

Nondisclosure and Adverse Disclosure as Signals of Firm Value

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We present a model in which some of the firm's information ("news") can be disclosed verifiably and some information ("type") cannot, to show that some firms may voluntarily withhold good news and disclose bad news. We describe an equilibrium in which high-type firms withhold good news and disclose bad news, whereas low-type firms disclose good news and withhold bad news. Under some parameter values, this equilibrium exists when other more traditional equilibria are ruled out by standard equilibrium refinements. The model explains some otherwise anomalous empirical evidence concerning stock price reactions to disclosure, provides some new empirical predictions, and suggests that mandatory disclosure requirements may have the undesirable consequence of making more difficult for firms to reveal information that cannot be disclosed credibly.

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we are often skeptical of someone who seems to be concealing the truth for his private ends. King Lear disinherited his daughter Cordelia after she responded, "Nothing, my lord . . . I cannot heave my heart into my mouth . . .," to his request that she publicly express her love for him. Yet this example presents a paradox. Since Lear could see Cordelia's refusal to disclose, he was free to draw an adverse inference, eliminating any conceivable gain to concealment. Arguments of this type have led Ross (1979), Grossman (1981), and Milgrom (1981) to conclude that if information can be announced credibly and costlessly, then full and truthful disclosure will take place.

The reasoning leading to full disclosure is as follows. The seller of a product has private knowledge about its value that is unknown to the buyer. If the credible announcement of the product's quality were infeasible, then all items would sell at the same price, leading to the classic lemons problem of Akerlof (1970). However, if the seller can costlessly and credibly communicate his private knowledge to the buyer, then the highest-quality seller has a clear incentive to disclose his private information. Once the highest-quality seller separates himself from the pool of lower-quality sellers by disclosing, the next highest-quality seller will have the incentive to disclose to distinguish himself from those remaining, and so on. Therefore, in equilibrium, the buyer will adopt a policy of extreme skepticism, and infer that a seller withholding information is of the lowest quality. Hence, the optimal strategy for all sellers is full disclosure; even the worst loses nothing by disclosing.

Analyses in which disclosure has a fixed cost were introduced by Jovanovic (1982), Verrecchia (1983), and McNichols (1984). They show that a fixed disclosure cost creates a threshold level of disclosure, so that only firms with sufficiently high values will disclose.¹

A more general extension by Titman and Trueman (1986) involves disclosure that is noisy as well as costly. The form of disclosure they examine is the hiring of an auditor who reports his assessment of the value of the firm with noise. They show that if a firm can attain a greater precision of credible disclosure by hiring a higher-quality auditor, then the level of precision purchased by a firm acts as a fully revealing signal of the firm value. Thus, in contrast with the models with fixed disclosure cost, their theory suggests that when disclosure costs are variable, an "unraveling" of the nondisclosing pool similar to that described by Grossman and Milgrom occurs.

However, what none of these models encompass is skepticism of an excessive desire to impart information. As Hamlet says of his mother,

¹ A cost of disclosure may result from the proprietary nature of the information, which may be used to the advantage of competition, or from the unwanted attention of regulators in the running of the firm.

“methinks the lady doth protest too much.” Overzealousness in publicizing good news, we suggest, may be an indication that the promoter does not expect further good news to appear spontaneously in the future.

In contrast with previous theories of disclosure, we present a model in which firms may prefer to withhold favorable nonproprietary information and disclose *bad* news voluntarily. The result here differs because of the presence of a nondisclosable piece of information (the firm’s “type”) about the firm’s likelihood of receiving good or bad news in the future. A firm that has received good news and is confident of further good news at a later date can prove its confidence by waiting until the later date to disclose its first piece of news. Furthermore, a confident firm with current bad news that it expects to be counteracted by later good news can prove its machismo by disclosing the bad news early. In contrast, a firm that currently possesses good news but is pessimistic about future prospects may prefer to disclose the earlier good news to prove that it is not the worst firm. At worst, a firm may have current bad news and little hope of obtaining good news in the future. Such a firm may withhold the current bad news in the hope of being mistaken initially for a confident, withholding firm.

We show that firms may withhold information even if there is no exogenous disclosure cost. The endogenous costs and benefits to disclosing early arise from the trade-off between current signaling benefit or loss and the gain or loss in credibility at a later date. The decision of whether to disclose acts here as a noisy signal of value without the deadweight disclosure costs assumed by previous researchers.

The analysis provides an explanation for a number of empirical observations. First, firms sometimes withhold favorable information even when there is no obvious cost to disclosure (such as a loss in competitive advantage).² The second empirical observation concerns the effect of disclosure on competitors. In an industry in which all firms are potential recipients of news, disclosure models based on skepticism of nondisclosure predict that when a firm makes a disclosure, the stock prices of nondisclosing firms will decrease (i.e., a negative information transfer will occur). In contrast, our model does not predict that “no news is bad news”—either positive, negative, or

² For example, according to the *Wall Street Journal* (November 22, 1989), Texas Instruments did not disclose the existence of a Japanese patent that “covers virtually all integrated circuits” made or used in Japan, a license that analysts estimated could bring it as much as \$700 million in annual revenue,” until after the story appeared on the front page of *Nihon Keizai Shimbun*. One analyst referred to this patent as “the signal event of the decade in the semiconductor industry.” A company spokesman stated that TI did not announce the patent because “we didn’t think it was up to us to blow our horn about this.” Nevertheless, the news led to a stock price increase in Texas Instruments of 9 percent during the trading day.

no net information transfer could occur. Third, the model explains why firms will voluntarily disclose information even if this leads (in the short run) to a more adverse price reaction than would nondisclosure. In contrast, in models based on skepticism of nondisclosure, firms disclose because they will be viewed more adversely if they do not. The model also provides predictions that have not been tested.

In addition, the analysis has implications concerning the social benefits to mandatory and voluntary disclosure. Previous researchers, such as Grossman (1981) and Ross (1979), view mandating disclosures as unnecessary (if costs of disclosure are zero) since firms will voluntarily disclose information. We argue that firms will not necessarily disclose fully even if information is favorable. Our analysis also suggests that it may be socially worthwhile to allow some information to be withheld, if the fact of concealment itself allows managers to communicate other valuable information more credibly to the market at a later date. Thus, the firm's strategic *timing* of disclosure can be informative to investors.

The remainder of the paper is organized as follows. The economic setting is described in Section 1. The equilibrium involving withholding of good news and disclosure of bad news is presented in Section 2. In Section 3, all other possible equilibria of the model are examined. In Subsection 3.1, we examine equilibria in which good news is withheld. In Subsection 3.2, we examine more traditional equilibria in which good news is disclosed, and explore when alternative types of equilibria will obtain for different parameter values. Section 4 concludes the paper.

1. The Model

Investors and managers are assumed to be risk neutral. There are two firm characteristics unknown to investors, which we refer to as *firm type* and *news*. Firm type refers to the propensity of the firm to receive good news, and is either high quality (H) with probability f for low quality (L) with probability $1 - f$. The firm knows its type but direct and credible disclosure of the firm's type to investors is infeasible. There are four dates, 0, 1, 2, and 3. At date 0, the firm learns its quality H or L . At date 1, it receives its first piece of good or bad news ($I_1 = G_1$ or B_1).³ The firm can choose either to withhold (W) or disclose (D) costlessly its news I_1 . It is assumed that all disclosures about news are truthful.³ Investors form an assessment of firm value based on whether or not news disclosed at date 1, and if it was disclosed,

³ In practice, a firm incurs legal liability if the disclosure is false. See Hughes (1986) for an analysis of contracts that enforce the credibility of disclosure.

on whether it was good or bad. At date 2, the first piece of news becomes known publicly, regardless of whether it was disclosed at date 1. Finally, at date 3, a second piece of news arrives and becomes visible to the public, $I_3 = G_3 \text{ or } B_3$ about the firm's investment projects. Thus, by date 3, news I_1 and I_3 (but not firm type) are both revealed regardless of the firm's decision at date 1.⁴

As an example, we can think of a forecasting context, in which G_1 or B_1 , if disclosed, leads to a favorable or an unfavorable forecast of earnings.⁵ At date 2, the actual value of the earnings being forecast is mandatorily revealed to the market. G_3 or B_3 refers to further news about the firm arriving at some later time than the term of the earnings forecast. Alternatively, dates 2 and 3 can be viewed as merged at the annual report release date with outcome G_3 or B_3 referring to all other information contained in the annual report, such as the order backlog, components of earnings, management discussion, and the auditor's statement.⁶ The sequence of events is described below, and the possible outcomes are summarized in Figure 1:

$t = 0$. The firm learns its type (H or L).

$t = 1$. The firm observes news I_1 (either G_1 or B_1), and then decides on action A to withhold or disclose news [$A = W$ (withhold), DG (disclose G_1), or DB (disclose B_1)]. Investors form expectations about the firm based on news if disclosed or on the nondisclosure event.

$t = 2$. The firm releases I_1 if news was withheld at date 1.

