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Capsules and Comments

Disclosure When the Market Is Unsure of Information Endowment of Managers

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1. Introduction

Whether insiders (e.g., managers, sellers) fully disclose their private information has been a research interest in accounting as well as in finance and economics. Grossman and Hart [1980] and Grossman [1981] support full disclosure of private information based on an adverse selection argument. That is, when insiders are known to withhold information, outsiders (e.g., investors, consumers) discount the quality of goods insiders deal with to the lowest possible value consistent with their discretionary disclosure. This in turn drives insiders to make full disclosure.

On the other hand, Dye [1985] has recently demonstrated the possibility of partial disclosure based on a scenario in which investors are not sure whether managers are endowed with private information.[1] In his scenario, given no information disclosure by managers, investors are uncertain whether the nondisclosure is due to nonexistence of information or due to its adverse content. This uncertainty on the part of investors deters the adverse selection and leads to partial disclosure

[1] In fact, Dye [1985] presented two separate scenarios leading to partial disclosure in equilibrium. We refer to his first model, in which there is no moral hazard problem.

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(given information endowment) in equilibrium.[2] Given no information disclosure, however, Dye [1985] uses in his analysis the unconditional probablity that managers have not disclosed any information, and this potentially causes multiple disclosure policies to arise in equilibrium (see n. 3 for details of the multiplicity).

In this study, we extend the Dye model to allow outside investors to revise, in the absence of disclosure, their probabilities that managers have received no private information. Using the revised conditional probabilities enables us to resolve the problem of potential multiplicity of partial disclosure policies and, thereby, establish its uniqueness. Such uniqueness is not only conceptually more plausible but also produces substantially more general results than those in Dye, as will be shown in Propositions 2 and 3. First, if investors believe that the likelihood managers will receive information increases as time elapses, then, on average, unfavorable (favorable) news is contained in late (early) announcements. Second, we demonstrate the possibility that investors' information acquisition from an independent source (e.g., the financial press, financial analysts) may trigger the release of information that would otherwise be withheld by managers.

Section 2 extends the Dye [1985] model and shows the existence of a unique partial disclosure policy. Section 3 contains comparative statics analyses and their implications.

2. The Model

Consider a single-period model in which the manager of a firm and risk-neutral investors share at the beginning of the period common prior beliefs regarding the period-end value of the firm $\tilde{x}$, but during the period the manager privately observes, with probability $(1 - p)$, a realization of firm value, denoted by x. The prior beliefs are represented by a density function $f(\tilde{x})$ with its support $[\underline{x}, \bar{x}]$ and mean μ. $(1 - p)$ and $f(\tilde{x})$ are common knowledge in the model. Upon receipt, the manager can make, at his discretion, credible announcements about the value of this information, so that the price of the firm becomes x after the announcements.

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[2] Other studies regarding discretionary disclosure policy include Jovanovic [1982] and Verrecchia [1983], which independently demonstrated that in the presence of disclosure-related costs, managers exercise discretion in disclosing their private information by suppressing unfavorable news and revealing only favorable news. In these models, as in Dye [1985], it is investors' uncertainty about managers' motivation for withholding information which induces partial disclosure; i.e., managers withhold information either because it is unfavorable or because its release is not warranted due to disclosure-related costs, and investors are unable to distinguish one from the other. The role of uncertainty in these discretionary disclosure models parallels the one in a finitely repeated reputation game, which is to help resolve the chain store paradox and thus allow reputation effects to play a meaningful role in such a game (see Kreps and Wilson [1982]).

The manager, however, cannot make a credible assertion that he has received no information. As in Dye [1985], we assume that the firm's shareholders unanimously agree to a disclosure policy which maximizes firm value, and the manager, being compensated a fixed salary, adopts this policy.

