = 0$ and
 $\lambda \geq \rho)$. However, $\max\{\rho - \lambda, -2\lambda + (\rho + 3\lambda)\pi, \frac{2\rho\pi}{1+\pi} - \frac{2(1-\pi)}{1+\pi}\lambda\}$ equals
 $\max\{\rho - \lambda, -2\lambda + (\rho + 3\lambda)\pi\}$, because $\rho - \lambda \geq \frac{2\rho\pi}{1+\pi} - \frac{2(1-\pi)}{1+\pi}\lambda$ for $\pi \leq \frac{\rho + \lambda}{\rho + 3\lambda}$ and
 $-2\lambda + (\rho + 3\lambda)\pi \geq \frac{2\rho\pi}{1+\pi} - \frac{2(1-\pi)}{1+\pi}\lambda$ for $\pi \geq \frac{\rho + \lambda}{\rho + 3\lambda}$. So, a non-negative scalar a satisfies conditions (i),
 (ii) and (iii) if and only if $(0 < a \leq 1 - 2\rho$ and
 $\max\{\rho - \lambda, -2\lambda + (\rho + 3\lambda)\pi\} \leq a \leq \min\{2(\rho + \lambda)\pi, -2(\lambda - \rho) + 4\lambda\pi, \rho + \lambda\}$) or $(a > 1 - 2\rho$
 and $\max\{\rho - \lambda, \frac{(1+6\lambda)\pi - 4\lambda + 2\rho - 1}{1+\pi}\} \leq a \leq \min\{2(\rho + \lambda)\pi, -2(\lambda - \rho) + 4\lambda\pi, \rho + \lambda\}$) or $(a = 0$ and $\lambda \geq \rho)$. \square

Proof of Proposition 1. When $\lambda = 0$ and $0 < \pi < \frac{1}{2}$, $\max\{\rho - \lambda, -2\lambda + (\rho + 3\lambda)\pi\} = \rho$,
 $\max\{\rho - \lambda, \frac{(1+6\lambda)\pi - 4\lambda + 2\rho - 1}{1+\pi}\} = \rho$ and $\min\{2(\rho + \lambda)\pi, -2(\lambda - \rho) + 4\lambda\pi, \rho + \lambda\} = 2\pi\rho < \rho$, so by
 Lemma 8 no equilibrium exists. When $\lambda = 0$ and $\frac{1}{2} \leq \pi < 1$, $\max\{\rho - \lambda, -2\lambda + (\rho + 3\lambda)\pi\} = \rho$,
 $\max\{\rho - \lambda, \frac{(1+6\lambda)\pi - 4\lambda + 2\rho - 1}{1+\pi}\} = \rho$ and $\min\{2(\rho + \lambda)\pi, -2(\lambda - \rho) + 4\lambda\pi, \rho + \lambda\} = \rho$, so by Lemma 8
 $(0, -\rho, \rho)$ is the unique equilibrium. \square

Proof of Proposition 2 and its corollary. In the case of $0 < \lambda < \rho$, a cannot exceed $1 - 2\rho$. This is
 because $a \leq \rho + \lambda$ by Lemma 8. As $\lambda < \rho$ and $\rho \leq \frac{1}{4}$, it follows that $a \leq \rho + \lambda < 2\rho \leq 1 - 2\rho$.
 So, in the case of $0 < \lambda < \rho$, Lemma 8 implies that a scalar $a \geq 0$ characterizes an equilibrium of
 the form $(0, -a, a)$ if and only if $(a > 0$ and $a_{\min} \leq a \leq a_{\max})$, where
 $a_{\min} = \max\{\rho - \lambda, (\rho + 3\lambda)\pi - 2\lambda\}$ and $a_{\max} = \min\{2(\rho + \lambda)\pi, -2(\lambda - \rho) + 4\lambda\pi, \rho + \lambda\}$. When
 $0 < \pi < \frac{1}{2} - \frac{\lambda}{\rho + \lambda}$, $a_{\min} = \rho - \lambda$ and $a_{\max} = 2(\rho + \lambda)\pi < \rho - \lambda$, so by Lemma 8 no equilibrium
 exists. However, when $\frac{1}{2} - \frac{\lambda}{\rho + \lambda} \leq \pi < 1$, there is a non-empty range (a_{\min}, a_{\max}) , such that any
 scalar $a \in (a_{\min}, a_{\max})$ characterizes a symmetric equilibrium of the form $(0, -a, a)$, where a_{\min}
 equals $\rho - \lambda$ if $\frac{1}{2} - \frac{\lambda}{\rho + \lambda} \leq \pi \leq \frac{1}{2} + \frac{\rho - \lambda}{2(\rho + 3\lambda)}$ and equals $(\rho + 3\lambda)\pi - 2\lambda$ if $\frac{1}{2} + \frac{\rho - \lambda}{2(\rho + 3\lambda)} \leq \pi < 1$, and
 where a_{\max} equals $2(\rho + \lambda)\pi$ if $\frac{1}{2} - \frac{\lambda}{\rho + \lambda} \leq \pi \leq$ and equals $\rho + \lambda$ if $\frac{1}{2} \leq \pi < 1$. Now, to prove the
 corollary, it should be noted that $a_{\max} < \rho$ when $\frac{1}{2} - \frac{\lambda}{\rho + \lambda} \leq \pi < \frac{1}{2} - \frac{\lambda}{2(\rho + \lambda)}$, $a_{\min} \leq \rho \leq a_{\max}$ when
 $\frac{1}{2} - \frac{\lambda}{2(\rho + \lambda)} \leq \pi \leq \frac{1}{2} + \frac{\rho + \lambda}{2(\rho + 3\lambda)}$, and $a_{\min} > \rho$ when $\frac{1}{2} + \frac{\rho + \lambda}{2(\rho + 3\lambda)} < \pi < 1$. \square