$t = 3$. The firm observes I_3 , and reveals I_3 , (G_3 or B_3). Investors revise expectations about firm type based on the separately observed I_1 and I_3 .

Define p_i^* as the probability that firm type $\omega = H$ or L observes news $I_i = G_i$ or B_i at date $t = 1, 3$. $p_{B_1|H}^*$ is the conditional probability that firm type w observes news I_3 given that I_1 was received. The conditional probability can be identical to, or different from, the unconditional probability to allow for either independent or correlated news at dates 1 and 3. More important, news depends on firm type. An H -firm is

⁴ The revelation at dates 2 and 3 might occur spontaneously or might be mandated by regulation. The assumption is not strictly necessary in that, if news were not exogenously revealed, the traditional unraveling argument of Grossman and Milgrom would lead to voluntary disclosure at date 3 of both I_1 and I_3 .

⁵ For a strict correspondence with our model, the manager's information about earnings must be perfectly accurate, so that if he issues a forecast, he provides an accurate description of actual earnings. However, results similar to the current model could be derived even if there were some noise in the manager's knowledge of whether news was really G_1 or B_1 .

⁶ Wilson (1986) showed that accruals (accounting adjustments to adjust costs to obtain earnings) have incremental information content beyond earnings.

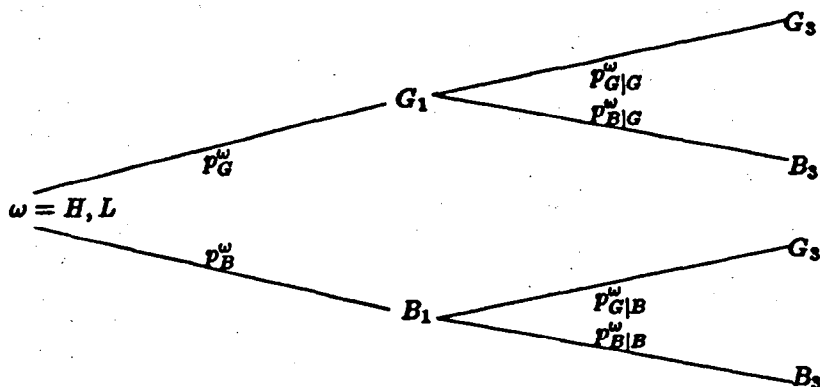


Figure 1

Outcome tree

Each firm type $\omega = H, L$ receives date-1 news, I_1 , which is either good news, G_1 , or bad news, B_1 , and further receives date-3 news, I_3 , which is either good news, G_3 , or bad news, B_3 . p_G^ω is the probability of date-1 news for given firm type ω . $p_{G|G}^\omega$ is the probability of date-3 news conditional on date-1 news for given firm type ω . The time subscripts for the probabilities are suppressed for clarity.

more likely to receive good news than an L -firm, and vice versa for bad news. To summarize, note the following.

Assumption 1. At date 1 or 3,

$$p_G^H > p_G^L, \quad (1)$$

$$p_{G|H}^H > p_{G|H}^L. \quad (2)$$

The full-information expected value of the firm is denoted as $X_{H,B}^\omega$, where $\omega = H$ or L , $I_1 = G_1$ or B_1 , and $I_3 = G_3$ or B_3 . For example, at date 1, if the investor observes G_1 and G_3 , and if he knows that the firm is type H , then he would value the firm at X_{GG}^H . The value X depends on both the firm type, which cannot be credibly disclosed, and the costlessly verifiable news about investment outcomes of the firm. For example, firm type might represent managerial expertise, and information I_i might be news about the cash flows to be generated from the firm's projects. (See also note 7 and the discussion following Proposition 2.)

Since good news G , indicates higher expected cash flows than bad news B , the full-information expected value of the firm X is higher for a firm with good news than bad news for a given firm type. In addition, we assume the expected value X is higher for an H -firm than an L -firm holding constant the information I_1 and I_3 about its

current projects. The higher value reflects the greater potential of an *H*-firm to generate future cash flows as compared to an *L*-firm.⁷ For simplicity, we assume that the ordering of the news events (G_1B_3 versus B_1G_3) is irrelevant for the underlying value of the firm. These assumptions are summarized as follows.

Assumption 2. For $\omega = H, L$, and $I_1, I_3 = G, B$,

$$X_{H_1B}^H > X_{H_1B}^L, \quad (3)$$

$$X_{GG}^* > X_{GB}^* = X_{BG}^* > X_{BB}^*. \quad (4)$$

Note that firm value is not assumed to be higher for an *H*-firm than an *L*-firm regardless of the information I_i ; it is possible that $X_{BB}^H < X_{GG}^L$. In other words, an *L*-firm can be lucky by drawing two successive good draws on its investment projects and be worth more than an unlucky *H*-firm with two successive bad-news draws on its projects.

Let V_t represent investors' valuation of the firm at date t , and let β be the investor belief. V_1 will depend on investor beliefs about what will lead a firm to withhold or disclose I_1 , and on G_1 or B_1 if I_1 is disclosed. V_3 will depend on both β and on the information I_1 and I_3 (which are both public by date 3).

We make the standard assumption in corporate signaling models that the firm's objective function U is a linear combination of its expected market values at two dates (1 and 3).^{8,9} Let α be the relative weight on firm value at date 1, and $(1 - \alpha)$ be the weight on firm value at date 3, where $0 < \alpha < 1$. Since the firm knows its type, it knows the probabilities of G_3 and B_3 . Using these, and investor beliefs β , the firm calculates its expected market values at date 1 in equilibrium depending on its action $A (= W, DG, \text{ or } DB)$. We will list the

⁷ While we focus on information arrival at only two dates, we assume that the firm remains as a going concern at date 3. Therefore, X reflects not only the cash flows received to date given news I_1 and I_3 , but also the expected future cash flows after date 3 given the firm type.

⁸ See, for example, Miller and Rock (1985). The assumed form for U reflects two shareholder objectives: (i) current shareholders may want to sell their shares for liquidity reasons, and (ii) shareholders may want a high future stock price if the firm intends to issue more equity for future projects. Dybvig and Zender (1991) show, in a model in which the choice of the managerial compensation contract is set optimally, that the manager has no incentive to signal his private information. However, they note that this conclusion may not obtain if there are limits to contracting such as "an inability of the firm to commit to a particular managerial incentive contract, restrictions on indentured servitude which make it hard to ensure that a manager will stay with the firm in bad states, and market structure that makes firms that maximize the value of equity subject to takeovers." As shown by Holmstrom and Ricart i Costa (1986), the ability of a manager to quit in good states can also lead to an incentive to choose actions that reveal quality, since his salary is increased in the future if he proves himself to be good early.

⁹ Identical results apply if the objective function puts weight on market value at date 2 as well (redefining weights approximately), because the manager's decision is made at date 1 before teaming I_1 , and the date-2 stock market value is set under risk neutrality as the expectation of the possible date-3 market values.

equilibrium beliefs $\mathfrak{B}$ after a semicolon in the functions U and V when needed for clarity, otherwise the belief argument of these functions will be suppressed. Let $\omega\text{-}I_1$ represent a firm of type ω with news I at date 1. Since there is no possible ambiguity, for notational ease, we write $H\text{-}G$, $L\text{-}G$, $H\text{-}B$, and $L\text{-}B$ without the subscript 1 (e.g., $H\text{-}G$ is an H -type firm with G_1). The firm's problem is to maximize over A the objective function

$$U(A, \omega\text{-}I_1; \mathfrak{B}) = \alpha V_1(A; \mathfrak{B}) + (1 - \alpha)E(V_3|A, \omega\text{-}I_1; \mathfrak{B}). \quad (5)$$

We apply the concept of perfect Bayesian equilibrium.

Definition of Equilibrium. An equilibrium for the model consists of the following.

- (i) A date-1 belief function of the publicly observed information at date 1 (either DG , DB , or W), which gives the probabilities investors assess at date 1 that the firm is $H\text{-}G$, $H\text{-}B$, $L\text{-}G$, and $L\text{-}B$.
- (ii) A date-3 belief function of the publicly observed information at date 3 (either DG , DB , or W , and news I_1 and I_3) describing the probability assessed at date 3 that the firm is high.
- (iii) A firm strategy as a function of the firm's information at date 1 ($H\text{-}G$, $H\text{-}B$, $L\text{-}G$, or $L\text{-}B$) that gives the probabilities that the firm will choose to withhold (W), disclose good news (DG), or disclose bad news (DB).

The belief functions must have the property that for any outcome that can occur with positive probability given the equilibrium strategy, the beliefs must be formed based on prior beliefs using Bayes rule. The strategy must weakly maximize the manager's objective function given the equilibrium belief functions.

Since a firm can receive either good or bad news at two dates and can choose to withhold or disclose news, there are 16 potential pure strategy equilibria. Investor beliefs in these potential equilibria are summarized in Table 1. For example, belief $\mathfrak{B}1$ is that all firms will withhold information at date 1, whereas with $\mathfrak{B}16$, all firms will disclose information at date 1.¹⁰ These potential equilibria will be analyzed in the remaining sections of the paper. We will see that only six of the asterisked beliefs can ever be perfect Bayesian equilibrium, and that parameter restrictions and equilibrium refinement criteria reduce the set further.