In this setting, investors perceive ex ante that one of three mutually exclusive events, denoted by A, B, and C, will be realized during the period. Event A is that no information is received and no disclosure is made by the manager. Event B is that information is received but withheld, while event C is that information is both received and disclosed. Note that if no disclosure is made ex post, investors cannot distinguish event A from event B. Since event A is a null-information event, investors' prior beliefs about firm value remain unaltered if that event is believed to have occurred. Therefore, the conditional expectation of $\tilde{x}$ given event A is identical with the unconditional mean, i.e.:

$$E(\tilde{x} \mid A) = \mu. \tag{1}$$

In contrast, when event B is believed to have taken place, rational investors infer that the manager withholds information because its content is unfavorable in the sense that the information signal is below some point, denoted by y, such that $y \in [\underline{x}, \bar{x}]$. The point y is referred to as the threshold value of disclosure. Accordingly, the conditional expectation of $\tilde{x}$ given event B is written as:

$$E(\tilde{x} \mid B) = \int_{\underline{x}}^{y} \frac{\tilde{x}}{F(y)} \, dF(\tilde{x}). \tag{2}$$

Further, we can assign probabilities to those three events on the basis of the information available to investors (including their conjectures about y).

Event	Probabilities
Event A: No information is received by the manager	$\text{Prob}(A) = p$
Event B: Information is received but not disclosed	$\text{Prob}(B) = (1 - p) \cdot F(y)$
Event C: Information is received and disclosed	$\text{Prob}(C) = (1 - p) \cdot [1 - F(y)]$

where:

$$F(y) = \text{Prob}(\tilde{x} \le y) = \int_{\underline{x}}^{y} dF(\tilde{x}).$$

From the firm's standpoint, the manager, upon receipt of information, will not disclose when the postdisclosure firm value is lower than in the

absence of disclosure. Accordingly, the set of x realizations that the manager would not disclose when received is given by:

$$D' = \{x \mid E(\tilde{x} \mid ND) \geq x\} \tag{3}$$

where $E(\tilde{x} \mid ND)$ is the conditional expectation of $\tilde{x}$ given no disclosure (ND). In a risk-neutral market, $E(\tilde{x} \mid ND)$ is the firm's value in the event of no disclosure. Therefore, when a realization of $\tilde{x}$ is lower than this conditional expectation, the manager rationally suppresses its release since postdisclosure firm value would equal the disclosed realization.

Given that A and B are the only events for which investors do not observe an information announcement, in the absence of such announcement, investors' prior probabilities for each event will be revised as follows:

Event	Revised Probabilities Given No Disclosure
A	$p/[p + (1 - p) \cdot F(y)]$
B	$(1 - p) \cdot F(y)/[p + (1 - p) \cdot F(y)]$
C	0

An expression for $E(\tilde{x} \mid ND)$ is obtained from the revised probabilities and the conditional expectations in (1) and (2).

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\begin{aligned}
E(\tilde{x} \mid ND) &= \frac{p \cdot E(\tilde{x} \mid A)}{p + (1 - p) \cdot F(y)} + \frac{(1 - p) \cdot F(y) \cdot E(\tilde{x} \mid B)}{p + (1 - p) \cdot F(y)} \\
&= \frac{p \cdot \mu}{p + (1 - p) \cdot F(y)} + \frac{(1 - p)}{p + (1 - p) \cdot F(y)} \cdot \int_{\underline{x}}^{y} \tilde{x} \, dF(\tilde{x}).
\end{aligned}
\tag{4}
$$

A rational expectations equilibrium dictates that the conjectures of investors with respect to the threshold value y be fulfilled; i.e., the conjecture should be consistent with the manager's optimal disclosure policy. This requires that:

$$E(\tilde{x} \mid ND) = y. \tag{5}$$

Substituting (5) into (4) and rearranging terms yields:

$$y[p + (1 - p) \cdot F(y)] = p \cdot \mu + (1 - p) \cdot \int_{\underline{x}}^{y} \tilde{x} \, dF(\tilde{x}). \tag{6}$$

An algebraic manipulation of (6) gives:

$$p(\mu - y) = (1 - p) \cdot \int_{\underline{x}}^{y} F(\tilde{x}) \, d\tilde{x}. \tag{7}$$

In what follows, we demonstrate the existence of a discretionary disclosure equilibrium and then examine its nature.

