Earnings management and firm valuation under asymmetric information

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Abstract

This paper seeks to provide an explanation for why corporate officers manage the disclosure of accounting information. We show that earnings management affects firm value when value-maximizing managers and investors are asymmetrically informed. In equilibrium, the strategic management of reported earnings influences investors' assessments of the market values of companies' shares.

Keywords: Earnings management; Asymmetric information; Accounting disclosure policies; Firm valuation

JEL classification: C72; D82; G12; G30; M41

1. Introduction

The belief that financial officers manage accounting earnings is widely accepted by users of financial statements and is supported by a growing body of empirical research. For example, Hand (1989) provides evidence that firms "time" the reported earnings gain from debt-equity swaps to smooth unexpected and transitory decreases in reported earnings. Healy (1985) shows that managers' accrual policies relate to incentives in their earnings-based bonus plans. Other studies, including DeAngelo (1986,1988), McNichols and Wilson (1989), Liberty and Zimmerman (1986), Moses (1987) and Elliot and Shaw...
(1989), also support the notion that managers use discretionary accruals and accounting changes to manage earnings. ¹

In addition to these empirical studies, several theoretical papers address earnings management. Lambert (1984) uses an agency model to demonstrate that risk averse managers have an incentive to smooth "economic" earnings. In contrast, Trueman and Titman (1989) examine managerial incentives to manipulate "reported" earnings and argue that managers can lower the market's assessment of earnings volatility by smoothing reported earnings. According to their model, lower quality firms mimic higher quality firms by smoothing reported earnings, which reduces borrowing costs. Hughes and Schwartz (1989) use informational asymmetry between managers and investors to motivate the choice of inventory accounting methods. In their paper, firms with better prospects signal high quality by choosing FIFO rather than LIFO, even though there are tax benefits associated with LIFO. ²

Other theoretical papers that examine earnings management include Dye (1988), Stein (1989) and Verrecchia (1986).

Dye (1989) and Lambert (1984) show that managers smooth income to smooth managerial compensation, while Trueman and Titman (1989) show that firms smooth income because they want investors to perceive that the firm is less risky. In our paper, we examine a more fundamental question. Do firms manipulate earnings because they want investors to believe that the firm is more valuable? Further, can this manipulation result in more informative earnings?

We examine earnings management using an asymmetric information model. In our model, there are two types of firms, high-value and low-value firms. Firm value is based on the ability to generate economic earnings. Consequently, firms have high value when investors expect high economic earnings. For instance, if a firm reports high earnings, investors will place higher value on the firm because they expect this level of earnings to be maintained in the future. For reported earnings to be a credible signal of firm value, there must be a cost associated with over-reporting earnings. Otherwise, all firms would...

¹ Casual empiricism provides many anecdotal examples of earnings management. In one particularly interesting case, an attorney for American Express was quoted in Fortune magazine as saying, "If you tell me that it's improper under all circumstances for management to want to smooth out their results, adjust the level of risk, or to smooth out reserves, or to move figures from one period to another... I'll tell you, you don't understand the way American business is conducted." (See Lomis, C. "The Earnings Magic at American Express," Fortune (June 25, 1984): 58–61). For other examples, see Getschow, G., "Slick Accounting Ploys Help Many Companies Improve Their Income," The Wall Street Journal (1980) and Worthy, F., "Manipulating Profits: How It's Done," Fortune (June 25, 1984): 50–54.

² See also the extension of this argument by Hughes, Schwartz, and Thakor (1988) to a setting in which managers signal quality through their choice of inventory accounting method and capital structure.
report the highest possible earnings level. We model this cost by assuming that reported earnings are taxable at the corporate level. Corporate taxation creates a trade-off between the benefit of being identified as a high-value firm and the additional tax liability from over-reporting earnings. Managers have additional incentives to manage earnings because their compensation is based on expected future firm values. If managers can convince the market that their firm is a high value firm (either correctly or incorrectly), the manager's compensation will be greater.

We show that a manager of a high-value firm over-reports income relative to the first-best tax minimizing reporting policy. Investors realize that only high-type firms are willing to pay the additional corporate taxes associated with over-reporting to this level and value such firms accordingly. On the other hand, managers of low value firms realize that the additional expected tax penalty from over-reporting earnings exceeds the benefits of being identified as a high-type firm and select the tax minimizing reporting policy.

In addition to over-reporting earnings, managers of high-type firms take actions to increase the probability that they are correctly identified by investors. By smoothing reported earnings around the "expected" earnings report, high type managers can reduce the noise in these reports, thereby allowing investors to increase the accuracy of their assessment of firm value. In our model, the greater the permitted level of smoothing, the more informative these reports become. If firms are permitted to perfectly smooth reported earnings, the earnings signal can be perfectly informative.

We find that there is a perfectly informative equilibrium that satisfies the Cho-Kreps intuitive criterion (Cho and Kreps, 1987). We say an equilibrium is perfectly informative if it communicates firm type with probability one on the (time 1) earnings report date. We also show (in Appendix B) that the Cho-Kreps intuitive criterion precludes the possibility of an uninformative equilibrium. An uninformative equilibrium is defined as an equilibrium in which investors cannot use reported earnings to update their prior assessments of firm type.

The remainder of the paper is organized into five sections. Section 2 describes the role of reported earnings in our model and describes firm valuation under asymmetric information. It also describes managerial compensation. Section 3 derives the reporting equilibria. Section 4 discusses the empirical implications of the model. Section 5 concludes the paper.

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3 Noise refers to the inability of investors to infer firm type from reported earnings. One report is noisier than another if the probability of identifying the correct type is lower.

4 The "expected" earnings report is the conditional expectation of the time 1 earnings report for the high-type firm under the equilibrium reporting policy.
2. Firm valuation under asymmetric information and managerial compensation

Our model characterizes asymmetric information by assuming that only managers observe economic earnings and firm type. Since investors cannot observe economic earnings, they must attempt to infer them from reported accounting earnings. This gives managers an incentive to use earnings reports to influence investors perceptions about firm value, since firm value is based on the present value of expected future economic earnings. Reported earnings also affect firm value through corporate taxes because we assume that corporate taxes are based on reported rather than economic earnings. This assumption reflects the fact that the tax authority bases its collections on observable numbers. Although taxable income and reported earnings are not necessarily equivalent, most of the differences between the two are due to temporary rather than permanent differences. Since temporary differences give rise to deferred tax assets or liabilities, they will eventually result in taxable amounts or deductions in the future.  