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Proof of Proposition 3 and its corollary. By Lemma 8, when $\rho \leq \lambda < \frac{1}{2}$, the pooling strategy $(0,0,0)$ is always an equilibrium. When $\rho \leq \lambda < \frac{1}{2}$ and $0 < \pi \leq \frac{1}{2} - \frac{\rho}{2\lambda}$, $\min\{2(\rho + \lambda)\pi, -2(\lambda - \rho) + 4\lambda\pi, \rho + \lambda\} = -2(\lambda - \rho) + 4\lambda\pi \leq 0$, so by Lemma 8 no separating equilibrium exists. However, when $\frac{1}{2} - \frac{\rho}{2\lambda} < \pi < 1$, in addition to the pooling equilibrium, there is a non-empty range (a_{\min}, a_{\max}) , such that any scalar $a \in (a_{\min}, a_{\max})$ characterizes an equilibrium of the form $(0, -a, a)$. When $\frac{1}{2} - \frac{\rho}{2\lambda} < \pi \leq \frac{1}{2} + \frac{\lambda - \rho}{2(\rho + 3\lambda)}$, $a_{\min} = 0$ because $\max\{\rho - \lambda, (\rho + 3\lambda)\pi - 2\lambda\} < 0$. When $\frac{1}{2} + \frac{\lambda - \rho}{2(\rho + 3\lambda)} \leq \pi < \min\{1, \frac{1}{2} + \frac{2 + \lambda - 5\rho}{2(\rho + 3\lambda)}\}$, $a_{\min} = \max\{\rho - \lambda, (\rho + 3\lambda)\pi - 2\lambda\} = (\rho + 3\lambda)\pi - 2\lambda$ and is increasing in π , getting the value of $1 - 2\rho$ at $\pi = \frac{1}{2} + \frac{2 + \lambda - 5\rho}{2(\rho + 3\lambda)}$. Therefore, from $\pi = \frac{1}{2} + \frac{2 + \lambda - 5\rho}{2(\rho + 3\lambda)}$ on, $a_{\min} = \max\{\rho - \lambda, \frac{(1 + 6\lambda)\pi - 4\lambda + 2\rho - 1}{1 + \pi}\} = \frac{(1 + 6\lambda)\pi - 4\lambda + 2\rho - 1}{1 + \pi}$, which also gets the value of $1 - 2\rho$ at $\pi = \frac{1}{2} + \frac{2 + \lambda - 5\rho}{2(\rho + 3\lambda)}$ and is increasing and concave in π . Also, a_{\max} equals $-2(\lambda - \rho) + 4\lambda\pi$ if $\frac{1}{2} - \frac{\rho}{2\lambda} < \pi \leq \frac{1}{2} + \frac{\lambda - \rho}{4\lambda}$ and $\rho + \lambda$ if $\frac{1}{2} + \frac{\lambda - \rho}{4\lambda} \leq \pi < 1$. Now, to prove the corollary, note $a_{\max} < \rho$ when $\frac{1}{2} - \frac{\rho}{2\lambda} < \pi < \frac{1}{2} - \frac{\rho}{4\lambda}$, $a_{\min} \leq \rho \leq a_{\max}$ when $\frac{1}{2} - \frac{\rho}{4\lambda} \leq \pi \leq \frac{1}{2} + \frac{\rho + \lambda}{2(\rho + 3\lambda)}$, and $a_{\min} > \rho$ when $\frac{1}{2} + \frac{\rho + \lambda}{2(\rho + 3\lambda)} < \pi < 1$. \square

Lemma 9. Scalars $0 \leq a \leq -\rho + \frac{1}{2}$ and $0 < b \leq -\rho + \frac{1}{2}$ satisfy $F^{a,b}(a) \geq F^{a,b}(f)$ for any $f \in \mathfrak{R}$ if and only if $(a > b$ and $\rho - \lambda \leq a \leq \min\{b + 2(-b + \rho + \lambda)\pi, \rho - \lambda + (-b + \rho + 3\lambda)\pi, \rho + \lambda\})$ or $(\rho - \lambda \leq a = b \leq \rho + \lambda)$ or $(0 \leq a < b$ and $\max\{b - 2\lambda + 2\frac{\rho - b}{\pi}, \rho - 3\lambda + \frac{\lambda + \rho - b}{\pi}\} \leq a \leq \min\{\rho + 3\lambda - \frac{\lambda - \rho - b}{\pi}, \rho + \lambda\})$.

Proof of the Lemma 9. The condition $F^{a,b}(a) \geq F^{a,b}(f)$ for any $f \in \mathfrak{R}$ is equivalent to intersection of the following conditions, which are derived under three cases: $a > b$, $a = b$ and $0 \leq a < b$.

The case of $a > b$ yields the following conditions:

$$\forall 0 < b < a \leq -\rho + \frac{1}{2}, f > a: F^{a,b}(a) \geq F^{a,b}(f) \Leftrightarrow a \geq \rho - \lambda \quad (12)$$

$$\forall 0 < b < a \leq -\rho + \frac{1}{2}, b < f < a: F^{a,b}(a) \geq F^{a,b}(f) \Leftrightarrow a \leq \min\{b + 2(-b + \rho + \lambda)\pi, \rho + \lambda\} \quad (13)$$

$$\forall 0 < b < a \leq -\rho + \frac{1}{2}: F^{a,b}(a) \geq F^{a,b}(b) \Leftrightarrow a \leq \rho - \lambda + (-b + \rho + 3\lambda)\pi \quad (14)$$

$$\forall 0 < b \leq a \leq -\rho + \frac{1}{2}, b \leq f < a: F^{a,b}(a) \geq F^{a,b}(f) \Rightarrow$$

$$\forall 0 < b < a < -\rho + \frac{1}{2}, -b < f < b: F^{a,b}(a) \geq F^{a,b}(f) \quad (15)$$

$$\forall 0 < b < a \leq -\rho + \frac{1}{2}: F^{a,b}(a) \geq F^{a,b}(b) \Rightarrow F^{a,b}(a) \geq F^{a,b}(-b) \quad (16)$$

$$\forall 0 < b < a \leq -\rho + \frac{1}{2}, b < f < a: F^{a,b}(a) \geq F^{a,b}(f) \Rightarrow$$

$$\forall 0 < b < a \leq -\rho + \frac{1}{2}, f < -b: F^{a,b}(a) \geq F^{a,b}(f) \quad (17)$$

The case of $a = b$ yields the following conditions:

$$\forall 0 < b \leq -\rho + \frac{1}{2}, f > b: F^{b,b}(b) \geq F^{b,b}(f) \Leftrightarrow b \geq \rho - \lambda \quad (18)$$

$$\forall 0 < b \leq -\rho + \frac{1}{2}, -b < f < b: F^{b,b}(b) \geq F^{b,b}(f) \Leftrightarrow b \leq \rho + \lambda \quad (19)$$

$$\forall 0 < b \leq -\rho + \frac{1}{2}: F^{b,b}(b) \geq F^{b,b}(-b) \quad (20)$$

$$\forall b > 0, f < -b: F^{b,b}(b) \geq F^{b,b}(f) \quad (21)$$

The case of $0 \leq a < b$ yields the following conditions:

$$\forall 0 \leq a < b \leq -\rho + \frac{1}{2}, f > b: F^{a,b}(a) \geq F^{a,b}(f) \Leftrightarrow a \geq b - 2\lambda + 2\frac{\rho-b}{\pi} \quad (22)$$

$$\forall 0 \leq a < b \leq -\rho + \frac{1}{2}: F^{a,b}(a) \geq F^{a,b}(b) \Leftrightarrow a \geq \rho - 3\lambda + \frac{\lambda + \rho - b}{\pi} \quad (23)$$

$$\forall 0 \leq a < b \leq -\rho + \frac{1}{2}, a < f < b: F^{a,b}(a) \geq F^{a,b}(f) \Leftrightarrow a \leq \rho + \lambda \quad (24)$$

$$\forall 0 \leq a < b \leq -\rho + \frac{1}{2}, a < f < b: F^{a,b}(a) \geq F^{a,b}(f)$$

$$\forall 0 \leq a < b \leq -\rho + \frac{1}{2}, -b < f < a: F^{a,b}(a) \geq F^{a,b}(f) \quad (25)$$

$$\forall 0 \leq a < b \leq -\rho + \frac{1}{2}: F^{a,b}(a) \geq F^{a,b}(-b) \Leftrightarrow a \leq \rho + 3\lambda - \frac{\lambda - \rho - b}{\pi} \quad (26)$$