PROPOSITION 1. There exists a nontrivial equilibrium disclosure policy which is characterized by a *unique* threshold value y, such that $x < y < \mu$, below (above) which the manager withholds (discloses) information.[3]

Proof. The proof here is similar to that of theorem 1 in Dye [1985]. At $y = x$, the LHS of (7) equals $p(\mu - x) > 0$, while the RHS is zero. At $y \geq \mu$, the LHS is nonpositive but the RHS equals:

$$(1 - p) \cdot \int_x^y F(\tilde{x}) d\tilde{x} > 0.$$

Both sides of (7) are continuous in y, and the LHS (RHS) is monotonically decreasing (increasing) in y. There accordingly exists a unique value of y satisfying (7) such that $x < y < \mu$.   *Q.E.D.*

Note that if $p = 0$, the threshold value equals x, implying full disclosure. However, when $p = 1$, $y = \mu$. Therefore, an announcement is made only when the information signal is higher than the unconditional mean. Note also that when $0 < p < 1$, the threshold y (the firm's value in the event of no disclosure) is strictly lower than the unconditional mean μ (the value of the firm prevailing while investors are sure that the manager has no private information). This implies that firm value will decrease if the manager discloses no information when investors have come to believe that he may have received private information.

In the following section, we will conduct some comparative statics analyses and discuss the results with their implications.

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[3] The possibility of multiple solutions for the threshold level y in the Dye model can be seen from his equilibrium condition [1985, p. 129]:

$$p \cdot \left[\tilde{x} - y - \int_y^{\bar{x}} F(\tilde{x}) d\tilde{x} \right] = \left[\frac{1 - p}{F(y)} + p \right] \cdot \int_x^y F(\tilde{x}) d\tilde{x}.$$

Note that the LHS is monotonically decreasing in y, whereas the RHS may not be monotonic in y. The existence of multiple solutions may not be consistent with the notion of the rational expectations equilibrium due to the possibility that the equilibrium threshold of the manager may not coincide with the one perceived by the market. An example is taken to illustrate this multiplicity. Suppose that investors' prior beliefs about firm value are a probability mass function given by:

$$f(\tilde{x}) = \begin{array}{ll} .01 & \text{for} \quad x = 1 \\ .01 & \text{for} \quad x = 2 \\ .02 & \text{for} \quad x = 3 \\ .48 & \text{for} \quad x = 4 \\ .48 & \text{for} \quad x = 5. \end{array}$$

By setting the probability of the manager's not receiving information (p) equal to 30%, one can easily verify that the set $\{1, 2, 3, 4\}$ is a nondisclosure set as defined by D in Dye [1985], while a subset of the nondisclosure set, $\{1, 2, 3\}$, is *not*.

3. Comparative Statics Analyses

PROPOSITION 2. As the probability $(1 - p)$ increases, the threshold value y becomes lower.[4]

Proof. Differentiating (7) with respect to p yields:

$$\left(\frac{dy}{dp}\right) \cdot [F(y) + p \cdot (1 - F(y))] = (\mu - y) + \int_x^y F(\tilde{x})d\tilde{x}. \tag{8}$$

Since both the RHS and the terms in the bracket on the LHS of (8) are positive, $\dfrac{dy}{dp} > 0$ as claimed.   *Q.E.D.*

Proposition 2 implies that if $(1 - p)$ increases as time elapses, then, on average, worse news is released in the later part of the period. The reason is that as $(1 - p)$ increases over time, the nondisclosure set D' diminishes, forcing out the release of incrementally worse information. This is indeed consistent with the empirical evidence that late earnings announcements contain, on average, worse news as compared to early announcements (see Patell and Wolfson [1982] and Chambers and Penman [1984]). An increasing $(1 - p)$ over time seems natural in the context of earnings announcements since the manager is more likely to receive information about period earnings as a fiscal year-end is drawing near.