¹⁰ Belief functions, as in the definition of equilibrium, are derived from beliefs β by the use of Bayes rule for possible outcomes, for out-of-equilibrium outcomes, any probability between 0 and 1 is possible for a belief function corresponding to belief β .

Table 1
Potential equilibria

Firm type	Date 1 news	Investor beliefs															
		Ⓐ1*	Ⓐ2	Ⓐ3*	Ⓐ4	Ⓐ5*	Ⓐ6	Ⓐ7*	Ⓐ8	Ⓐ9	Ⓐ10	Ⓐ11*	Ⓐ12	Ⓐ13	Ⓐ14	Ⓐ15	Ⓐ16*
H	G ₁	W	W	W	W	W	W	W	W	DG	DG	DG	DG	DG	DG	DG	DG
H	B ₁	W	W	W	W	DB	DB	DB	DB	W	W	W	W	DB	DB	DB	DB
L	G ₁	W	W	DG	DG	W	W	DG	DG	W	W	DG	DG	W	W	DG	DG
L	B ₁	W	DB	W	DB	W	DB	W	DB	W	DB	W	DB	W	DB	W	DB

Firm type is either high (*H*) or low (*L*), news at date 1 is either good *G*₁ or bad *B*₁, Ⓐ are investor beliefs about the action that a firm of given type and news will take at date 1 in equilibrium, either withhold (*W*), disclose good news (*DG*), or disclose bad news (*DB*). Only asterisked (*) beliefs are perfect Bayesian equilibrium beliefs.

2. The Separating Equilibrium

The main theme of the paper is that good news may be withheld even when there are no exogenous costs of disclosure. To illustrate, in this section we consider an equilibrium with the property that good news will sometimes be withheld and bad news sometimes revealed. In Section 3, we will see that there are several equilibria with these properties. For expositional purposes, we focus here on the equilibrium based on beliefs Ⓐ7. This is a separating equilibrium (in fact, the unique separating equilibrium), such that at date 3, investors can fully distinguish between *H* versus *L* firm type (as well as observe *I*₁ and *I*₃), even though direct -disclosure of firm type is infeasible. We will compare the separating equilibrium with the more traditional all-disclose and the threshold equilibria in Subsection 3.2.

2.1 Investor valuations

We first consider the investor valuation functions and the manager’s decision problem. The aim is to show that the proposed set of beliefs is consistent with a signaling equilibrium. In general, investors’ beliefs at date 3 will depend on both the disclosure decision taken at date 1 and on the date-1 and date-3 news. Ⓐ7 will imply the following investor assessments for firm value at date 3:

$$V_3(G_1, G_3, W) = X_{GG}^H, \quad V_3(G_1, G_3, DG) = X_{GG}^L,$$
$$V_3(G_1, B_3, W) = X_{GB}^H, \quad V_3(G_1, B_3, DG) = X_{GB}^L,$$
$$V_3(B_1, G_3, DB) = X_{BG}^H, \quad V_3(B_1, G_3, W) = X_{BG}^L,$$
$$V_3(B_1, B_3, DB) = X_{BB}^H, \quad V_3(B_1, B_3, W) = X_{BB}^L.$$

(6)

For example, given Ⓐ7, investors will infer that a firm that withholds news at date 1 and reveals *G*₁ at date 2 and *G*₃ at date 3 is type *H*, and

will therefore value the firm as X_{GG}^H . The withholding of information at date 1 reveals to investors that the firm is either $H-G$ or $L-B$, and the subsequent revelation of G_1 at date 2 confirms that the firm was $H-G$.

Investors' valuation of the firm at date 1 is a probability-weighted average of the full-information date-3 values of the firm given the equilibrium beliefs. $\mathfrak{B}7$ implies that at date 1 investors infer that a firm that discloses good news G_1 is an $L-G$ firm, a firm that discloses bad news B_1 is an $H-B$ firm, and a silent firm is either an $H-G$ firm or an $L-B$ firm. Therefore, investors' valuations at date 1 are as follows.

If G_1 is disclosed (DG),

$$V_1(DG) = p_{G|G} X_{GG}^L + p_{B|G} X_{GB}^L \equiv V_G^L \quad (7)$$

If B_1 is disclosed (DB),

$$V_1(DB) = p_{G|B} X_{BG}^H + p_{B|B} X_{BB}^H \equiv V_B^H. \quad (8)$$

If news I_1 is withheld (W),

$$V_1(W) = \gamma V_G^H + (1 - \gamma) V_B^L, \quad (9)$$

where

$$V_G^H \equiv p_{G|G}^H X_{GG}^H + p_{B|G}^H X_{GB}^H,$$

$$V_B^L \equiv p_{G|B}^L X_{BG}^L + p_{B|B}^L X_{BB}^L,$$

and

$$\gamma \equiv \frac{f p_G^H}{f p_G^H + (1 - f) p_B^L}$$

is the probability that a withholding firm is $H-G$.

To check whether $\mathfrak{B}7$ can be confirmed in equilibrium, consider first the firm's decision. The firm observes I_1 and knows its type, based on which it assesses probabilities of receiving good or bad news at date 3. Given beliefs $\mathfrak{B}7$, the firm expects investors to value the firm at date 3 as follows:

$$\begin{aligned} E(V_3 | W, H-G) &= p_{G|G}^H X_{GG}^H + p_{B|G}^H X_{GB}^H = V_G^H, \\ E(V_3 | DG, H-G) &= p_{G|G}^H X_{GG}^L + p_{B|G}^H X_{GB}^L, \\ E(V_3 | W, H-B) &= p_{G|B}^H X_{BG}^L + p_{B|B}^H X_{BB}^L, \\ E(V_3 | DB, H-B) &= p_{G|B}^H X_{BG}^H + p_{B|B}^H X_{BB}^H = V_B^H, \\ E(V_3 | W, L-G) &= p_{G|G}^L X_{GG}^H + p_{B|G}^L X_{GB}^H, \end{aligned} \quad (10)$$

Table 2
Firm's utility from withholding or disclosing information

Firm type	Date 1 news	Utility if withhold	Utility if disclose
<i>H</i>	G_i	$\alpha V_1(W) + (1 - \alpha)E(V_3 W, H-G)^*$	$\alpha V_1(DG) + (1 - \alpha)E(V_3 DG, H-G)$
<i>H</i>	B_i	$\alpha V_1(W) + (1 - \alpha)E(V_3 W, H-B)$	$V_1(DB) = V_G^L$
<i>L</i>	G_i	$\alpha V_1(W) + (1 - \alpha)E(V_3 W, L-G)$	$V_1(DG) = V_G^L$
<i>L</i>	B_i	$\alpha V_1(W) + (1 - \alpha)E(V_3 W, L-B)^*$	$\alpha V_1(DB) + (1 - \alpha)E(V_3 DB, L-B)$

* denotes equilibrium behavior. The utility of a firm is a weighted average of investors' valuations of the firm at date 1, $V_1(A)$, and expected investors' valuation at date 3, $E(V_3|A, \omega-I_1)$, where A is the action the firm takes at date 1 (withhold W , disclose good news DG , or disclose bad news DB); ω is firm type (H or L); I_1 is news that the firm received at date 1 (good news G_i or bad news B_i); α is the weight given to investors' valuation at date 1; and $1 - \alpha$ is the weight given to expected investors' valuation at date 3.

$$E(V_3|DG, L-G) = p_{G|G}^L X_{GG}^L + p_{B|G}^L X_{GB}^L = V_G^L,$$

$$E(V_3|W, L-B) = p_{G|B}^L X_{BG}^L + p_{B|B}^L X_{BB}^L = V_B^L,$$

$$E(V_3|DB, L-B) = p_{G|B}^L X_{BG}^H + p_{B|B}^L X_{BB}^H.$$

The expected utility $U(A, \omega-I_1)$ of the firm from either withholding or disclosing good or bad news is shown in Table 2.

Given beliefs $\mathfrak{B}7$, $U(DB, H-B)$ reduces to V_B^H from (8) and $U(DG, L-G)$ reduces to V_G^L from (7) because the disclosure of bad news reveals that the firm is $H-B$ and the disclosure of good news reveals $L-G$.