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$$\begin{aligned} \forall 0 \leq a < b \leq -\rho + \frac{1}{2}, a < f < b: F^{a,b}(a) \geq F^{a,b}(f) &\Rightarrow \\ \forall 0 \leq a < b \leq -\rho + \frac{1}{2}, f < -b: F^{a,b}(a) \geq F^{a,b}(f) &\quad (27) \end{aligned}$$

The proof of the Lemma now follows from (12)-(27). \square

Lemma 10. Scalars $0 \leq a \leq -\rho + \frac{1}{2}$ and $0 < b \leq -\rho + \frac{1}{2}$ satisfy $G^{a,b}(-a) \geq G^{a,b}(f)$ for any $f \in \mathfrak{R}$ if and only if $(a > b$ and $\rho - \lambda \leq a \leq \min\{b + 2(-b + \rho + \lambda)\pi, \rho - \lambda + (-b + \rho + 3\lambda)\pi, \rho + \lambda\})$ or $(\rho - \lambda \leq a = b \leq \rho + \lambda)$ or $(0 \leq a < b$ and $\max\{b - 2\lambda + 2\frac{\rho-b}{\pi}, \rho - 3\lambda + \frac{\lambda+\rho-b}{\pi}\} \leq a \leq \min\{\rho + 3\lambda - \frac{\lambda-\rho-b}{\pi}, \rho + \lambda\})$.

Proof of the Lemma 10. Using symmetry considerations, the proof of Lemma 10 immediately follows from Lemma 9. \square

Lemma 11. Scalars $0 \leq a \leq -\rho + \frac{1}{2}$ and $0 \leq b < -\rho + \frac{1}{2}$ satisfy $\frac{1}{2}H^{a,b}(b) + \frac{1}{2}H^{a,b}(-b) \geq \frac{1}{2}H^{a,b}(f) + \frac{1}{2}H^{a,b}(-f)$ for any $f \in \mathfrak{R}$ if and only if $(a > b$ and $b \leq \lambda$ and $a \geq \max\{-\lambda + (\rho + 2\lambda)\pi, \frac{2\pi}{1+\pi}\rho - \frac{1-\pi}{1+\pi}\lambda\})$ or $(\pi\rho - \lambda \leq a = b \leq \pi\rho + \lambda)$ or $(0 \leq a < b$ and $b \leq \lambda + (\rho - 2\lambda)\pi$ and $\lambda - \frac{\lambda-b}{\pi} \leq a \leq 2\rho - \lambda + \frac{\lambda-b}{\pi})$.

Proof of the Lemma 11. Using symmetry considerations, we can restrict the proof to non-negative values of f . The condition $\frac{1}{2}H^{a,b}(b) + \frac{1}{2}H^{a,b}(-b) \geq \frac{1}{2}H^{a,b}(f) + \frac{1}{2}H^{a,b}(-f)$ for any $f \in \mathfrak{R}$ is thus equivalent to intersection of the following conditions, which are derived under three cases: $a > b$, $a = b$ and $0 \leq a < b$.

The case $a > b$ yields the following conditions:

$$\forall 0 < b < a \leq -\rho + \frac{1}{2}, 0 \leq f < b: H^{a,b}(b) \geq H^{a,b}(f) \Leftrightarrow b \leq \lambda \quad (28)$$

$$\forall 0 < b < a \leq -\rho + \frac{1}{2}, b < f < a: H^{a,b}(b) \geq H^{a,b}(f) \quad (29)$$

$$\forall 0 < b < a \leq -\rho + \frac{1}{2}: H^{a,b}(b) \geq H^{a,b}(a) \Leftrightarrow a \geq \pi\rho - (1 - 2\pi)\lambda \quad (30)$$

$$\forall 0 < b < a \leq -\rho + \frac{1}{2}, f > a: H^{a,b}(b) \geq H^{a,b}(f) \Leftrightarrow a \geq \frac{2\pi}{1+\pi}\rho - \frac{1-\pi}{1+\pi}\lambda \quad (31)$$

The case $a = b$ yields the following conditions:

$$\forall 0 < b \leq -\rho + \frac{1}{2}, 0 \leq f < b: H^{b,b}(b) \geq H^{b,b}(f) \Leftrightarrow b \leq \pi\rho + \lambda \quad (32)$$

$$\forall 0 < b \leq -\rho + \frac{1}{2}, f > b: H^{b,b}(b) \geq H^{b,b}(f) \Leftrightarrow b \geq \pi\rho - \lambda \quad (33)$$

The case $0 \leq a < b$ yields the following conditions:

$$\forall 0 \leq a < b \leq -\rho + \frac{1}{2}, 0 \leq f < a: H^{a,b}(b) \geq H^{a,b}(f) \Leftrightarrow a \leq 2\rho - \lambda + \frac{\lambda-b}{\pi} \quad (34)$$

$$\forall 0 \leq a < b \leq -\rho + \frac{1}{2}: H^{a,b}(b) \geq H^{a,b}(a) \Leftrightarrow b \leq \pi\rho + (1-2\pi)\lambda \quad (35)$$

$$\forall 0 \leq a < b \leq -\rho + \frac{1}{2}, a < f < b: H^{a,b}(b) \geq H^{a,b}(f) \Leftrightarrow a \geq \lambda - \frac{\lambda-b}{\pi} \quad (36)$$

$$\forall 0 \leq a < b \leq -\rho + \frac{1}{2}, f > b: H^{a,b}(b) \geq H^{a,b}(f) \quad (37)$$

The proof of the Lemma now follows from (28)-(37). \square

Proof of Proposition 4. Two scalars $a, b \in \mathfrak{R}$, such that $0 \leq a \leq \frac{1}{2} - \rho$ and $0 < b \leq \frac{1}{2} - \rho$, characterize an equilibrium of the form $(\pm b, -a, a)$ if and only if the following three conditions hold:

(i) $F^{a,b}(a) \geq F^{a,b}(f)$; (ii) $G^{a,b}(-a) \geq G^{a,b}(f)$; and (iii) $\frac{1}{2}H^{a,b}(b) + \frac{1}{2}H^{a,b}(-b) \geq H^{a,b}(f)$ for any $f \in \mathfrak{R}$.