In the remainder of this section, we illustrate how firm value is determined. We begin by defining the basic structure of the assumed market. We then examine the process investors use to infer economic earnings from reported earnings. This includes a formal definition of economic earnings and a description of how reported and economic earnings differ. Next, we describe the valuation process under perfect and asymmetric information. Finally, we describe managerial compensation.

2.1. Market structure

We consider a two-period economy with three dates: \( t_0 \), the current date, \( t_1 \), the date when the first period economic earnings are realized and \( t_2 \), the date when the second period economic earnings are realized. In this economy, a firm may be one of two types. A “high-value” firm has expected economic earnings \( \mu_h \) and a “low-value” firm has expected economic earnings \( \mu_l \). Asymmetric information is characterized by the following assumption:

(A1) The distributions for economic earnings are common knowledge, but only the manager knows firm type.

This assumption implies that investors cannot directly infer firm type from

\[ \text{An alternative approach to modelling the cost of the signal is to assume that dividends paid increase proportionately to reported earnings, i.e. firms maintain a target payout ratio. Thus, over-reporting results in increased dividends; and a low value firm will be forced to pay an unaffordable amount of dividends to mimic a high value firm.} \]
the available information. We also assume that investors have homogeneous prior beliefs.

(A2) The prior probabilities of a low-value and high-value firm are \( p_l \) and \( p_h \), respectively.

2.2. Economic and reported earnings

Firms produce economic earnings \( (\tilde{X}_{jt}) \) each period according to the following process:

\[
\tilde{X}_{jt} = \mu_j + \tilde{e}_{jt}
\]  

(1)

The distribution of \( \tilde{e}_{jt} \) is normal with mean zero and is stationary over time. This distribution takes either a low-value \( (\mu_l, \sigma_l^2) \) or a high-value \( (\mu_h, \sigma_h^2) \). That is,

(A3) Economic earnings are normally distributed and stationary over time.

Managers face limits on the extent to which they can manage earnings because earnings reports must be prepared in accordance with generally accepted accounting principles (GAAP). GAAP defines the set of acceptable disclosure policies that managers may use to receive an unqualified opinion from the firm's independent auditor. Also, GAAP defines the limits within which reported earnings can deviate from economic earnings.

An earnings report is GAAP consistent if current differences between economic and reported earnings reverse in the future. This reversal constraint produces an income measure that is "tidy" in the sense of Demski and Sappington (1990). Without this reversal constraint, low-value managers could indefinitely mimic the earnings reports of high-value firms. Since GAAP restricts managers from consistently over-reporting earnings year after year, it effectively eliminates persistent "false" disclosure practices.

Managers of high-value firms attempt to communicate their private information about the firm's future economic earnings to investors through financial statements. Because we assume investors rely on the information contained in financial statements, the required disclosures permit investors to make inferences about firm value over time. An implication of a GAAP consistent reporting policy is that, over the life of the firm, the distributions for economic and reported earnings have the same unconditional mean.

We assume that managers may report earnings that deviate from economic earnings in the following manner:

\[
\tilde{R}_{j1} = \tilde{X}_{j1} + \gamma_j (\mu_j - \tilde{X}_{j1}) + \delta_j
\]  

(2)

\[
\tilde{R}_{j2} = \tilde{X}_{j2} - \gamma_j (\mu_j - \tilde{X}_{j1}) - \delta_j
\]  

(3)

\(^6\text{We do not restrict either the mean or the variance of these distributions other than to assume } \mu_h > \mu_l. \text{ Thus, } \sigma_l \text{ can be greater than or less than } \sigma_h.\)
where $\tilde{R}_{jt}$ is reported earnings for firm $j$ at time $t$ and $\gamma_j$ and $\delta_j$ are parameters that allow managers to shift income across periods. That is,

\begin{equation}
(A4) \text{Reported earnings are linear GAAP consistent transformation of economic earnings. The acceptable income reporting parameters are } \gamma_j \in [\gamma_{\text{min}}, 1] \text{ and } \delta_j \in [\delta_{\text{min}}, \delta_{\text{max}}] \text{ where, } -\infty < \gamma_{\text{min}} < 0, -\infty < \delta_{\text{min}} < 0, \text{ and } 0 < \delta_{\text{max}} < \infty.
\end{equation}

This first income reporting parameter ($\gamma_j$) changes the conditional variance of reported earnings relative to economic earnings but preserves the unconditional mean. If $0 < \gamma_j \leq 1$, a manager “smoothes” income toward the mean level of economic earnings ($\mu_j$) which reduces the variability of reported earnings relative to economic earnings. If $\gamma_j < 0$, the manager increases the variability of reported earnings relative to economic earnings by shifting $\tilde{R}_{jt}$ away from the mean (i.e. reverse-smoothes). If $\gamma_j = 1$, the firm perfectly smoothes income. This implies that the firm reports earnings equal to the conditional mean of earnings.

The second income reporting parameter ($\delta_j$) allows managers to change the conditional mean of reported earnings relative to economic earnings but preserves the unconditional variance. If a manager selects $\delta_j < 0$ ($> 0$), the conditional mean of reported earnings decreases (increases).

Taken together, the acceptable reporting parameters allow managers to change the conditional mean and variance of reported earnings relative to economic earnings over time. The feasible parameters provide managers with considerable flexibility. In fact, they can be selected so that the conditional distribution for time 1 reported earnings takes any mean in the interval $[\mu_j + \delta_{\text{min}}, \mu_j + \delta_{\text{max}}]$ and any variance in the interval $[0, \sigma_j^2 \max((1 - \gamma_{\text{min}})^2, (1 - \gamma_{\text{max}})^2)]$.