2.2 The equilibrium

The beliefs and managerial behavior described in the preceding section lead to the separating equilibrium, in which an H -firm withholds good news but discloses bad news and an L -firm withholds bad news but discloses good news if the following conditions hold:

$$U(W, H-G) > U(DG, H-G), \quad (11)$$

$$U(W, L-G) < U(DG, L-G), \quad (12)$$

$$U(W, H-B) < U(DB, H-B), \quad (13)$$

$$U(W, L-B) > U(DB, L-B). \quad (14)$$

Let $\lambda \equiv (1 - \alpha)/\alpha$. Since $0 < \alpha \leq 1$, then $0 \leq \lambda < \infty$. From the definitions in Table 2 and (10), conditions (11)-(14) can be rewritten as

$$V_1(DG) - V_1(W) < \lambda(p_{G|G}^H \Delta_{GG} + p_{B|G}^H \Delta_{GB}), \quad (11')$$

$$V_1(DG) - V_1(W) > \lambda(p_{G|G}^L \Delta_{GG} + p_{B|G}^L \Delta_{GB}), \quad (12')$$

$$V_1(W) - V_1(DB) < \lambda(p_{G|B}^H \Delta_{BG} + p_{B|B}^H \Delta_{BB}), \quad (13')$$

$$V_1(W) - V_1(DB) > \lambda(p_{G|B}^L \Delta_{BG} + p_{B|B}^L \Delta_{BB}), \quad (14')$$

where $\Delta I_1 I_3 \equiv X_{H1}^H - X_{H1}^L$ is the difference between a high- and low-type firm given news at both dates 1 and 3.

The LHS of (11') indicates the cost to an H-C firm of being pooled with an L-B firm by withholding G_1 at date 1. The RHS measures the gain to an H-G firm of being distinguished from an L-G firm at date 3. (The RHS is weighted by λ and the LHS weight is normalized to 1.) This benefit derives from the confidence of an H-G firm of obtaining later good news G_3 and the consequent higher cash flows. Condition (11') implies that this expected signaling gain at date 3 outweighs the cost of withholding at date 1. The opposite is true for an L-G firm because it is less confident of receiving G_3 than an H-G firm; the RHSs of (11') and (12') differ only in the probability weights $p_{B|H}^H$ and $p_{B|H}^L$.

Condition (13') indicates that for an H-B firm the immediate cost of revealing B_1 is outweighed by the signaling benefit at date 3 when it is distinguished from an L-B firm, adjusting for time preference.¹¹ Finally, condition (14') indicates that an L-B firm prefers to withhold because the benefit from pooling with an H-G firm at date 1 outweighs the expected cost of being distinguished as L at date 3 after adjusting for time preference.¹²

From assumption (2), Δ_{H1} is always positive, and from assumption (1), the probability of good news is always higher for an H-firm than an L-firm, and vice versa for bad news. Under suitable parameter restrictions on Δ_{H1} , it is possible that the RHS of (11') is larger than the RHS of (12'), and the RHS of (13') is larger than (14'). Therefore, we may expect that there will exist parameter values such that all four conditions (11')-(14') can be simultaneously satisfied. This is stated in the following proposition (the proofs of all the propositions are provided in the Appendix).

Proposition 1. *There exists a nonempty open set of the exogenous parameter values such that assumptions (1) and (2) hold and a separating equilibrium obtains in which at date 1, an H-type firm withholds good news and discloses bad news, while an L-type firm discloses good news and withholds bad news.*

¹¹ This adverse disclosure case is related to the model of security issues in Allen and Faulhaber (1989), where a low issue price is used to signal that the entrepreneur expects good news about a project.

¹² An alternative explanation for why managers may suppress unfavorable news is offered by Dye (1985). He shows that contracts that induce the manager to withhold information are mutually beneficial if the information does not affect the firm's earnings.

There are alternative explanations for why firms might withhold good news. One is high disclosure costs, which could lead all firms to withhold.¹³ Alternatively, if a manager intends to trade, based on inside information, he may wish to delay disclosure. Our model differs from these hypotheses in that it predicts that a firm might be willing to withhold good news and yet disclose bad news. Furthermore, an inside trader need only withhold news long enough for him to take his, long or short position, a relatively brief period of time. In our model, a firm may withhold information for a substantial period of time in order to signal that it has high quality.

Two alternative theories also predict that a firm might withhold good news and yet disclose bad news. One is that disclosure of good news about industry demand invites, while disclosure of bad news deters, entry of competitors.¹⁴ Another is that firms that are bargaining with unions may wish to appear in poor shape. The difference between our model and these theories is that our analysis applies to competitive as well as oligopolistic or bargaining settings. On the other hand, our results are based, on restrictions on the relation between firm value and private information that are stronger in some ways than the restrictions in these other articles.

Some necessary conditions imposed by (11')-(14') on the exogenous parameters of the model for the separating equilibrium to exist are the following.

Proposition 2. *A necessary condition for the separating equilibrium is that good news have a greater impact on the value of a high than a low-quality firm, that is,*

$$\Delta_{GG} \equiv X_{GG}^H - X_{GG}^L > \Delta_{GB} \equiv X_{GB}^H - X_{GB}^L, \quad (15)$$

$$\Delta_{BG} \equiv X_{BG}^H - X_{BG}^L > \Delta_{BB} \equiv X_{BB}^H - X_{BB}^L. \quad (16)$$

In addition, there must be a trade-off between the type of the firm and news such that an L-type firm with consecutive good news is valued more than an H-type firm with consecutive bad news,

$$X_{BB}^H < X_{GG}^L. \quad (17)$$

Conditions (15) and (16) require that H- type be complementary with good news in generating high value. Consider, for example, a

¹³ However, Darrough and Stoughton (1990) show that full disclosure is possible even in the presence of proprietary costs that arise endogenously as a result of a potential industry entrant.

¹⁴ This is related to recent literature on proprietary costs of disclosure arising from entry of competitors; see Bhattacharya and Ritter (1983). Darrough and Stoughton (1990), Feltham and Xie (1990), Verrecchia (1990), and Wagenhofer (1990).

case in which firm type refers to managerial or organizational quality and news (good or bad) concerns investment opportunities. Conditions (15) and (16) require that a firm with high managerial quality be able to generate higher expected cash flows from the same investment opportunities than a firm with low quality. Furthermore, they require that good managerial talent be more valuable in a firm with good investment opportunities than one with poor investment prospects (perhaps because a talented manager can better exploit growth opportunities).

The above description applies, for example, in the earnings forecast context. As discussed in note 5, we assume for simplicity that forecasts are perfectly accurate. At date 1, the manager knows what earnings will be at date 2. If he forecasts favorably or unfavorably (G_1 or B_1), a good or bad earnings outcome occurs at date 2, which immediately affects firm value. In addition, there is a second component of firm value arising from cash flows that the firm will receive later than date 2. These cash flows are, in general, positively correlated with the earnings at date 2. For example, if news is that demand is strong for the firm's product, then this will tend to increase earnings at date 2 and also future cash flows. Complementarity will obtain if, for the reasons given in the preceding paragraph, a favorable earnings outcome at date 2 is more strongly associated with favorable later cash flows for a high-quality firm than for a low-quality firm.

As an alternative example, G versus B could refer to the amount of free cash flows of the firm, and H versus L refer to the manager's tendency to refrain from squandering free cash flows. Conditions (15) and (16) require that it is more important to have a high-quality manager who is less prone to squandering cash when cash is likely to be abundant.

Finally, the parameter restriction in (17) implies that the value of the firm must not depend unduly on the unverifiable firm type (H versus L); the verifiable news (I_1 , I_3) must also be important for the valuation of the firm. This is a mild condition, because it is plausible that even a high-quality manager or firm can be unlucky and do poorly, and even a lowquality one can be lucky and do well.

2.3 Empirical implications

We shall explore some of the empirical implications of this separating equilibrium. Let the ex ante expected value of the firm be $\bar{V}$.

Proposition 3. *If the separating equilibrium obtains, then a firm that discloses good news is valued more highly than a firm that withholds, and a firm that withholds is valued more than a firm that discloses*

bad news; that is,

$$V_1(DG) > V_1(W) > V_1(DB). \quad (18)$$

It follows that investors react positively to a disclosure of good news and negatively to a disclosure of bad news,

$$V_1(DG) - \bar{V} > 0, \quad V_1(DB) - \bar{V} < 0. \quad (19)$$

That disclosure of good news raises, and bad news reduces, the stock price may seem surprising since the disclosure of bad news signals an *H*-firm and the disclosure of good news signals an *L*-firm. However, the disclosure of good news also reveals that the firm is performing well on its current projects. The market value of the firm depends on both the cash flows from current projects and the expected cash flows from future projects. On balance, this value is lower for an *H-B* firm than for an *L-G* firm ($V_G^L < V_B^H$). This value crossover condition of the separating equilibrium is stronger than (17) above. We discuss the consequence of relaxing this parameter constraint in Subsection 3.1.