By Lemmata 9-11, these conditions hold if and only if ($a > b$ and $b \leq \lambda$ and

$$\max\{-\lambda + (\rho + 2\lambda)\pi, \frac{2\pi}{1+\pi}\rho - \frac{1-\pi}{1+\pi}\lambda, \rho - \lambda\} \leq a \leq \min\{(1-2\pi)b + 2\pi\rho + 2\pi\lambda, -\pi b + (\pi+1)\rho + (3\pi-1)\lambda, \rho + \lambda\}$$

) or ($\max\{0, \rho - \lambda\} \leq a = b \leq \lambda + \pi\rho$) or ($0 \leq a < b$ and $b \leq \lambda + \pi(\rho - 2\lambda)$ and

$$\max\{\lambda - \frac{\lambda-b}{\pi}, b - 2\lambda + 2\frac{\rho-b}{\pi}, \rho - 3\lambda + \frac{\lambda+\rho-b}{\pi}\} \leq a \leq \min\{2\rho - \lambda + \frac{\lambda-b}{\pi}, \rho + 3\lambda - \frac{\lambda-\rho-b}{\pi}, \rho + \lambda\}.$$

Any equilibrium of the form $(\pm a, -a, a)$, where $0 < a \leq \frac{1}{2} - \rho$, must satisfy

$\max\{0, \rho - \lambda\} \leq a \leq \pi\rho + \lambda$. When $\lambda = 0$, it must be that $\rho \leq a \leq \pi\rho$, but since $0 < \pi < 1$ it cannot be that $\rho \leq a \leq \pi\rho$. Equilibria of this type exist only when $\lambda > 0$ and provided that

$\rho - \lambda \leq \pi\rho + \lambda$. Hence, the set S_3 is not empty if and only if

$$\left((0 < \lambda < \frac{1}{2}\rho) \text{ and } \left(\frac{1}{2} - \frac{4\lambda-\rho}{2\rho} \leq \pi < 1 \right) \right) \text{ or } \left(\frac{1}{2}\rho \leq \lambda < \frac{1}{2} \right).$$

Any equilibrium $(\pm b, -a, a)$ with $0 < b < a \leq \frac{1}{2} - \rho$ must satisfy $0 < b \leq \lambda$ and $a_{\min} \leq a \leq a_{\max}$,

where $a_{\min} = \max\{-\lambda + (\rho + 2\lambda)\pi, \frac{2\pi}{1+\pi}\rho - \frac{1-\pi}{1+\pi}\lambda, \rho - \lambda\}$ and

$a_{\max} = \min\{b+2(-b+\rho+\lambda)\pi, \rho-\lambda+(-b+\rho+3\lambda)\pi, \rho+\lambda\}$. Such equilibria exist only for $\lambda > 0$, because $\lambda = 0$ implies $0 < b \leq \lambda = 0$.

For any $0 < \lambda < \rho$, $0 < b \leq \min\{\lambda, \rho - \lambda\}$, a_{\min} equals $\rho - \lambda$ if $0 < \pi \leq \frac{1}{2} + \frac{\rho - 2\lambda}{2(\rho + 2\lambda)}$ and equals $-\lambda + (\rho + 2\lambda)\pi$ if $\frac{\rho}{\rho + 2\lambda} \leq \pi < 1$, a_{\max} equals $b + 2(-b + \rho + \lambda)\pi$ if $0 < \pi \leq \frac{1}{2}$ and equals $\rho + \lambda$ if $\frac{1}{2} \leq \pi < 1$, and $a_{\min} \leq a_{\max}$ if and only if $\pi \geq \frac{1}{2} - \frac{\lambda}{-b + \rho + \lambda}$. Hence, the set S_1 is not empty if and only if $\pi \geq \frac{1}{2} - \frac{\lambda}{-\min\{\lambda, \rho - \lambda\} + \rho + \lambda}$. Substituting $\min\{\lambda, \rho - \lambda\} = \lambda$ when $0 < \lambda < \frac{1}{2}\rho$ and $\min\{\lambda, \rho - \lambda\} = \rho - \lambda$ when $\frac{1}{2}\rho \leq \lambda < \rho$, we get that the set S_1 is not empty if and only if $\left(\left(0 < \lambda < \frac{1}{2}\rho\right) \text{ and } \left(\frac{1}{2} - \frac{\lambda}{\rho} \leq \pi < 1\right)\right) \text{ or } \left(\frac{1}{2}\rho \leq \lambda < \rho\right)$.

For $\frac{1}{2}\rho \leq \lambda \leq \frac{1}{2}\rho$, $\max\{0, \rho - \lambda\} < b \leq \lambda$, a_{\min} equals b if $0 < \pi \leq \frac{b + \lambda}{\rho + 2\lambda}$ and equals $-\lambda + (\rho + 2\lambda)\pi$ if $\frac{b + \lambda}{\rho + 2\lambda} \leq \pi < 1$, a_{\max} equals $\rho - \lambda + (-b + \rho + 3\lambda)\pi$ if $0 < \pi \leq \frac{2\lambda}{-b + \rho + 3\lambda}$ and equals $\rho + \lambda$ if $\frac{2\lambda}{-b + \rho + 3\lambda} \leq \pi < 1$, and $a_{\min} \leq a_{\max}$ if and only if $\pi \geq \frac{b - \rho + \lambda}{-b + \rho + 3\lambda}$. Hence, the set S_2 is not empty if and only if $\pi \geq \frac{\max\{0, \rho - \lambda\} - \rho + \lambda}{-\max\{0, \rho - \lambda\} + \rho + 3\lambda}$. Substituting $\max\{0, \rho - \lambda\} = \rho - \lambda$ when $\frac{1}{2}\rho \leq \lambda < \rho$ and $\max\{0, \rho - \lambda\} = 0$ when $\rho \leq \lambda < \frac{1}{2}\rho$, we get that the set S_2 is not empty if and only if $\left(\frac{1}{2}\rho \leq \lambda < \rho\right) \text{ or } \left(\rho \leq \lambda < \frac{1}{2}\rho\right) \text{ and } \left(\frac{1}{2} - \frac{3\rho + \lambda}{2(\rho + 3\lambda)} \leq \pi < 1\right)$.