In our model, managers choose a time 0 income reporting strategy, $\Lambda_j$ where $\Lambda_j = (\gamma_j, \delta_j)$. This is an important assumption in our model and is

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7 This specification for reported earnings nests the Trueman and Titman (1989) specification as a special case, i.e. $\delta_j = 0$.
8 It would be straightforward to allow $\gamma_j > 1$. However, given our results, we can abstract from this rather counterintuitive possibility without loss of generality.
9 If the firm perfectly smoothes income, the conditional variance is zero. This produces a degenerate distribution for earnings reports in which the level of reported earnings is deterministic. In contrast, the conditional variance becomes unbounded as $\gamma_{\text{min}}$ approaches $-\infty$.
10 We show that the optimal reporting policy for the high-value firm is to perfectly smooth reported income at $t = 1$. Because the posterior probabilities are degenerate under the perfect smoothing policy (the probability of correctly identifying the high-value firm is one), we obtain a closed-form solution, which allows us to describe analytical results. If the perfect smoothing policy is not feasible at $t = 1$, the posterior distribution is nondegenerate and solutions are not available in closed-form. Analysis of the nondegenerate case must be handled numerically. Simulation evidence indicates that qualitatively similar results emerge when these bounds are restricted.
driven, to some extent, by tractability considerations. Zmijewski and Hagerman (1981) suggest that managers attempt to achieve an optimal level of reported earnings over time by choosing a set of accounting policies that agree with the firm’s income strategy. They contend that managers may accomplish this goal by any of a number of methods acceptable under GAAP. Truemen and Titman (1989) also assume that their income reporting parameters are chosen at time zero in their income smoothing paper (except they also assume \( \delta = 0 \)). This assumption reflects the notion that managers precommit to certain reporting practices when they select accounting methods. For example, managers, knowing their firm’s type and reporting strategy, select accounting methods such as inventory or depreciation methods ex ante. However, the choice of methods does not imply that future earnings are deterministic. In essence, investors know that each method defines a range of possible earnings reports around the mean of economic earnings. A range exists because variations in the application of most accounting methods exist. As examples, the useful lives for depreciable assets are often not disclosed; there are various types of LIFO inventory methods; and managers can allocate fixed overhead using many alternative bases. Even though these variables are not observable, once chosen they become difficult to change, and auditors insure that the methods and their applications are consistent over time. In reality managers may also manipulate earnings after observing economic earnings; however, they are limited in their ability to rely on such end-of-the-year adjustments as unusual reporting practices initiated then are more likely to be detected by independent auditors.

To ensure that earnings reports contain information, we assume that managers cannot communicate their income reporting strategies at time 0. If managers communicate their choices truthfully at time 0, all firms would follow their first-best strategies under perfect information and investors can identify firm type. Formally, this assumption can be stated as:

\[(A5) \text{Managers select an income reporting strategy at time 0 that is not disclosed to investors.}\]

2.3. Valuation under perfect information

This section examines the perfect information case where investors know firm type and can observe economic and reported earnings. We make three additional assumptions, that are maintained throughout the paper.

\[(A6) \text{Investors and managers are risk-neutral and the risk-free rate of interest is } r \text{ with } r > 0.\]

\[(A7) \text{Dividends are not paid until the firm is liquidated at time 2.}\]

\[(A8) \text{Corporate taxes are paid at the rate } \tau_c \text{ and are proportional to reported earnings. That is, corporate taxes equal } \tau_c R_jt.\]
Risk neutrality is a standard assumption for models of this type. We assume that the risk-free rate exceeds zero because this provides managers with an incentive to reduce income taxes in the current period even though current period under-reporting leads to future over-reporting. The present value of the expected tax benefits from under-reporting the current period's income disappears if the risk-free rate is zero. We assume that only liquidating dividends are paid to abstract from the possible signalling role of dividend policy.

Firm value is determined at time 0 as the present value of the firm's expected cash flows. That is,

$$V_{j0}^* = \sum_{t=1}^{\infty} E_0 \left( \frac{\bar{X}_{jt} - \tau_c \bar{R}_{jt}}{(1 + r)^t} \right)$$

where $$V_{j0}^*$$ is the perfect information market value of firm j at time 0 and $$E_0(\cdot)$$ is the expectations operator based on the time 0 information set. For the two-period case, firm value in (4) becomes

$$V_{j0}^* = \mu_j (1 - \tau_c) \left( \frac{1}{1 + r} + \frac{1}{(1 + r)^2} \right) - \tau_c \delta_j \left( \frac{r}{(1 + r)^2} \right).$$

Eq. (5) indicates that, even when investors are perfectly informed, value-maximizing managers will optimally report earnings that deviate from economic earnings. Specifically, the optimal reporting policy requires managers to report earnings that minimize the present value of the future corporate tax payments. Since $$\partial V_{j0}^* / \partial \delta_j = -\tau_c r / (1 + r)^2$$, the tax minimizing income reporting policy is to set $$\delta_j = \delta_{\text{min}}$$. We denote this optimal reporting strategy as $$\Lambda_j^*$$ where $$\Lambda_j^* = (\gamma_j^* , \delta_{\text{min}})$$ and $$\gamma_j^*$$ is any feasible $$\gamma_j \in [\gamma_{\text{min}}, 1]$$.  

2.4. Valuation under asymmetric information

Firm value at the end of the first period ($t = 1$)

Suppose that investors are unable to observe either the firm's economic earnings or firm type. Then, at time 1, firm j reports earnings of $$R_{jt}$$. Investors use $$R_{jt}$$ to update their prior probability that firm j is either a high

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11 Note that firm value is affected by the conditional mean but not the conditional variance of reported earnings. The conditional variance does not affect firm value because investors are risk neutral and $$\gamma_j$$ induces a mean-preserving spread around the optimal time 1 conditional mean ($$\mu_j + \delta_{\text{min}}$$). As a consequence, even though reported earnings affect corporate taxes, the symmetric nature of reported earnings around $$\mu_j + \delta_{\text{min}}$$ implies that for each state of nature in which the firm expects to pay lower taxes, there is a corresponding state in which the firm expects to pay higher taxes.
or a low-value firm using Bayes’ rule. Investors respectively assess the probability that firm $j$ is a low-value or a high-value firm as:

\[
pr(j = l|R_{j1}) = \frac{\phi_l(R_{j1})p_l}{\phi_l(R_{j1})p_l + \phi_h(R_{j1})p_h},
\]

\[
pr(j = h|R_{j1}) = \frac{\phi_h(R_{j1})p_h}{\phi_l(R_{j1})p_l + \phi_h(R_{j1})p_h}
\]

where $\phi_l(R_{j1})$ and $\phi_h(R_{j1})$ denote the marginal distribution that $R_{j1}$ comes from a low-value and a high-value firm.