The second comparative statics analysis concerns investors' prior beliefs about firm value, $f(\tilde{x})$.

PROPOSITION 3. Denote by y_f and y_g the threshold values for two density functions $f(\tilde{x})$ and $g(\tilde{x})$, respectively, and assume that both densities have the same support $[\underline{x}, \bar{x}]$. If $f(\tilde{x})$ dominates $g(\tilde{x})$ in the sense of first- or second-order stochastic dominance, then $y_g \leq y_f$.

Proof. Suppose the contrary that $y_g > y_f$. y_f and y_g are defined implicitly by:

$$p(\mu_f - y_f) = (1 - p)\int_{\underline{x}}^{y_f} F(\tilde{x})d\tilde{x} \tag{9}$$

$$p(\mu_g - y_g) = (1 - p)\int_{\underline{x}}^{y_g} G(\tilde{x})\,d\tilde{x}. \tag{10}$$

That F dominates G with the supposition of $y_g > y_f$ implies:

$$\int_{\underline{x}}^{y_f} F(\tilde{x})d\tilde{x} \leq \int_{\underline{x}}^{y_f} G(\tilde{x})d\tilde{x} < \int_{\underline{x}}^{y_g} G(\tilde{x})d\tilde{x}. \tag{11}$$

Combining (9), (10), and (11), we obtain:

$$p(\mu_f - y_f) < p(\mu_g - y_g). \tag{12}$$

F dominating G also implies $\mu_f \geq \mu_g$, and hence (12) requires $y_f > y_g$. This, however, contradicts the supposition.   *Q.E.D.*

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[4] Note that unlike corollary 1 in Dye [1985], our result holds for any density function.

Proposition 3 can be interpreted under the additional assumption that prior to information disclosure by the manager, investors independently acquire information about firm value, and thus revise their prior beliefs. Suppose that f and g are the prior and the posterior beliefs of investors, respectively, and that f stochastically dominates g because investors have acquired unfavorable information about the firm. Then, by Proposition 3, the posterior threshold y_g is lower than the prior threshold y_f. Accordingly, if the manager has received but is currently withholding private information, and if the value of the information signal exceeds y_g, then the information will be released. That is, investors' information acquisition through an independent source may trigger the release of private information which had previously been suppressed due to its unfavorableness but has now become favorable compared to the information that the market has independently acquired. This result suggests that the release of bad news about a firm in the financial press may be immediately followed by the announcement of "not-so-bad" news by the firm.

Further implications can be derived regarding firm value changes when no information announcement from the manager follows the information acquisition by the investors. Since the threshold value is the firm's value in the event of no disclosure, the possibility of $y_g < y_f$ implies a decrease in firm value. This result is intuitively obvious when f first-order stochastically dominates g, because investors' posterior mean has shifted down. The fact that f second-order stochastically dominates g means, among other things, that g has been obtained from f by a sequence of mean-preserving spreads in the sense introduced by Rothschild and Stiglitz [1970]. That is, g has more variability than f while having the same mean. Accordingly, $y_g < y_f$ implies that even neutral information (in the sense that the [unconditional] mean remains unchanged) will induce firm value adjustments; i.e., if the posterior g minus the prior f is (an iteration of) the mean-preserving spread, then the firm's value, given no disclosure by the manager, will decrease. This result suggests that risk-neutral investors (as assumed in this study) may react to changes in return variability. The underlying intuition is that investors, given no disclosure, look only on the increase in lower-end variability because no disclosure by the manager conveys information that higher values have not been realized. This amounts to a downward shift of mean value for the nondisclosure set D', and hence a firm value decrease results.

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