Lastly, any equilibrium of the form $(\pm b, -a, a)$, where $0 \leq a < b \leq \frac{1}{2} - \rho$, must satisfy $b \leq \lambda + \pi(\rho - 2\lambda)$ and $a_{\min} \leq a \leq a_{\max}$, where $a_{\min} = \max\{\lambda - \frac{\lambda - b}{\pi}, b - 2\lambda + 2\frac{\rho - b}{\pi}, \rho - 3\lambda + \frac{\lambda + \rho - b}{\pi}\}$ and $a_{\max} = \min\{2\rho - \lambda + \frac{\lambda - b}{\pi}, \rho + 3\lambda - \frac{\lambda - \rho - b}{\pi}, \rho + \lambda\}$. Such equilibria exist only for $\rho \leq \lambda < \frac{1}{2}$. This is because $a \geq b - 2\lambda + 2\frac{\rho - b}{\pi}$ implies $\pi a + (2 - \pi)b \geq 2\rho - 2\pi\lambda$. Using now $a < b \leq \lambda + \pi(\rho - 2\lambda)$, we get $\pi(\lambda + \pi(\rho - 2\lambda)) + (2 - \pi)(\lambda + \pi(\rho - 2\lambda)) \geq \pi a + (2 - \pi)b \geq 2\rho - 2\pi\lambda$ or $2(\lambda + \pi(\rho - 2\lambda)) \geq 2\rho - 2\pi\lambda$ or $\lambda \geq \rho$. For $\rho \leq \lambda < \frac{1}{2}$, $0 < b \leq \lambda + \pi(\rho - 2\lambda)$ implies $0 < \pi \leq \frac{\lambda - b}{2\lambda - \rho}$. As the inequality $b - 2\lambda + 2\frac{\rho - b}{\pi} < \rho - 3\lambda + \frac{\lambda + \rho - b}{\pi}$ always holds, $a_{\min} = \max\{\lambda - \frac{\lambda - b}{\pi}, \rho - 3\lambda + \frac{\lambda + \rho - b}{\pi}\}$. Now note that $\lambda - \frac{\lambda - b}{\pi} \geq \rho - 3\lambda + \frac{\lambda + \rho - b}{\pi}$ if and only if $\pi \geq \frac{\rho - 2b + 2\lambda}{4\lambda - \rho}$. However, as the inequality $\frac{\rho - 2b + 2\lambda}{4\lambda - \rho} > \frac{\lambda - b}{2\lambda - \rho}$ always holds, $0 < \pi \leq \frac{\lambda - b}{2\lambda - \rho}$ implies $0 < \pi < \frac{\rho - 2b + 2\lambda}{4\lambda - \rho}$. So, $a_{\min} = \max\{0, \rho - 3\lambda + \frac{\lambda + \rho - b}{\pi}\}$. Next, $0 < b \leq \lambda + \pi(\rho - 2\lambda)$ implies

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$2\rho - \lambda + \frac{\lambda - b}{\pi} \geq \rho + \lambda$, so $a_{\max} = \min\{\rho + 3\lambda - \frac{\lambda - \rho - b}{\pi}, \rho + \lambda\}$. Also, $\rho + \lambda \geq b$ because $0 < b \leq \lambda + \pi(\rho - 2\lambda)$, implying $a_{\max} = \min\{\rho + 3\lambda - \frac{\lambda - \rho - b}{\pi}, b\}$. A necessary condition for the existence of such equilibrium is $0 < b \leq \lambda + \pi(\rho - 2\lambda)$, which implies $0 < \lambda + \pi(\rho - 2\lambda)$ or $\pi < \frac{\lambda}{2\lambda - \rho}$ or $\pi < \frac{1}{2} + \frac{\rho}{2(2\lambda - \rho)}$. Another necessary condition for the existence of such equilibrium is $a_{\min} \leq a_{\max}$, but this condition always holds for $b = \lambda + \pi(\rho - 2\lambda)$. Hence, the set S_4 is not empty if and only if $(\rho \leq \lambda < \frac{1}{2})$ and $(0 < \pi < \frac{1}{2} + \frac{\rho}{2(2\lambda - \rho)})$. \square

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Figures

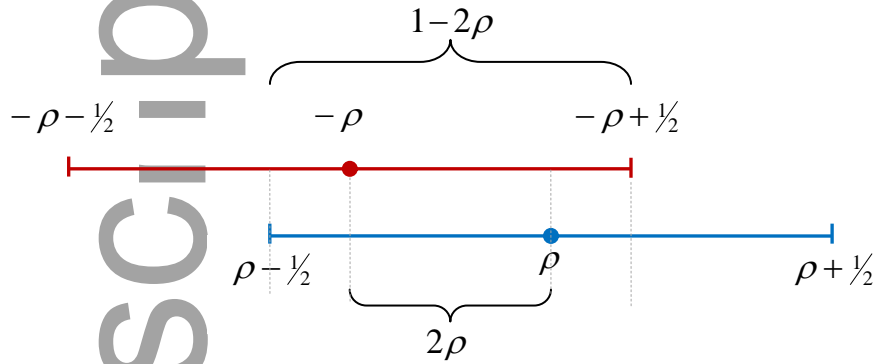


Figure 1. The figure illustrates the earnings distribution. The red interval is the support of the uniform earnings distribution conditional on $\mu = -\rho$. The blue interval is the support of the uniform earnings distribution conditional on $\mu = \rho$. The length of the overlap between the two intervals is $1 - 2\rho$. The distance between their midpoints is 2ρ .

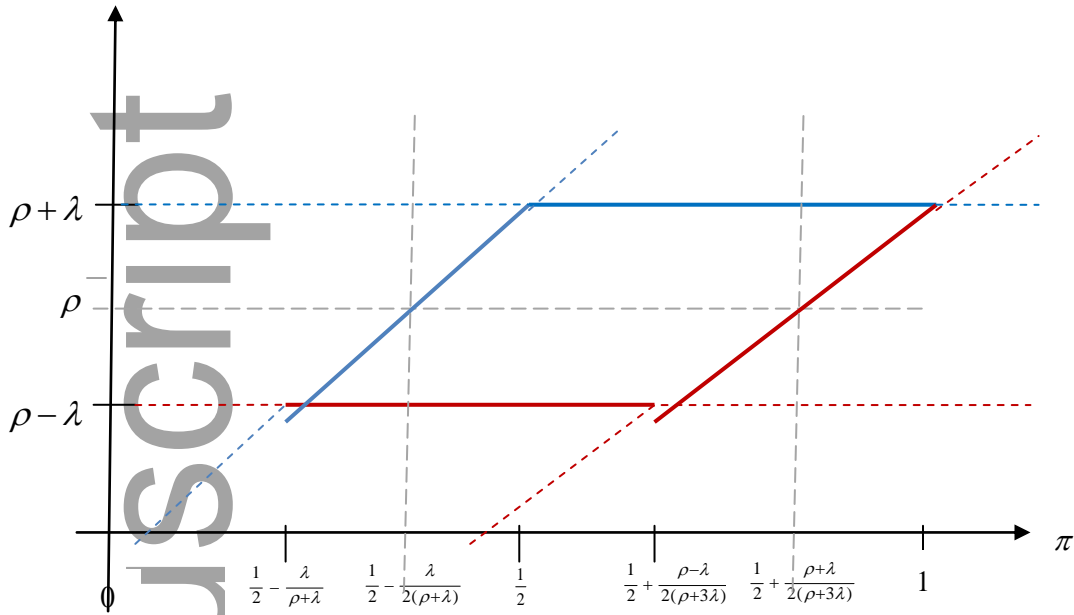


Figure 2a. The figure illustrates the space of all separating equilibria of the form $(0, -a, a)$ in the case of $0 < \lambda < \rho$. The horizontal axis in the figure represents all the possible values of the probability π of being informed. The vertical axis represents all the possible reporting choices of an informed analyst with favorable information, where ρ is the truthful reporting choice. The broken red line describes the lower bound a_{\min} of the equilibrium earnings forecast a reported by an informed analyst with favorable information as a function of π , whereas the broken blue line describes the upper bound a_{\max} of his report a as a function of π . Given the probability π of being informed, any scalar a that lies in the trapezium between the two corresponding bounds characterizes an equilibrium of the form $(0, -a, a)$.