Because earnings reports are informative (in a Bayesian sense) but not necessarily fully revealing, investors determine firm value at time 1 by computing the following conditional expectation:

\[
V_{j1}(R_{j1}) = pr(h|R_{j1})v_h(R_{j1}) + pr(l|R_{j1})v_l(R_{j1})
\]

(6)

where $V_{j1}(R_{j1})$ denotes the time 1 market value of a firm that reports $R_{j1}$, and $v_l(R_{j1})$ and $v_h(R_{j1})$ denote the value placed on a low-value and a high-value firm that reports earnings of $R_{j1}$.

For example, if $R_{j1}$ is released by a high-value firm ($R_{j1} = R_{h1}$), $v_h(R_{j1})$, is determined as:

\[
v_h(R_{j1}) = X_{h1} - \tau_c(R_{h1}) + \frac{E_t(X_{h2} - \tau_c(R_{h2}))}{1 + r}
\]

\[
= X_{h1}(1 - \tau_c) + \frac{\mu_h(1 - \tau_c)}{1 + r} + \tau_c r \left\{ \frac{\gamma_h(X_{h1} - \mu_h) - \delta_h}{1 + r} \right\}. 
\]

The value of the low-value firm, $v_l(R_{j1})$, is determined in an analogous manner. Note that $V_{j1}(R_{j1})$ is affected by the amount of reported income and the tax effects of the reported income.

Firm value at the end of the second period ($t = 2$)

Since a liquidating dividend is paid at time 2, investors become fully informed when they receive this payment. As a result, when the second earnings report is released at time 2, the value of the firm equals cash flow available to shareholders. That is,

\[
V_{j2}(R_{j2}) = v_j(R_{j2}) = X_{j2} - \tau_c(R_{j2}) + (1 + r)\left[ X_{j1} - \tau_c(R_{j1}) \right].
\]

(7)

Note that Eq. (7) reflects the time 2 cash flow plus the proceeds from investing the time 1 cash flows at the risk free rate. As in the perfect information case, this valuation is affected by the tax effects of the disclosure policy.
2.5. Managerial compensation

Managers are motivated to select income reporting strategies because we assume that their compensation depends on firm value over time. Formally, this assumption is:

\[(A10) \text{Managerial compensation is linear in (time 0) expected future firm values, and compensation plans are specified exogenously. That is}
\]

\[C_j(\lambda_j) = a_1 E_0[V_j1(R_{j1})] + a_2 E_0[V_j2(R_{j2})]
\]

where \(a_i\) denotes the relative contribution to the manager's compensation derived from \(V_{jt}(R_{jt})\).

Other papers making these assumptions include Hughes and Schwartz (1989), Hughes et al. (1988), Miller and Rock (1985), and Harris and Raviv (1985). Our results (and those cited above) depend on the assumption that managers cannot select a compensation contract allowing them to signal firm value. Lucas and McDonald (1990) argue that, even though optimal contracts are relatively easy to design for stylized models, it is difficult to implement such contracts in practice. They offer a number of explanations suggesting that contracts can mitigate but not eliminate problems of asymmetric information.

3. Income reporting equilibria

This section establishes the existence of an income reporting equilibrium in which managers select reporting policies that affect the informativeness of earnings reports. In this equilibrium, since investors use earnings reports to update their prior probabilities about firm value, manager’s select reporting policies to communicate firm-value.

In our model, there are two opposing incentives that influence the equilibrium reporting policy. First, low-value managers wish to reduce the information content of earnings reports to increase the probability that they are valued as a high-type firm. Conversely, high-value managers wish to enhance the information content of earnings reports so that prices coincide more closely with their perfect information value.

To demonstrate how the information content of earnings reports can be altered, consider the following case. Suppose that investors know that the

\[12\text{For a detailed discussion of this problem, see Dybvig and Zender (1991). Feltham and Hughes (1988) provide an example of how managers use contract selection to signal firm value. In a setting where entrepreneurs issue securities at the time a firm goes public, the percentage of ownership retention can be used to signal firm value.}\]
high-value firm perfectly smooths earnings ($\gamma_h = 1$) and does not shift the mean level of reported earnings ($\delta_h = 0$). Since this implies that, at time 1, there is no under or over-reporting and the conditional variance of reported earnings is zero, a high-value firm reports earnings equal to the mean of its economic earnings ($\mu_h$). That is, at time 1, a high-value firm reports a single amount. In addition, suppose that investors also know that the low-value firm does not mimic the high-value firm's reporting policy. By contrast to the high-value firm, this implies that the low-value firm's earnings report is normally distributed.

Given these reporting strategies, investors assume (correctly) that any report not equal to $\mu_h$ comes from a low-value firm. The only time an investor is unsure about firm type is when reported earnings equal $\mu_h$. In this case, the report could have originated from either type firm. Since investors know that high-value firms report earnings at $\mu_h$ with certainty and that the probability of low-value firms reporting earnings at this level has measure zero, an investor treats a report of $\mu_h$ as if it came from a high-value firm. Even though this implies that a low-value firm is over-priced if it reports $\mu_h$.

3.1. The necessary and sufficient conditions for an equilibrium

In this section, we demonstrate that although incentives may exist for the manager of the low-value firm to mimic the high-value firm's earnings reports and block the informativeness of earnings, the high-value firm can take actions that effectively eliminate such incentives. A low-value manager can "block" information revelation by selecting a reporting strategy $\Lambda^m_i$ so that the low-value firm's distribution for reported earnings at time 1 has the same conditional mean and variance as the high-value firm. This strategy is defined as:

$$\Lambda^m_i = (\gamma_i^m, \delta_i^m)$$

with $\gamma_i^m = (\sigma_h/\sigma_l)(1 - \gamma_h)$, and $\delta_i^m = \delta_h + \mu_h - \mu_l$, such that $\gamma_h$ and $\delta_h$ are any feasible parameter values. This policy renders earnings reports uninformative because investors cannot distinguish one report from the other. That is, the prior and posterior distributions of firm type are the same, i.e. $pr(h|\hat{R}_{ij}) = p_h$ and $pr(l|\hat{R}_{ij}) = p_l$.