The traditional disclosure models of Grossman (1981), Milgrom (1981), Jovanovic (1982), Verrecchia (1983), and McNichols (1984) predict a negative average information transfer between firms in an industry that are all potential recipients of news since only inferior firms withhold information. In other words, firms that do not disclose are subject to a downward revision in their stock price when a competitor makes a disclosure ("no news is bad news"). In contrast, Proposition 3 is consistent with either a positive, negative, or no-net-information transfer. In this respect, our model is consistent with the diverse results of Foster (1981), Clinch and Sinclair (1987), and Lev and Penman (1990); the first two papers found a positive information transfer within the industry when firms made forecasts of earnings, whereas Lev and Penman found no significant information transfer within the industry.¹⁵

Moreover, Ajinkya and Gift (1984), Waymire (1984), McNichols (1989), and Lev and Penman (1990) provide evidence consistent with our model that firms voluntarily make announcements that lead to a downward revision in their stock prices. For example, McNichols finds that the majority of management forecasts in the 1979-1983 period are bad news and that the average announcement effect is statistically significantly negative. Given the evidence of either a zero or positive

¹⁵ If the forecast contains industry-wide as well as firm-specific information, the net information transfer will depend on the relative strength of these two effects; see Rotemberg and Scharfstein (1990). Lev and Penman (1990) attempted to correct for the Industry covariability of unexpected returns, and did not find a net information transfer.

reaction to withholding by Lev and Penman and Clinch and Sinclair, the negative stock price reaction to the announcement of management forecasts appears to be inconsistent with the predictions of traditional disclosure models. The price reaction from a disclosure, however adverse, should be less negative than withholding. In contrast, our model is consistent with this evidence, since it predicts a more negative reaction to disclosing bad news than withholding in Proposition 3.

A further implication of the separating equilibrium may be derived regarding the persistence of earnings fluctuations. Consider the forecasting interpretation of the model discussed earlier, in which a forecast is issued at date 1, actual earnings are revealed at date 2, and let us interpret the further-news at date 3 as the next year's actual earnings. Consider the correlation between date-2 and date-3 earnings for firms that make a forecast (disclose) and for firms that do not forecast (withhold), without conditioning on whether the disclosure was good or bad. Suppose the H -type firm is associated with a higher probability of G_3 than the L -type firm, regardless of date-1 news. Then, since a withholding firm is either H - G or L - B , either good or bad earnings performance at date 2 should persist strongly, to date 3 (i.e., the correlation should be high). In contrast, since a disclosing firm is either H - B or L - G , there should be lower persistence among firms that disclose at date 1. It would be interesting to test this prediction by comparing the persistence of earnings between nonforecasters and forecasters during a time period following the forecast.¹⁶

¹⁶ Suppose that earnings at dates 1 and 3 can take on either of two values, E_G and E_B . Let the mean earnings at date $t = 1, 3$ be $\bar{E}_1^W$ for withholding firms and $\bar{E}_1^D$ for disclosing firms. (X the terminal value of the firm, therefore, consists of earnings at both dates 1 and 3, and another component with the complementarity property.) Define

$$\gamma = \Pr(H|W) = \frac{fp_G^H}{fp_G^H + (1-f)p_B^H}$$

$$\eta = \Pr(H|D) = \frac{fp_G^H}{fp_G^H + (1-f)p_B^H}$$

Then, the mean earnings for withholding and disclosing firms at dates 1 and 3 are

$$\bar{E}_1^W = \gamma E_G + (1-\gamma)E_B$$

$$\bar{E}_1^D = (1-\eta)E_G + \eta E_B$$

$$\bar{E}_3^W = (\gamma p_{G1G}^H + (1-\gamma)p_{B1G}^H)E_G + (\gamma p_{G1B}^H + (1-\gamma)p_{B1B}^H)E_B$$

$$\bar{E}_3^D = ((1-\eta)p_{G1G}^H + \eta p_{B1G}^H)E_G + ((1-\eta)p_{G1B}^H + \eta p_{B1B}^H)E_B$$

Note that earnings of date 1 will be disclosed at date 2 for withholding firms. Let $\Delta_1 = E_G - E_B$. Then, the covariance between date-1 and date-3 earnings conditional on withhold (W) or disclose (D) (but not on news) can be written as

$$\begin{aligned} \text{cov}(E_1, E_3|W) &= \gamma(E_G - \bar{E}_1)[p_{G1G}^H(E_{G0} - \bar{E}_3) + p_{B1G}^H(E_{B0} - \bar{E}_3)] \\ &\quad + (1-\gamma)(E_B - \bar{E}_1)[p_{G1B}^H(E_{G0} - \bar{E}_3) + p_{B1B}^H(E_{B0} - \bar{E}_3)] \\ &= \gamma(1-\gamma)\Delta_1^2(p_{G1G}^H - p_{B1G}^H), \end{aligned} \quad (F1)$$

On a more conjectural level, the separating equilibrium tends to imply differences in both the cross-sectional and time-series variances of earnings of withholding firms versus disclosing firms. This is only a tendency, however, and is parameter dependent. A firm that withholds at date 1 is either *L-B* or *H-G*, which have very different expected values. This is true both because of news already received, and because of the greater tendency of the *H*-firm to receive G_3 and the *L*-firm to receive B_3 . A disclosing firm is revealed to the market specifically as *L-G*, or else as *H-B*. Thus, at date 3, if the priors on *L-G* versus *H-B* are fairly even, then the amount of uncertainty that is resolved at date 3 will be larger for a withholding firm than a firm that discloses either good or bad news. Thus, the stock price volatility from date 1 (after the decision of whether or not to disclose) through date 3 will tend to be higher for withholding firms than for disclosing firms.¹⁷ A similar prediction will tend to obtain with respect to the cross-sectional volatility at date 3 in a sample of firms that had disclosed at date 1 versus those that had withheld at date 1.

Since the separating equilibrium is parameter dependent, let us consider when it is most likely to hold. We showed earlier that an empirical implication of the separating equilibrium is that firms that withhold good news will tend to have a subsequent increase in earnings that persists, while firms that disclose bad news will have a subsequent decrease in earnings that is transitory. More generally, the persistence of earnings will also be related to whether or not the separating equilibrium obtains. The separating equilibrium is only applicable when news provides information about future earnings prospects as well as current earnings. This is reflected in the complementarity condition of Proposition 2, which implies that good news affects value differently for high or low firms. If news was merely about a transitory cash flow, this would be unlikely to occur. But if news conveys information not only about current earnings, but also about investment opportunities or continuing cash flow prospects, then firms with different characteristics may be better or worse at exploiting these investment opportunities, or better or worse with

$$\begin{aligned} \text{cov}(E_1, E_3|D) = & (1 - \eta)(E_G - \bar{E}_1)[p_{G1}^L(E_{GG} - \bar{E}_3) + p_{B1}^L(E_{GB} - \bar{E}_3)] \\ & + \eta(E_B - \bar{E}_1)[p_{GB}^H(E_{BG} - \bar{E}_3) + p_{BB}^H(E_{BB} - \bar{E}_3)] \\ = & -\eta(1 - \eta)\Delta_1^H(p_{G1}^H - p_{G1}^L). \end{aligned} \quad (F2)$$

it follows that a sufficient condition for (F1) to be larger than (F2) is that high-type firms are more likely to get good news than bad news, implying that $p_{GB}^H > p_{GB}^L$ and $p_{BB}^H > p_{BB}^L$. This condition though not unreasonable, is stronger than is needed because it ensures that the covariance for disclosing firms is not just smaller, but is actually negative. The variances of the stock-price reactions conditional on withhold or disclosure can be similarly calculated.

¹⁷ This prediction also tends to apply over a period from date 0 through date 3, because learning that a firm is *H-G* versus *L-B* leads to a greater resolution of uncertainty than learning that it is *H-B* versus *L-G*.

respect to squandering of substantial free cash flow. Thus, a firm that is expected to receive information relevant for long-term as well as short-term prospects is more likely to disclose bad news and withhold good news than a firm that is expected to receive information that is relevant only for short-term earnings.

Jaggi and Grier (1980) found that firms that make forecasts have prior low earnings variability, while Lev and Penman (1990) found no difference in the variability of earnings changes. This is not in itself a test of our model. However, it would be interesting to extend these analyses by examining whether firms that had high persistence of earnings prior to the forecast decision tended to forecast bad news and withhold good news with higher frequency than firms with low prior persistence.^{18,19}

2.4 Welfare and regulatory issues

In the separating equilibrium, all information is revealed to the market by date 2, including the firm type (H or L). In contrast, if there were mandatory disclosure at date 1, investors would be uncertain as to the firm's type at date 2. The loss of information under mandatory disclosure occurs because the opportunity to signal by withholding information is eliminated.

The results of Grossman (1981), Milgrom (1981), and Ross (1979) suggest that when disclosure is costless, voluntary disclosure provides as much information to the market as mandatory disclosure, making mandatory disclosure rules redundant. In contrast, Proposition 1 suggests that voluntary disclosure may ultimately provide more information to investors, and thus mandatory disclosure rules can actually be detrimental (even if they are costless to administer).

At date 1, however, the unregulated regime is not strictly more informative. The partition induced on the set of possible signals observed by the manager $\{HG, HB, LG, LB\}$ by voluntary disclosure is not comparable to the partition induced by mandatory disclosure.²⁰ Thus, the desirability of mandated disclosure will depend on a balance of costs and benefits, which includes the importance of the different types of information and how important it is that revelation occur at date 1 versus date 2.

¹⁸ See Lipe (1990) for a discussion of the difference between variance of earnings changes and earnings persistence.