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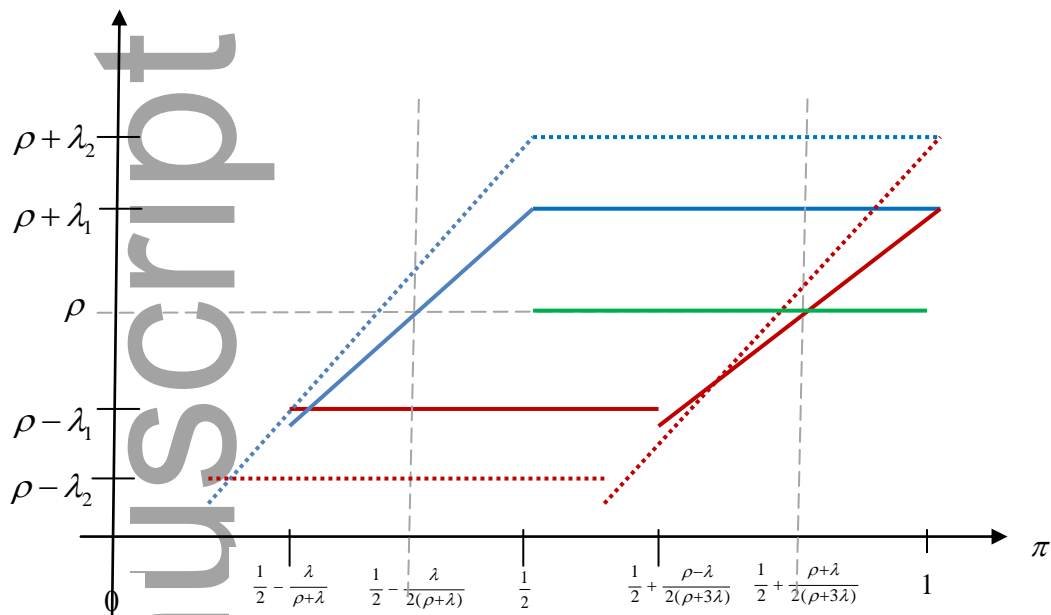


Figure 2b. The figure illustrates how the space of all separating equilibria of the form $(0, -a, a)$ changes in the degree λ of the analysts' risk aversion in the case of $0 < \lambda < \rho$. As in Figure 2a, the horizontal axis in the figure represents all the possible values of the probability π of being informed, while the vertical axis represents all the possible reporting choices of an informed analyst with favorable information, where ρ is the truthful reporting choice. The solid red (blue) plot describes the lower (upper) bound a_{\min} (a_{\max}) of the equilibrium earnings forecast a reported by an informed analyst with favorable information as a function of π , for a fixed value λ_1 of the parameter λ . The lower (upper) bound a_{\min} (a_{\max}) of the trapezium, which depicts the equilibria space, moves from the solid red (blue) plot toward the dotted red (blue) plot as the degree λ of the analysts' risk aversion increases from λ_1 to λ_2 , where $0 < \lambda_1 < \lambda_2 < \rho$. The equilibria space in the benchmark case $\lambda = 0$ of risk neutrality is obtained at the limit as λ converges to zero and the trapezium becomes so thin that eventually its upper and lower parallel sides conjoin into the green line segment.

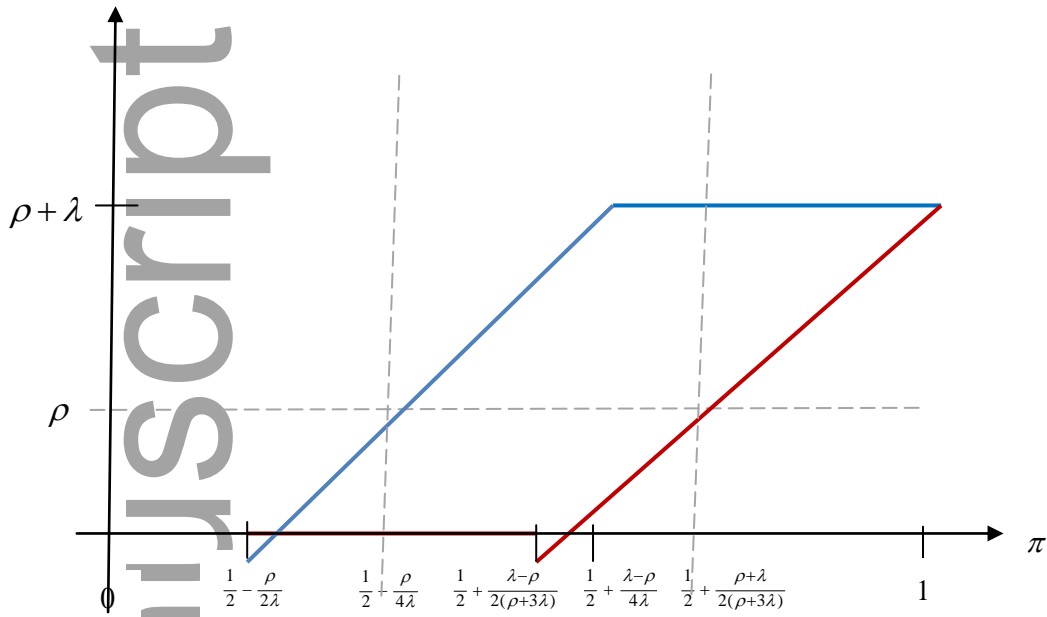


Figure 3a. The figure illustrates the space of all separating equilibria of the form $(0, -a, a)$ in the case of $\rho \leq \lambda \leq 1 - 3\rho$. The horizontal axis in the figure represents all the possible values of the probability π of being informed. The vertical axis represents all the possible reporting choices of an informed analyst with favorable information, where ρ is the truthful reporting choice. The broken red line describes the lower bound a_{\min} of the equilibrium earnings forecast a reported by an informed analyst with favorable information as a function of π , while the broken blue line describes the upper bound a_{\max} of his report a as a function of π . Given the probability π of being informed, any scalar a that lies in the trapezium between the two corresponding bounds characterizes an equilibrium of the form $(0, -a, a)$.