What action can the manager of the high-value firm take to keep the low-value firm from mimicking its earnings reports? Managers of high-value firms can over-report earnings to discourage low-value firms from impeding the information revelation process. Over-reporting is costly for the low-value firm due to the additional tax burden. However, over-reporting also is costly for the high-value firm. The manager of the high-value firm only over-reports earnings if the compensation from over-reporting is greater than the compensation from other reporting strategies (not over-reporting).
To characterize when over-reporting is optimal, we examine the conditional mean of this reporting policy relative to the first best income reporting policy. To do this, we define excess earnings for firm \( j \) as the difference between the conditional mean of the time 1 earnings report and the first-best earnings report. For a high-value firm, excess earnings are:

\[
\epsilon_h = \left[ \left( \mu_h + \delta_h \right) - \left( \mu_h + \delta_{\text{min}} \right) \right] = \left[ \delta_h - \delta_{\text{min}} \right]
\]

For a low-value firm, excess earnings are the difference between the conditional mean from over-reporting earnings (and matching the high-value firm's mean earnings) and the first-best earnings report, or

\[
\epsilon_l = \left[ \mu_h + \delta_h \right] - \left[ \mu_l + \delta_{\text{min}} \right] = \left[ \mu_h - \mu_l + \left( \delta_h - \delta_{\text{min}} \right) \right]
\]

Thus, for the manager of the low-value firm, excess earnings include the excess earnings of the high-value firm plus the difference between the mean value of the two firm's cash flows. If the high-value manager reports excess earnings of \( \epsilon_h \), a low-value manager would be required to report excess earnings of \( \epsilon_l = \mu_h - \mu_l + \epsilon_h \) to block the informativeness of the earnings report.

The compensation of the low-value firm's manager is strictly decreasing from over-reporting income. Fig. 1 illustrates this point. As the amount of excess earnings increases, income taxes accrued on excess earnings increase; firm value decreases; and the manager's compensation decreases. When the amount of over-reporting reaches \( \epsilon_{l}^{\text{pl}} \), the manager of the low-value firm prefers the compensation that would be received with the first-best reporting.
strategy. At this point, there is no incentive for the manager to mimic the earnings report of the high-value firm, and the manager of the low-value firm becomes indifferent between blocking and choosing the first-best reporting strategy, $\Lambda_f^* = (\gamma_f^*, \delta_{\text{min}})$. We denote this reporting strategy as $\Lambda_f^m = (\gamma_f^m, \delta_{\text{min}} + \epsilon_f^m)$. Any increase in the high-value firm's reported earnings above this level induces the low-value firm to avoid blocking.

There are two necessary and sufficient conditions for a perfectly informative equilibrium. The first condition is:

(C1) The low-value firm's incentive to block information revelation by selecting an income reporting strategy that mimics the income reporting strategy of the high-value firm is eliminated if the low-value firm's manager's compensation from following the first-best reporting strategy ($\Lambda_f^*$) exceeds the compensation from following a mimicking policy ($\Lambda_f^m$).

Fig. 2 illustrates the compensation condition from the viewpoint of the high-value firm. Similar to the low-value firm manager's compensation, the high-value firm manager's compensation also decreases as excess earnings approach $\epsilon_h^m$. Compensation decreases because the high-value firm also incurs additional taxes from over-reporting. However, when excess earnings reach $\epsilon_h^m$, the high-value firm manager's compensation increases to $C_h(\Lambda_h^{pi})$, since a low-value manager no longer mimics the high-value firm's earnings reports and earnings become more informative.

The manager of the high-value firm over-reports earnings by $\epsilon_h^{pi}$ if the compensation from following a reporting strategy of $\Lambda_h^{pi} = (\gamma_h, \delta_{\text{min}} + \epsilon_h^{pi})$ results in greater compensation than if the firm follows an alternative reporting strategy of $\Lambda_h^m = (\gamma_h, \delta_{\text{min}} + \epsilon_h^m)$ and the low-value firm mimics. Therefore the second necessary and sufficient condition, is
(C2) A high-value firm manager's compensation with the perfectly informative earnings reporting strategy (A\textsuperscript{P}\textsubscript{h}) exceeds the compensation received under a strategy that permits mimicry (A\textsuperscript{M}\textsubscript{h}).

As Fig. 2 illustrates, a high-value manager will never over-report by more than \(\epsilon\textsuperscript{P}\textsubscript{h}\), since additional over-reporting results in strictly lower compensation.

3.2. Equilibrium income reporting policies

This section demonstrates that there exists a perfectly informative equilibrium for our model that satisfies the Cho-Kreps intuitive criterion (CKIC). In a perfectly informative equilibrium, the manager of the high-type firm finds it necessary to over-report time 1 earnings relative to the first-best reporting policy because the payment of excess corporate taxes is the only credible way to signal firm type. The high-value manager also perfectly smooths reported earnings to ensure that the market realizes that this excess tax penalty has been incurred. Given the high-value manager's actions, a low-value firm has no incentive to over-report and simply reports the earnings level consistent with the first-best reporting strategy. These findings imply that high-value firms smooth income relative to low-value firms and that high-value firms tend to over-report income relative to low-value firms. We summarize these results in Proposition 1.

**Proposition 1:** Given assumptions (A1) through (A10), there exists a perfectly informative equilibrium that satisfies the Cho-Kreps intuitive criterion. The optimal reporting strategy for the manager of the high-value firm is to employ a reporting strategy, \(A_h^{*} = (1, \delta_{\text{min}} + \epsilon_h^{*})\), where \(\epsilon_h^{*}\) represents the increase in the conditional mean of the high-value firm's reported earnings such that if the low-value firm mimics, the low-value firm manager's compensation is equal to the first-best compensation, or \(C_f(A_h^{*}) = C_f\). The manager of the low-value firm uses a reporting strategy of \(A_l^{*} = (y_l, \delta_{\text{min}})\), where \(y_l\) is any feasible parameter. The level of over-reporting by the high-value firm is

\[
\epsilon_h^{**} = \max(0,\epsilon_h^{pi})
\]

where

\[
\epsilon_h^{pi} = \left(\frac{a_1}{a_1 + a_2(1 + r)}\right)\left(\frac{\theta_1}{\theta_2}\right) - 1\left(\mu_h - \mu_l\right)
\]

\[
\theta_1 = \left(1 + \frac{1}{1 + r}\right)(1 - \tau_c)
\]

\[
\theta_2 = \frac{\tau_c r}{1 + r}.
\]

**Proof:** See Appendix A.
This proposition implies that the manager of the high-value firm perfectly smooths reported earnings around $\mu_h + \delta_{\min} + \epsilon_h^{*\cdot}$. At this level of reported earnings, the manager of the low-value firm does not mimic the earnings report of the high-value firm and chooses the tax-minimizing reporting strategy. Note that $\theta_1$ is the after-tax present value of a two-period annuity due, and $\theta_2$ is the present value of a $1$ corporate tax deduction that can be accelerated forward one period.