¹⁹ The conservatism in forecasting behavior reported by Jaggi and Grier (firms forecast only if earnings prior to the forecast were relatively stable) may reflect liability exposure of managers making forecasts in the sample period 1971-1974. Such conservatism may be attenuated in forecast samples after 1979, when the SEC instituted the Safe Harbor Rule, protecting managers making forecasts; see SEC Release 5362, *Statement by the Commission on the Disclosure of Projections of Future Economic Performance*, and McNichols (1989).

²⁰ Specifically, the partition under mandatory disclosure at date 1 is $\{HG, LG\}, \{HB, LB\}$, since G or B is disclosed; whereas under voluntary disclosure it is $\{HG, LB\}, \{LG, HB\}$, corresponding to sets that withhold, disclose good news, and disclose bad news.

The reason that voluntary disclosure (or nondisclosure) can be superior in our setting is that the mandatory disclosure alternative applies to only one of the two kinds of information. This is thus analogous to the general possibility that removing specific frictions (such as an informational asymmetry) can be undesirable, given that a frictionless first-best outcome is not attainable.

In Diamond (1985), both good and bad news is disclosed to reduce the cost to investors of investigation. In our setting, in which type is not directly disclosable, withholding leads to revelation of type and, therefore, is consistent with reducing the costs investors incur of investigating type. Fishman and Hagerty (1990) analyze the problem of limited disclosure when the number of signals that can be disclosed is exogenously specified to be less than the number of unknown parameters. In our model, the manager is also constrained in that he can only disclose news but not firm type. As in their paper, information revealed to investors is not confined to the contents of the disclosure. Information is also conveyed by the choice of the signals to disclose in Fishman and Hagerty, and by the decision of whether or not to disclose in our model. One key difference is that, owing to the multistate structure in our model, the manager will sometimes withhold favorable news or even disclose the unfavorable news; whereas in Fishman and Hagerty the manager always discloses the most favorable news possible.

3. Other Equilibria

So far, we have focused on the separating equilibrium to illustrate why firms may withhold good news. In this section, we examine the entire set of possible equilibria, to examine the robustness of the conclusions drawn from the separating equilibrium. A compelling argument for taking the separating equilibrium seriously is that it leads to full revelation (news and type), whereas other equilibria do not. However, it is useful to examine explicitly the parameter values under which alternative equilibria exist, and whether some equilibria are unreasonable in the sense of standard equilibrium refinement concepts.

The equilibria of this model may be divided into two categories, those in which good news is withheld, and “traditional” equilibria in which good news is always disclosed. The four equilibria (based on beliefs **β**₁, **β**₃, **β**₅, and **β**₇) involve withholding of good news, consistent with our main theme. The traditional equilibria based on beliefs **β**₁₁ and **β**₁₆ involve always disclosing good news.²¹

²¹ The working paper version [Teoh and Hwang (1990)] demonstrated that the other 10 candidates are never perfect Bayesian equilibria.

In the next subsection, we examine equilibria in which good news is withheld, and in which not only is good news withheld, but also bad news is disclosed. Then, in Subsection 3.2, we examine the two traditional equilibria, the all-disclose and the threshold equilibria, in which good news (though perhaps not bad news) is always disclosed. We show that such equilibria always exist, but argue that they are sometimes not reasonable in our setting. In contrast, the separating equilibrium $\mathfrak{B7}$ of Section 2 only exists for some parameter values, but is, we argue, reasonable and survives all standard refinement criteria.

3.1 Equilibria in which good news is withheld

The three beliefs, $\mathfrak{B1}$, $\mathfrak{B3}$, and $\mathfrak{B5}$, lead to perfect Bayesian equilibria with properties similar to the separating equilibrium $\mathfrak{B7}$ in that high-quality firms withhold good news (and low firms withhold bad news). $\mathfrak{B3}$ has the additional similarity with $\mathfrak{B7}$ that low-quality firms disclose good news, and $\mathfrak{B5}$ has the similar feature that high-quality firms disclose bad news.

An important condition needed for the separating equilibrium of the preceding section was the complementarity of high type with good news in generating high value. Intuitively, complementarity is needed for separation of high and low types, because it leads to a differential signaling benefit between high and low to taking an action (such as withholding good, or disclosing bad news) that is, in the short run, costly. We argued above that this condition, is reasonable in settings where news provides information about future opportunities whose value depended on firm type. However, some of our main conclusions still apply when complementarity is weak or partial.

The conditions for $\mathfrak{B1}$ to be an equilibrium do not imply complementarity of high type with good news in generating high cash flow. Thus, good news can be withheld even without complementarity. However, high and low types end up pooled in the all-withhold equilibrium.²²

Equilibria $\mathfrak{B5}$ and $\mathfrak{B7}$ have both bad news disclosed as well as good news withheld. $\mathfrak{B5}$ holds even if the complementarity condition is partly weakened.²³ Thus, having both withholding of good news and release of bad news does require some degree of complementarity in our model. Although not our primary focus here, the range of parameters under which good news is withheld and bad news disclosed is expanded by the existence of mixed strategies with the

²² This feature of the equilibrium is not appealing. This equilibrium is not eliminated by the Cho-Kreps intuitive criterion, but would be eliminated by stronger refinements.

²³ Instead of requiring that high type raises the difference between cash flows arising from good or bad news at date 1 regardless of date-1 news, this need obtain only after bad news at date 1.

relevant properties. For example, $H-B$ may randomize between disclose and withhold, leading to an equilibrium “in between” $\mathfrak{B}3$ and $\mathfrak{B}7$.

Another important condition for the separating equilibrium is of value crossover ($V_G^L > V_B^H$), as implied by (18). This condition is not required in equilibria $\mathfrak{B}3$ and $\mathfrak{B}5$, resulting in different stock price predictions. In $\mathfrak{B}3$, $V_G^L > V_1(W; \mathfrak{B}3)$, so a firm disclosing good news is valued more highly than a withholding firm; but V_B^H could be either greater or less than $V_1(W; \mathfrak{B}3)$, since disclosing bad news never occurs in equilibrium. Thus, the equilibrium predicts a positive reaction to disclosing good news, while the reaction to disclosing bad news could be either positive or negative. In $\mathfrak{B}5$, $V_B^H < V_1(W; \mathfrak{B}5)$, so a firm disclosing bad news is valued less than the value of a withholding firm, but a firm that discloses good news may be valued either higher or lower than a withholding firm. Thus, there is still a negative reaction to disclosing bad news, but either a positive or negative reaction to disclosing good news. Equilibrium $\mathfrak{B}5$, however, has the property that good news is withheld (by $H-G$) and bad news disclosed (by $H-B$).

3.2 The all-disclose and threshold equilibria

Previous research has focused on equilibria very different from that of Section 2. In the analyses of Grossman (1981), Milgrom (1981), and Ross (1979), all firms disclose (except the firm with the worst news, which is indifferent). In models with fixed costs of disclosure, only the firms with sufficiently good news will disclose. The corresponding equilibria in our model are the all-disclose candidate, based on $\mathfrak{B}16$, and the threshold candidate, based on $\mathfrak{B}11$, in which firms with good news disclose but firms with bad news do not.

In this section, we explore the parameter values under which either the separating equilibrium of the previous section or the more “traditional” all-disclose and threshold equilibria obtain. We argue, that the two traditional equilibria are sometimes not plausible in our setting. Intuitively, these equilibria leave too much information hidden. In an equilibrium in which both high- and low-type firms disclose good news, a high firm has an incentive to defect by withholding good news in order to demonstrate its type. We show that the threshold equilibrium can sometimes be eliminated under some parameter values even using the relatively mild Intuitive Criterion of Cho and Kreps (1987). Stronger refinements suggest that the threshold equilibrium can frequently be eliminated when the complementarity condition holds. In contrast, in the separating equilibrium of Section 2, all information is revealed, removing any incentive of a firm to defect

from the equilibrium to signal its type. Thus, when it exists, the separating equilibrium satisfies all standard refinements.

We first examine $\mathfrak{B}11$ in which the firm puts its best foot forward by disclosing good news but withholding bad news. We call this the threshold equilibrium. At date 1, there are two possible equilibrium Investor valuations depending on whether good news was revealed or news was withheld: $V_1(DG; \mathfrak{B}11)$ is a probability-weighted average of V_G^H and V_G^L and $V_1(W; \mathfrak{B}11)$ is a probability-weighted average of V_B^H and V_B^L . H and L firms are pooled at date 1. Even at date 3 when I_3 is revealed, H and L firms remain pooled. Investors can only distinguish between firms according to their news $(I_1, I_3) = (G_1, G_3)$, (G_1, B_3) , (B_1, G_3) , or (B_1, B_3) . This contrasts with the separating equilibrium in the previous section, where there is partial, separation of firm types (H or L) at date 1 and full separation at date 2 when investors can distinguish perfectly between firm types as well as news (I_1, I_3) .