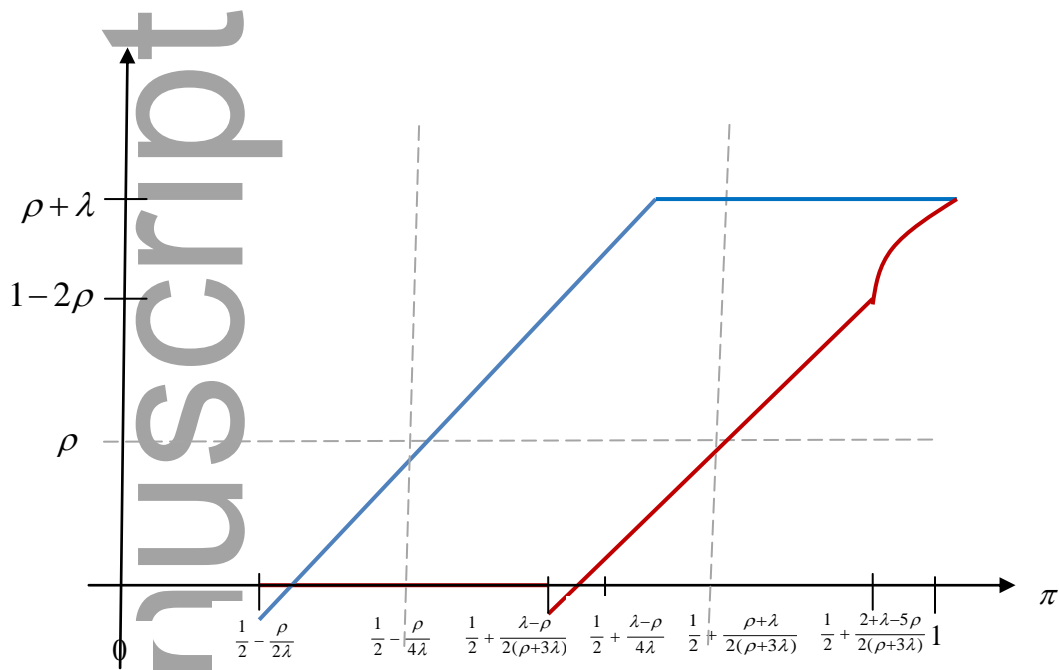


Figure 3b. The figure illustrates the space of all separating equilibria of the form $(0, -a, a)$ in the case of $1 - 3\rho < \lambda < \frac{1}{2}$. The horizontal axis in the figure represents all the possible values of the probability π of being informed. The vertical axis represents all the possible reporting choices of an informed analyst with favorable information, where ρ is the truthful reporting choice. The red curve describes the lower bound a_{\min} of the equilibrium earnings forecast a reported by an informed analyst with favorable information as a function of π , while the broken blue line describes the upper bound a_{\max} of his report a as a function of π . Given the probability π of being informed, any scalar a that lies between the two corresponding bounds characterizes an equilibrium of the form $(0, -a, a)$.

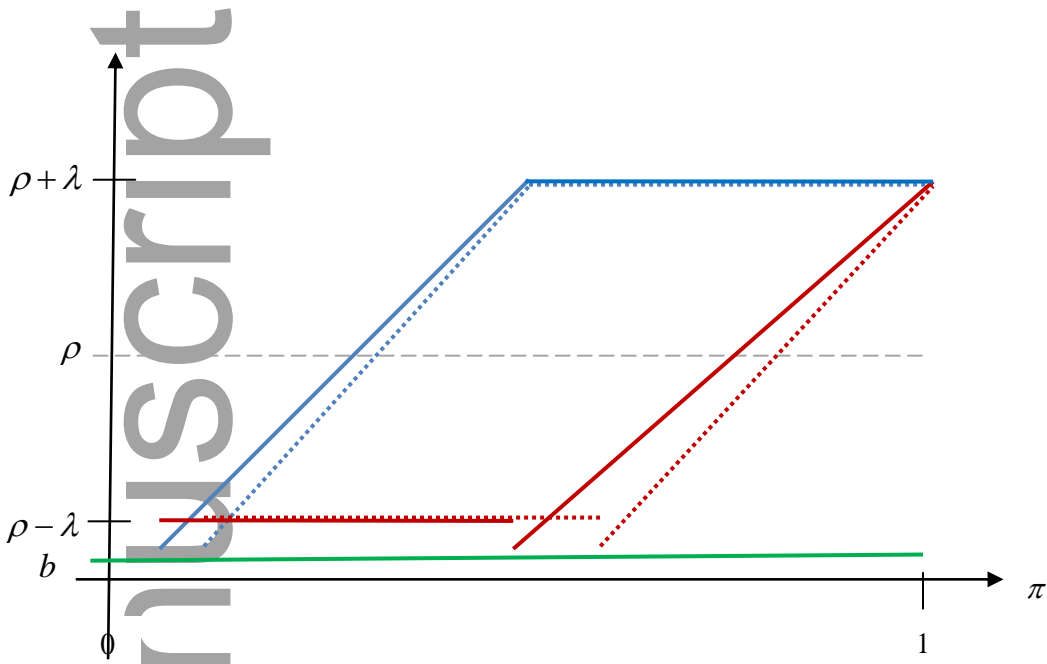


Figure 4a. The figure illustrates the space of all equilibria of the form $(\pm b, -a, a)$ for a fixed value of b , such that $0 < b < \rho - \lambda$, in the case of $\frac{1}{2}\rho \leq \lambda < \rho$. The horizontal axis in the figure represents all the possible values of the probability π of being informed. The vertical axis represents all the possible reporting choices. The horizontal solid green line describes the fixed value of b . The broken solid red line describes the lower bound of the equilibrium announcement a of an informed analyst with favorable information as a function of π , while the broken solid blue line describes the upper bound of his announcement a as a function of π . Given the probability π of being informed, any scalar a that lies in the trapezium between the solid red and the solid blue bounds characterizes an equilibrium of the form $(\pm b, -a, a) \in \mathcal{S}_1$. The dotted trapezium is the space of all equilibria of the form $(0, -a, a)$ for the same parameter values.