Given Proposition 1, we can state the following corollary.

Corollary: If $\epsilon_h^{*\cdot}$ equals zero and assumptions (A1) through (A8) hold, there is a “costless,” perfectly informative equilibrium that satisfies the Cho-Kreps intuitive criterion. This equilibrium is costless because the high-value manager finds it optimal to follow the first-best reporting policy under perfect information.

The perfect-information solution obtains because investors realize that the corporate tax penalty required to mimic a high-type firm’s first-best reporting policy is sufficient to eliminate the low-value firm’s incentive to block information revelation. Therefore, a high-type manager finds the first-best reporting policy incentive compatible. To ensure that investors recognize the firm has high-value, the manager perfectly smooths earnings around the first-best report. In this manner, firm type is revealed and managers maximize their compensation. As before, since low-value managers have no incentive to block the information revelation process, their compensation is maximized by adopting the first-best reporting policy.

4. Empirical implications

Several empirical inferences may be drawn from our model. First, we argue that the informativeness of earnings increases for firms with smooth earnings. Therefore, we expect that firms with smooth earnings have greater earnings response coefficients, where the earnings response coefficient measures the association between earnings and security returns. A larger earnings response coefficient for a particular firm suggests that the market places more reliability on that firm’s reported earnings, as evidenced in a stronger reaction to the information contained therein, whether it be good news or bad. Smoother income may serve to aid the reader in assessing the future prospects of the firm by enhancing the usefulness of the information conveyed for predictive purposes. For example, if a firm has had a history of erratic earnings trends, the reader will be reluctant to rely on an increase in income in the current year, knowing that it may be followed by a blip in the opposite direction in the future.
Second, predictions regarding accounting choice may be derived from the implications of our model. There has been significant debate over why all firms don’t use the same accounting policies, such as FIFO or LIFO. For instance, why don’t all firms switch to LIFO in a period of rising prices? Our model predicts that high-value firms over-report earnings while low-value firms choose a tax-minimizing reporting strategy. In the FIFO-LIFO debate, in a period of rising prices, FIFO-users report higher earnings even though the firm incurs higher taxes, while a LIFO-user reports lower profits and pays less in taxes. Our model suggests that high-value firms may choose FIFO and incur the tax penalty to signal high-value, while low-value firms might choose LIFO. Of course, inventory choice is only one of a number of choices comprising a firm’s income reporting strategy; others include depreciation methods, investment tax credit, leases, etc.

In a recent paper, Chaney and Lewis (1993) examine the market performance of 489 firms immediately after going public. They develop a smoothing proxy computed by dividing the variance of the firm’s operating cash flows by the variance of operating income over the five years after the IPO. A high value for the proxy indicates income smoothing since the variance of income is less than the variance of cash flows. They find a strong positive association between their smoothing proxy and the market performance of the IPO firms. This result is consistent with our model.

5. Conclusion

This paper develops a valuation model under asymmetric information in which the demand for earnings management arises endogenously from the nature of the managers’ compensation contracts. We show that managers of different firms are motivated to adopt distinct reporting strategies. The model predicts that high-value firms smooth income and adopt income-increasing accounting treatments relative to other firms.

We show that compensation-maximizing, high-value managers select reporting policies that mitigate the degree to which communication is “blocked”. The observation that managerial discretion in setting accruals is limited compels Schipper (1989) to argue that “opportunities for earnings management in the current reporting system do not eliminate the usefulness of accounting earnings for valuing shares.” To the contrary, the opportunity for managerial discretion may actually enhance the usefulness of reported earnings. An implication of our analysis is that it may make sense to allow greater management discretion in formulating earnings reports than GAAP currently allows.
6. Appendix A

This appendix contains the proofs to the propositions. We begin by summarizing and redefining a number of relations from the paper.

6.1. Firm valuation

Since managerial compensation is a function of firm value, we define firm value at different levels of over-reporting. If investors correctly infer firm type and the high-value firm over-reports earnings by $\epsilon_h$ the (time 0) expected value of a high-type firm is:

$$V_h(\Lambda_h(\epsilon_h)) = \mu_h \theta_1 - \delta_{\min} \theta_2 - \epsilon_h \theta_2$$

$$V_h(\Lambda_1(\epsilon_h)) = V_h(\Lambda_h(\epsilon_h))(1 + r)$$

where

$$\theta_1 = \left(1 + \frac{1}{1 + r}\right)(1 - \tau_c)$$

$$\theta_2 = \frac{\tau_c r}{1 + r}.$$

In an analogous fashion, if investors correctly infer firm type and the low-value manager over-reports by $\epsilon_l$, the (time 0) expected value of a low-type firm is:

$$V_l(\Lambda_l(\epsilon_l)) = \mu_l \theta_1 - \delta_{\min} \theta_2 - \epsilon_l \theta_2$$

$$V_l(\Lambda_l(\epsilon_l)) = V_l(\Lambda_l(\epsilon_l))(1 + r)$$

6.2. Managerial compensation

Using these valuation equations, we can reexamine the manager's compensation functions. For purposes of the analysis to follow, we define managerial compensation under two scenarios: (1) investors correctly infer firm type and (2) investors incorrectly infer firm type.

Managerial compensation if investors correctly infer firm type

If investor's correctly infer firm type, a manager expects to receive

$$C_i(\Lambda_i(\epsilon_i)) = a_1 V_{i1}(\Lambda_i(\epsilon_i)) + a_2 V_{i2}(\Lambda_i(\epsilon_i))$$

$$= a_1 (\mu_i \theta_1 - \delta_{\min} \theta_2 - \epsilon_i \theta_2) + a_2 (1 + r)(\mu_i \theta_1 - \delta_{\min} \theta_2 - \epsilon_i \theta_2)$$

$$= \alpha (\mu_i \theta_1 - \delta_{\min} \theta_2 - \epsilon_i \theta_2)$$

(1)
where $C_i(A_i(e_i))$ is a manager’s compensation level if earnings are over-reported by $e_i$ using the reporting strategy $A_i(e_i)$ and where $i = (l,h)$ and $\alpha$ equals $a_1 + a_2(1 + r)$.