We discuss the Cho-Kreps (1987) refinement concept to describe how the threshold equilibrium can be eliminated. The description here is condensed; details may be found in the working paper version. A modest extension of Cho and Kreps's Intuitive Criterion is needed to deal with the fact that Investors form two sets of beliefs: the first after the firm chooses whether to disclose at date 1; and the second at date 3, when news (but not firm type) is revealed. A defection from the equilibrium move may immediately be perceived by investors as a defection at date 1, or may at date 1 seem consistent with equilibrium and only be recognized as a defection at date 2. For example, in the all-withhold equilibrium, disclosing good news would immediately be visible as a defection at date 1. On the other hand, in the threshold equilibrium, if an H - G firm were to withhold, investors would at date 1 believe that this was a firm with bad news, withholding in obedience to its equilibrium strategy. For our purposes, we need consider only defections in which the off-equilibrium nature of, the move only becomes apparent at date 2.

Our extension to the intuitive criterion is as follows. Let a firm's class refer to its type (H or L) combined with its date 1 news (G or B). (Thus, there are four classes, H - G , H - B , L - G , and L - B .) Suppose that a firm of class K contemplates a defection from its equilibrium strategy to a move m which, at date 1, appears to investors to be consistent with an equilibrium move by some other class. If, regardless of investors' inferences at date 3, the other class with the same news (e.g., an L - G firm) would not find it profitable to mimic this defection no matter what investors would infer from it at date 3, then when this move is observed at date 3, investors must believe that it was made by class K . Class K , recognizing this inference, will defect

to move m if K is better off by defecting than by following its equilibrium strategy. If so, the equilibrium will be broken.

The difference in the benefits to the defection of *withhold* between H - G and L - G arises from the higher probability that an H - G firm has of receiving good news at date 1 than an L - G firm. This leads to the following proposition.

Proposition 4. *There exists a nonempty open set of exogenous parameter values such that a separating equilibrium obtains in which a type- H firm withholds good news but discloses bad news and a type- L firm discloses good news but withholds bad news, while the threshold equilibrium in which all firms disclose good news and withhold bad news is eliminated by the Cho-Kreps Intuitive Criterion.*

Such a set of parameter values is given in the Appendix. A more general argument against the traditional equilibria in our setting can be made based on the Universal Divinity refinement of Banks and Sobel (1987). When the complementarity condition holds, universal divinity (appropriately defined) eliminates the threshold equilibrium. According to this refinement concept, if one type can profit from a defection under a wider range of responses than another type, then if the defection is observed, probabilityweight should be shifted away from the prior beliefs toward the latter type.

With respect to the threshold equilibrium, consider the inference of investors at date 3 when they realize that the firm withheld G_1 . Consider an inferred probability ξ that the firm is H based on G_1 and the fact of defection. Assume that this Inference is then updated using Bayes rule and the date-3 news G_3 or B_3 . If $\xi < \Pr(H|G_1, \emptyset 11)$, the equilibrium belief, then defection is unprofitable for both an H and L firm. The H - G firm gains from withholding under a wider range of inferences where $\xi > \Pr(H|G_1, \emptyset 11)$ than does an L - G firm, because the H - G firm has a greater chance of G_3 . Given complementarity, the higher probability of G_3 causes the expected benefit to being viewed as H to be higher for the H -firm than the L -firm.²⁴ Thus, the set of beliefs such that H will gain from defection will be an interval of ξ that is larger than the set of beliefs such that L will gain from defection, Universal divinity, therefore, requires that the inference from defection should be that it is the H type that withheld. But under this very favorable belief, withholding may be preferable to disclosing, in which case the equilibrium is eliminated.

Thus, the complementarity condition, which is necessary for the

²⁴ The complementarity condition (15) implies that $X_{aa}^H - X_{aa}^L > X_{ab}^H - X_{ab}^L$, so that the increase in value associated with being H versus L is higher if G , than if B , is received.

existence of the separating equilibrium, reduces the plausibility of the threshold equilibrium. This reinforces the conclusion that we expect to see withholding of good news and disclosure of bad news for firms in which the complementarity condition holds (as when earnings news is correlated with investment prospects, or when managers are prone to squandering free cash flow).

An alternative equilibrium that is similar to the threshold equilibrium (**§11**) is the traditional all-disclose equilibrium (**§16**). In the all-disclose equilibrium, all firms disclose good and bad news regardless of firm type. Since in the threshold equilibrium only bad news firms remain silent, investors' valuation $V_1(DB; \text{§16})$ is exactly the same as $V_1(W; \text{§11})$. *H*- and *L*-firms remain pooled at both dates 1 and 3. Exactly the same information is conveyed in the threshold and the all-disclose equilibria. However, by a reasoning analogous to that of Grossman and Perry (1986), the all-disclose equilibrium **§16** is weakly subject to defection if disclosure is costless, and strongly if there is any positive cost of disclosure, however small. The defection takes the form of withholding when news is bad, as in the threshold equilibrium.

The Grossman-Perry refinement allows for defection by sets of firm classes (rather than just a single class). It is based on the idea that, an equilibrium that is subject to a self-confirming defection is not credible. To see how this concept applies to the all-disclose equilibrium, suppose that *L-B* and *H-B* firms defect by withholding. If investors believe that this is the set of firm classes that will defect, then their belief about the defection (withhold) is precisely the same as their belief about the equilibrium move (disclose bad). Hence, a bad-news firm is indifferent between the defection and the equilibrium move. In contrast, a good-news firm strongly prefers its equilibrium move to the defection, under these beliefs.

Hence, defecting is weakly self-confirming. If the slightest cost of disclosure, however small, is added to the model, then a bad-news firm strictly prefers to withhold in order to avoid the disclosure cost, so the defection becomes strongly self-confirming. Thus, the all-disclose equilibrium **§16** is eliminated. This discussion is summarized by the following corollary to Proposition 4.

Corollary to Proposition 4. *There exists a nonempty open set of exogenous parameter values such that all reasonable equilibria have the property that a firm will sometimes withhold good news.*

Thus, there exist some circumstances in which all reasonable equilibria are consistent with the theme of this paper, that firms may withhold good news to signal favorable information about their non-

disclosable quality. Specifically, when complementarity is strong, we expect that some firms will withhold good news.

4. Conclusion

The classic literature on disclosure has argued that, when disclosure is costless and credible, there will be full disclosure owing to the desire of firms with good news to distinguish themselves from firms with bad news and a consequent skepticism by investors of nondisclosing firms. This leads to the policy conclusion that legally mandated disclosure in securities markets is a matter of indifference, aside from direct costs of disclosure; see Ross (1979). Policymakers appear to have a different viewpoint. For example, the SEC has adopted numerous disclosure requirements; the most stringent is probably Rule 10b-5, which, under some conditions, requires the immediate disclosure of information that may have a material impact on the firm.²⁵

Employing a model in which there is nonverifiable information about the firm's propensity to receive good or bad news in a later period, we demonstrate that a high-quality firm may, not disclose unless it has *bad* news to impart, which helps to distinguish itself from a low-quality firm. On the other hand, a low-quality firm strongly prefers not to disclose unless it has good news; An important feature of this equilibrium is the full revelation of the firm's quality as well as news. By applying standard refinement concepts, we show that there are some parameter values under which such an equilibrium is reasonable while full disclosure is not. Specifically, withholding of good news will tend to occur when good news is complementary with high firm quality in raising firm value. While concealment of information by the firm may make the market less informed in the short run, it makes the market price a more precise estimate of firm value in the long run. The possible superiority of voluntary disclosure is a second-best outcome that arises from the fact that not all kinds of information can be directly disclosed.

Disclosure can be a very costly process, especially if it is interpreted broadly as including activities such as signaling and changing operating policy in order to reveal favorable information. Brennan (1990) showed that firms may sacrifice underlying value in order to realize latent assets, which demonstrates high value observably. Our analysis suggests that a failure to disclose can serve as signal of high firm quality; This suggests that firm value can sometimes be signaled at a *negative* real cost to the firm.

²⁵ See SEC Release 5092 (1970). The Commission also requires monthly filings (Form 8-K item 5) by a public corporation if it has experienced an event that is "important" to security holders; see Accounting Series Release (ASR) No. 138 and 177.

Empirically, the model is consistent with the evidence of Lev and Penman (1990), who found no significant price reaction for silent firms when other firms in the same industry made forecasts of earnings, and with Foster (1981) and Clinch and Sinclair (1987), who found a positive information transfer between forecasting firms and nonforecasting firms. These findings are contrary to the predictions of traditional models of disclosure. Our model also provides an explanation for the seemingly anomalous evidence that firms voluntarily make announcements that lead to a more adverse (negative) price reaction than does nondisclosure.

Normatively, the analysis suggests some qualification to the sanguine policy conclusion that all relevant information can and will be voluntarily disclosed to the market. We conclude that not all information will be disclosed even though the disclosure is costless and credible. However, it may be socially worthwhile to permit strategic nondisclosure, if the delay in disclosure allows managers to communicate other valuable information more credibly to the market. Under a mandatory disclosure regime, investors would learn information that can be credibly disclosed (good or bad news) but not unverifiable information (high or low firm type). The paper shows that by allowing strategic timing of disclosure, even information that cannot be directly disclosed is indirectly revealed.