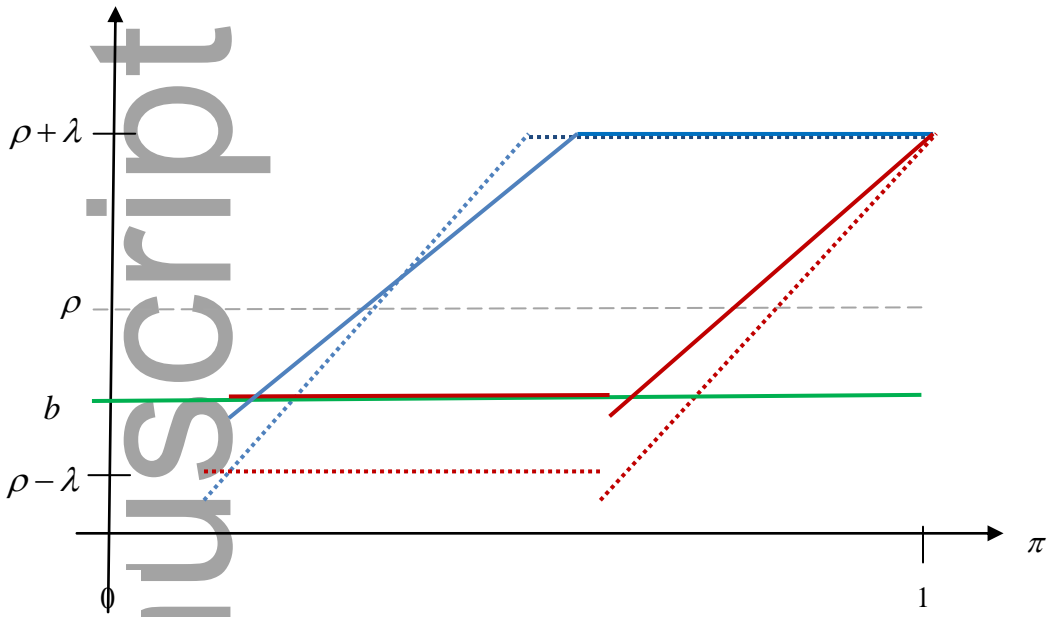


Figure 4b. The figure illustrates the space of all equilibria of the form $(\pm b, -a, a)$ for a fixed value of b , such that $b > \rho - \lambda$, in the case of $\frac{1}{2}\rho \leq \lambda < \rho$. The horizontal axis in the figure represents all the possible values of the probability π of being informed. The vertical axis represents all the possible reporting choices. The horizontal solid green line describes the fixed value of b . The broken solid red line describes the lower bound of the equilibrium announcement a of an informed analyst with favorable information as a function of π , while the broken solid blue line describes the upper bound of his announcement a as a function of π . Given the probability π of being informed, any scalar a that lies in the trapezium between the solid red and the solid blue bounds characterizes an equilibrium of the form $(\pm b, -a, a) \in \mathcal{S}_2$. The dotted trapezium is the space of all equilibria of the form $(0, -a, a)$ for the same parameter values.

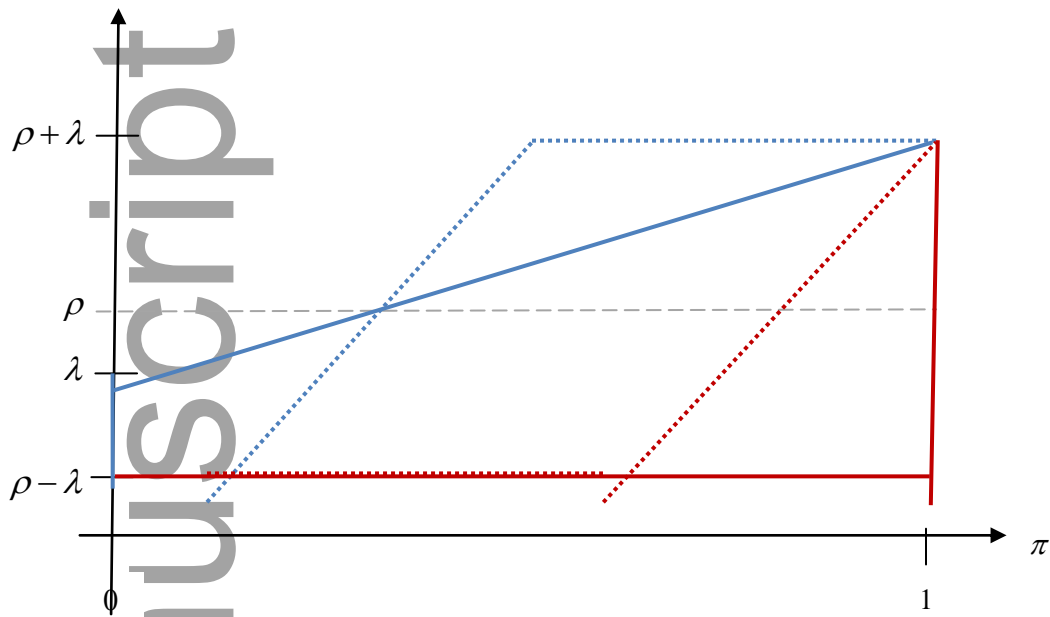


Figure 4c. The figure illustrates the space of all equilibria of the form $(\pm a, -a, a)$ in the case of $\frac{1}{2}\rho \leq \lambda < \rho$. The horizontal axis in the figure represents all the possible values of the probability π of being informed. The vertical axis represents all the possible reporting choices. The horizontal red line describes the lower bound of a , while the sloping blue line describes the upper bound of a as a function of π . Given the probability π of being informed, any scalar a that lies in the trapezium between the horizontal red and the sloping blue bounds characterizes an equilibrium of the form $(\pm a, -a, a)$. The dotted trapezium is the space of all equilibria of the form $(0, -a, a)$ for the same parameters values.

Author

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Tables

Analyst \ Rival	Informed $\mu = \rho$	Informed $\mu = -\rho$	Uninformed
Informed $\mu = \rho$	π	0	$1 - \pi$
Informed $\mu = -\rho$	0	π	$1 - \pi$
Uninformed	$\frac{1}{2}\pi$	$\frac{1}{2}\pi$	$1 - \pi$

Table 1. The table presents the beliefs of each analyst with respect to the information status of his rival, conditional on his own information status. Each row in the table pertains to one of the three possible information statuses of an analyst: (1) informed with favorable signal; (2) informed with unfavorable signal; and (3) uninformed. The three possible information statuses of his rival are similarly presented in the columns of the table. The slot in row i ($i = 1, 2, 3$) and column j ($j = 1, 2, 3$) presents the probability that an analyst with information status i ascribes to the scenario that the information status of his rival is j .

	$b = 0$		$b > 0$		
	$a > 0$	$a = 0$	$a > b$	$a = b$	$a < b$
$\lambda = 0$	$\frac{1}{2} \leq \pi < 1$	-	-	-	-
$0 < \lambda < \frac{1}{2}\rho$	$\frac{1}{2} - \frac{\lambda}{\rho + \lambda} \leq \pi < 1$	-	$\frac{1}{2} - \frac{\lambda}{\rho} \leq \pi < 1$	$\frac{1}{2} - \frac{4\lambda - \rho}{2\rho} \leq \pi < 1$	-
$\frac{1}{2}\rho \leq \lambda < \rho$	$\frac{1}{2} - \frac{\lambda}{\rho + \lambda} \leq \pi < 1$	-	$0 < \pi < 1$	$0 < \pi < 1$	-
$\rho \leq \lambda < \frac{1}{2}$	$\frac{1}{2} - \frac{\rho}{2\lambda} < \pi < 1$	$0 < \pi < 1$	$\frac{1}{2} - \frac{3\rho + \lambda}{2(\rho + 3\lambda)} \leq \pi < 1$	$0 < \pi < 1$	$0 < \pi < \frac{1}{2} + \frac{\rho}{2(2\lambda - \rho)}$

Table 2. The table presents the range of the parameter values, for which there exist symmetric equilibria of the form $(\pm b, -a, a)$. The rows in the table pertain to four levels of risk aversion of the analysts: (1) $\lambda = 0$; (2) $0 < \lambda < \frac{1}{2}\rho$; (3) $\frac{1}{2}\rho \leq \lambda < \rho$; and (4) $\rho \leq \lambda < \frac{1}{2}$. The columns pertain to five classes of symmetric equilibria of the form $(\pm b, -a, a)$: (1) $a > b = 0$; (2) $a = b = 0$; (3) $a > b > 0$; (4) $a = b > 0$; and (5) $b > a \geq 0$. The slot in row i ($i = 1, 2, 3, 4$) and column j ($j = 1, 2, 3, 4, 5$) presents the range of the probabilities π , for which there exist symmetric equilibria of type j under a level i of risk aversion.

Author

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