**Managerial compensation if investors incorrectly infer firm type**

If a low-value firm is mistaken for a high-value firm at time 1, there is an initial over-valuation. That is, if investors observe an earnings report at time 1 and incorrectly identify the low-value firm as a high-value firm, the expected value of the manager’s first period compensation is

$$a_1(\mu_h \theta_1 - \delta_{\text{min}} \theta_2 - e_h \theta_2)$$ (2)

where $e_h$ is the amount of over-reporting by the high-value firm. Note that the low-value manager’s expected compensation reflects the reporting strategy of the high-value firm (since this is how investors price the high-value firm).

However, because the firm liquidates at time 2, this mispricing does not persist through time 2. Hence, if investors believe a low-value firm has high-value at time 1, a low-value manager’s compensation is only affected in the first period. This implies that the expected value of the low-value manager’s period two compensation is

$$a_2(1 + r)(\mu_l \theta_1 - \delta_{\text{min}} \theta_2 - e_l \theta_2)$$ (3)

Combining Eqs. (2) and (3), a low-value manager’s compensation is:

$$C_i^m(A_i(e_i)) = a_1(\mu_h \theta_1 - \delta_{\text{min}} \theta_2 - e_h \theta_2) + a_2(1 + r)(\mu_l \theta_1 - \delta_{\text{min}} \theta_2 - e_l \theta_2)$$

$$= \alpha(\mu_h \theta_1 - \delta_{\text{min}} \theta_2 - e_h \theta_2) + a_1[(\mu_h - \mu_l)\theta_1 - (e_h - e_l)\theta_2]$$ (4)

where $C_i^m(A_i(e_i))$ denotes the low-value manager’s compensation if the low-value firm is mistaken for a high-value firm in the first period. Eq. (4) has two components: the first term is the low-value manager’s compensation if the firm is correctly identified by investors (see Eq. (1)) and the second term reflects the increase in compensation from being overvalued in the first period.

By contrast, if investors believe a high-type firm’s earnings report came from a low-value firm, the manager’s compensation level is:

$$C_h^m(A_h(e_h)) = a_1(\mu_h \theta_1 - \delta_{\text{min}} \theta_2 - e_h \theta_2) + a_2(1 + r)(\mu_h \theta_1 - \delta_{\text{min}} \theta_2 - e_h \theta_2)$$

$$= \alpha(\mu_h \theta_1 - \delta_{\text{min}} \theta_2 - e_h \theta_2) - a_1[(\mu_h - \mu_l)\theta_1 - (e_h - e_l)\theta_2]$$ (5)

where $C_h^m(A_h(e_h))$ denotes the high-value manager’s compensation if the high-value firm is mistaken for a low-value firm in the first period. Eq. (5) has a similar interpretation except that the second component reflects the decrease in market value due to being undervalued in the first period.
6.3. Derivation of the perfectly revealing equilibrium

Using these definitions, we prove that there is a perfectly informative equilibrium that satisfies the CKIC. An outline of our proof is as follows:

(1) Using the low-value manager's incentive compatibility condition, we derive the level of over-reporting that makes the low-value manager indifferent between blocking information revelation and his first-best outcome. We define this level of over-reporting as $e_f^*$. If a high-type manager wishes to ensure that the low-value manager's incentive compatibility condition holds, earnings must be over-reported. We define this level of over-reporting as $e_p^*$. That is, $e_f^*$ is the amount by which a high-type manager must over-report earnings to force the low-type manager to over-report by $e_p^*$.

In our paper, over-reporting is defined relative to the first-best, tax-minimizing reporting strategy. Since this first-best reporting strategy requires a firm to under-report earnings as much as possible at time 1 ($\delta_i = \delta_{\text{min}}$), it is not feasible for $e < 0$. As a consequence, we define the feasible levels of over-reporting to be $e_h^* = \max(0,e_f^*)$ and $e_i = \mu_h - \mu_l + e_h^*$. 

(2) Having derived the level of over-reporting that is required to prevent information blocking, we show that the feasible $e_h^*$ is incentive compatible for a high-value firm.

(3) Then, we prove that the perfect income smoothing strategy allows investors to infer firm type with probability one (provided the low-value manager does not find it incentive compatible to mimic the high-value firm's earnings reports).

(4) Finally, we establish that the perfectly informative equilibrium satisfies the CKIC. Since the low-value manager's optimal reporting strategy permits him to report earnings using any feasible conditional variance, we break the proof into two parts. First, we show that the proposed equilibrium satisfies the CKIC for $\gamma = 1$. Then, we show that the proposed equilibrium satisfies the CKIC for $\gamma \neq 1$. This dichotomy is needed because, if $\gamma = 1$, the low-value manager's earnings report is deterministic and an investor must consider how to evaluate off-equilibrium earnings reports. In contrast, if $\gamma \neq 1$, a low-value firm’s reported earnings are normally distributed which implies that any possible earnings report on the support of the distribution $(-\infty, \infty)$ is consistent with the proposed equilibrium. As a result, there are no off-equilibrium reports to consider and investors simply use Bayes’ rule to update their priors.

Low-value firm manager incentive compatibility and over-reporting

In a perfectly informative equilibrium, the low-value manager must find the first-best outcome incentive compatible. That is,

$$C_l(A_l^* (\epsilon_l = 0)) \geq C_l^m(A_l^m (\epsilon_l = \epsilon_l^m)).$$
Using (6), we can find \( \epsilon_{l}^{pi} \) such that (6) holds as an equality or
\[
P(A_i(\epsilon_i = 0)) = C^m_i(A_i(\epsilon_i = \epsilon_{l}^{pi})).
\]  
(7)
Substituting Eqs. (1) and (4) into (7) and solving for \( \epsilon_{l}^{pi} \) yields:
\[
\epsilon_{l}^{pi} = \left( \frac{a_i}{\alpha} \right) \left( \frac{\theta_1}{\theta_2} \right)(\mu_s - \mu_i)
\]
which is strictly positive. Since \( \epsilon_{l}^{pi} = \mu_s - \mu_i + \epsilon_{h}^{pi} \), the corresponding level of over-reporting by the high-type firm is
\[
\epsilon_{h}^{pi} = \left( \frac{a_i}{\alpha} \right) \left( \frac{\theta_1}{\theta_2} \right) - 1(\mu_s - \mu_i).
\]
Notice that the sign of \( \epsilon_{l}^{pi} \) can be negative or positive. If an \( \epsilon_{l}^{pi} < 0 \) is not feasible, the level of over-reporting by the high-value firm that is required to ensure incentive compatibility is
\[
\epsilon_{h}^{*} = \max(0, \epsilon_{h}^{pi})
\]  
(8)
The corresponding level of over-reporting by a low-value firm is
\[
\epsilon_{l} = \mu_s - \mu_i + \epsilon_{h}^{*}.
\]