There may be social costs to concealment if investors expend resources trying to ferret out the concealed information.²⁶ As Diamond (1985) demonstrates, an enforceable disclosure commitment can improve traders' welfare *ex ante* by reducing the incentive to acquire private information. However, these costs must be weighed against the social costs of alternative signals to which managers might resort if the option of strategic concealment is eliminated by regulation.

Appendix

A numerical example

A numerical example is provided here to illustrate that there is a set of parameter values that satisfy the conditions for the existence of the separating equilibrium and also cause the unraveling of the threshold equilibrium by the Cho-Kreps refinement concept. This proves Proposition 1 and Proposition 4. Let

$$\begin{array}{ll} p_G^H &= .60, & X_{BB}^L &= 0, \\ p_B^L &= .50, & X_{BG}^L = X_{GB}^L &= 7, \end{array}$$

²⁶ Fishman and Hagerty (1989) emphasize investors' costs of assimilating information contained in corporate disclosures.

$$\begin{array}{llll} p_{G|G}^H = p_{B|B}^L = .95, & X_{GG}^L & = 60, \\ p_{G|B}^H = p_{B|G}^L = .50, & X_{BB}^H & = 1, \\ f & = .08, & X_{BG}^H = X_{GB}^H & = 9, \\ \alpha & = .30, & X_{GG}^H & = 80. \end{array}$$

Then, γ , the fraction of H - G in the withholding pool of the separating equilibrium, is 0.09. From (10), when belief is β_7 , the firm anticipates market values at date 1 conditional on the disclosure policy at date 1 to be

$$\begin{array}{ll} E(V_3|W, H-G; \beta_7) = 76.45, & E(V_3|DG, H-G; \beta_7) = 57.35, \\ E(V_3|W, H-B; \beta_7) = 3.50, & E(V_3|DB, H-B; \beta_7) = 5.00, \\ E(V_3|W, L-G; \beta_7) = 44.50, & E(V_3|DG, L-G; \beta_7) = 33.50, \end{array}$$

The investors' valuations of the firm at date 1 conditional on firm action are

$$V_1(DG; \beta_7) = 33.50,$$

$$V_1(DB; \beta_7) = 5.00,$$

$$V_1(W; \beta_7) = 7.54.$$

Therefore, the firm's utility from withholding or disclosing news as described in Table 2 is

$$\begin{array}{ll} U(W, H-G; \beta_7) = 55.78 > U(DG, H-G; \beta_7) = 50.20, \\ U(W, H-B; \beta_7) = 4.71 < U(DB, H-B; \beta_7) = 5.00, \\ U(W, L-G; \beta_7) = 33.41 < U(DG, L-G; \beta_7) = 33.50, \\ U(W, L-B; \beta_7) = 2.51 > U(DB, L-B; \beta_7) = 2.48. \end{array}$$

Therefore, at date 1: H - G withholds good news, H - B discloses bad news, L - G discloses good news, and L - B withholds bad news. Constraints (11')-(14') are satisfied and β_7 is confirmed as an equilibrium belief.

The properties of the separating equilibrium in Proposition 3 are confirmed as follows. The ex ante firm value is $\bar{V} = 19.40$. Inequalities (18) and (19) are confirmed by

$$V_1(DG; \beta_7) = 33.50 > V_1(W; \beta_7) = 7.54 > V_1(DB; \beta_7) = 5.00.$$

The stock price increases by 14.1 at the announcement of good news, and declines by 14.40 at the announcement of bad news. There is a decrease of 11.86 in the price of a firm that withholds information at date 1. This is smaller than the price decline in the event of a disclosure of bad news.

We show next that the conditions to rule out the threshold equilibrium using the Cho-Kreps intuitive criterion are also satisfied with

the same parameter values. The specific steps in finding the conditions that will break the disclosure threshold equilibrium are enumerated below for the proposed equilibrium.

(1) Find investors' valuation at date 1 of a firm that discloses good news $V_1(DG; \beta_{11})$ and a firm that withholds bad news $V_1(W; \beta_{11})$.

(ii) Find $U(DG, H-G; \beta_{11})$ and $U(DG, L-G; \beta_{11})$, the payoffs to disclosing good news for an $H-G$ and $L-G$ firm, respectively.

(iii) Find $\tilde{U}(W, L-G; \beta_{11})$, the maximum payoff an $L-G$ firm could hope to obtain from making the off-equilibrium move of withholding G_1 . The maximum is ensured by calculating the payoff assuming the most favorable investor 'response for the off-equilibrium move, which is to value the firm as if only the $H-G$ class would make this move.

(iv) Find $U(W, H-G; \beta_{11})$, the payoff expected by an $H-G$ firm from making the off-equilibrium move of withholding G_1 , assuming again the most favorable response.

The threshold equilibrium is broken if an $H-G$ firm gains by withholding the good news,

$$U(W, H-G; \beta_{11}) > U(DG, H-G; \beta_{11}), \quad (A1)$$

but an $L-G$ firm cannot benefit from withholding the good news,

$$\tilde{U}(W, L-G; \beta_{11}) < U(DG, L-G; \beta_{11}). \quad (A2)$$

See the Appendix of our working paper version [Teoh and Hwang (1990)] for details for the computations of the expected date-3 values conditional on out-of-equilibrium moves. Investors' valuations when belief is β_{11} are

$$V_1(DG; \beta_{11}) = 37.56, \quad V_1(W; \beta_{11}) = 0.65.$$

For firms with good news at date 1, the firm's assessments of market values at date 1 conditional on the disclosure policy at date 1 are

$$\begin{aligned} E(V_3 | W, H-G; \beta_{11}) &= 76.45, & E(V_3 | DG, H-G; \beta_{11}) &= 60.49, \\ E(V_3 | W, L-G; \beta_{11}) &= 44.50, & E(V_3 | DG, L-G; \beta_{11}) &= 35.16. \end{aligned}$$

Therefore, the following payoffs are anticipated:

$$\begin{aligned} U(W, H-G; \beta_{11}) &= 53.71 > U(DG, H-G; \beta_{11}) = 53.61, \\ U(W, L-G; \beta_{11}) &= 31.35 < U(DG, L-G; \beta_{11}) = 35.88. \end{aligned}$$

Therefore, $H-G$ will defect by withholding good news but $L-G$ will prefer to disclose the good news. Thus, the disclosure pool is broken. None of the calculations are sensitive to small perturbation of the parameters; hence, the same conclusions follow on an open set of the parameter values.

Proof of Proposition 2

A necessary condition for (11') and (12') to be true is that the RHS of (11') > RHS of (12'):

$$p_{G1G}^H \Delta_{GG} + p_{B1G}^H \Delta_{GB} > p_{G1G}^L \Delta_{GG} + p_{B1G}^L \Delta_{GB}.$$

This requires that

$$(p_{G1G}^H - p_{G1G}^L)(\Delta_{GG} - \Delta_{GB}) > 0.$$

Since $p_{G1G}^H - p_{G1G}^L > 0$ from assumption (1), a necessary condition for (11') and (12') is, therefore,

$$\Delta_{GG} \equiv (X_{GG}^H - X_{GG}^L) > \Delta_{GB} \equiv (X_{GB}^H - X_{GB}^L).$$

By comparing the RHS of (13') and (14') and using a similar reasoning, a necessary condition for (13') and (14') is

$$\Delta_{BG} \equiv (X_{BG}^H - X_{BG}^L) > \Delta_{BB} \equiv (X_{BB}^H - X_{BB}^L).$$

Since probabilities are nonnegative and from assumption (2) Δ_{GG} and Δ_{GB} are positive, the RHS of both (12') and (14') are positive. This implies that $V_G^L > V_1(W) > V_B^H$. Since

$$X_{BG}^H > V_B^H > X_{BB}^H,$$

a necessary condition for $V_G^L > V_B^H$ is that $X_{GG}^L > X_{BB}^H$.

Proof of Proposition 3

Since probabilities are nonnegative and from Assumption (2) Δ_{GG} and Δ_{GB} are positive, the RHS of (12') is positive. This implies that

$$V_1(DG) - V_1(W) > 0.$$

Similarly, probabilities are nonnegative and from Assumption (2) Δ_{BG} and Δ_{BB} are positive, and therefore the RHS of (14') is positive. This implies that

$$V_1(W) - V_1(DB) > 0.$$

Therefore,

$$\begin{aligned} V_1(DG) &> V_1(W) > V_1(DB), \\ V_1(DG) - \bar{V} &> V_1(W) - \bar{V} > V_1(DB) - \bar{V}. \end{aligned}$$

Since V is a probability-weighted average of $V_1(DG)$, $V_1(W)$, and $V_1(DB)$, the stock price reaction must be positive for the disclosure of G_I , and negative for the disclosure of B_I ,

$$V_1(DG) - \bar{V} > 0, \quad V_1(DB) - \bar{V} < 0.$$

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