**High-value firm manager incentive compatibility and over-reporting**

Next, we determine if the level of over-reporting is incentive compatible for the high-value manager. Over-reporting by \( \epsilon_{h}^{*} \) is incentive compatible if the high-value manager’s compensation, \( C_h(A_h(\epsilon_{h}^{*})) \), exceeds the compensation level received if investors believe the firm has low-value with probability one, \( C^m_h(\epsilon_{h}^{m}) \).

**Lemma 1:** If a high-value manager over-reports income by \( \epsilon_{h}^{*} \),
\[
C_h(A_h(\epsilon_{h}^{*})) > C^m_h(\epsilon_{h}^{m})
\]
where \( \epsilon_{h}^{*} \) is the level of over-reporting defined by Eq. (8) and \( \epsilon_{h}^{m} \) is the level of over-reporting if investors believe the firm has low-value with probability one.

**Proof:** To prove this lemma, we establish an upper bound for \( C^m_h(\epsilon_{h}^{m}) \) which we define as \( \overline{C} \). Then, we show that \( C_h(A_h(\epsilon_{h}^{*})) > \overline{C} \).

If investors believe a firm has low-value with probability one, a high-value manager has no incentive to over-report earnings. Therefore, an upper bound for \( C^m_h(\epsilon_{h}^{m}) \) is obtained by setting \( \epsilon_{h}^{m} = 0 \). This implies that:
\[
\overline{C} = C^m_h(\epsilon_{h}^{m} = 0) = a(\mu_s \theta_1 - \delta_{min} \theta_2 - \epsilon_{h}^{m} \theta_2) - a_i(\mu_s - \mu_i) \theta_1 - a_i \epsilon_{h}^{m} \theta_2.
\]
(9)

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13 If \( \epsilon_{h}^{pi} \) is positive, the high-value firm must over-report earnings by \( \epsilon_{h}^{pi} \) to ensure a perfectly informative equilibrium. However, if \( \epsilon_{h}^{pi} \) is negative, the firm could under-report earnings by more than is currently feasible under the first-best reporting policy and still have the equilibrium be perfectly informative.
Since \( \varepsilon^m = \mu_h - \mu_l + \varepsilon^m_h \), we can rewrite Eq. (9) as:

\[
\bar{C} = \alpha(\mu_h \theta_1 - \delta_{\min} \theta_2) - a_1(\mu_h - \mu_l)(\theta_1 - \theta_2).
\]

To show that \( C_h(\Lambda_h(\varepsilon_h^*)) > \bar{C} \), we consider the cases \( \varepsilon_h^* > 0 \) and \( \varepsilon_h^* = 0 \) separately.

Suppose \( \varepsilon_h^* > 0 \). Taking the difference between \( C_h(\Lambda_h(\varepsilon_h^*)) \) and \( \bar{C} \), we obtain:

\[
C_h(\Lambda_h(\varepsilon_h^*)) - \bar{C} = \alpha(\mu_h \theta_1 - \delta_{\min} \theta_2 - \varepsilon_h^* \theta_2) - \alpha(\mu_h \theta_1 - \delta_{\min} \theta_2) - a_2(\mu_h - \mu_l)(\theta_1 - \theta_2)
\]

\[
= a_2(1 + r)(\mu_h - \mu_l)\theta_2 > 0.
\]

The second line is obtained by substituting for \( \varepsilon_h^* \) and simplifying. The inequality follows because all terms are strictly positive.

Suppose \( \varepsilon_h^* = 0 \), then

\[
C_h(\Lambda_h(\varepsilon_h^*)) - \bar{C} = a_1(\mu_h - \mu_l)(\theta_1 - \theta_2) - \alpha \varepsilon_h^* \theta_2
\]

\[
= a_1(\mu_h - \mu_l)(\theta_1 - \theta_2) > 0.
\]

The second line follows from \( \varepsilon_h^* = 0 \); the inequality follows because \( \theta_1 > \theta_2 \) by assumption (A4). This completes the proof.

**Information revelation and perfect income smoothing**

Next, we show that the perfect income smoothing strategy can unambiguously communicate firm value.

**Lemma 2:** Assuming that the low-value manager does not mimic the high-value firm's reporting strategy and assumptions (A1) through (A10) hold, there exists at least one reporting strategy for which the high-type firm's expected market value at time one equals its perfect information value at time one, i.e.,

\[
V_{h1}(\Lambda_h^*(\varepsilon_h^*)) = V_{h1}^*.
\]

This strategy requires the high-value firm to perfectly smooth reported earnings at time 1. It can be characterized as \( \Lambda_h^* = (I, \delta_h^+) \) where \( \delta_h^+ \) is any feasible value.

**Proof:** To prove Lemma 2, it is sufficient to establish the existence of a reporting strategy that equates the high-value firm's expected market value with its perfect information value. This proof proceeds by showing that perfect income smoothing by the high-type firm \((\gamma_h = 1)\) is such a strategy. Because we assume that the low-value firm does not have an incentive to block communication, it must be the case that either, \( \gamma_l \neq (\sigma_h / \sigma_l)(1 - \gamma_h) \), \( \delta_l \neq \delta_h + \mu_h - \mu_l \), or both conditions hold.

If a high-type firm perfectly smooths income, the conditional variance of its earnings reports is zero. This produces a degenerate distribution in which
a high-type firm's reported earnings are deterministic. Since this implies that $pr(h\cdot) = 1$, it follows that:

$$V_{hl}(A_+^h(e_h^+)) = E_0\{pr(h\mid R_{hl})v_h(R_{hl}(A_+^h)) + pr(\bar{h}\mid R_{hl})v_1(R_{hl}(A_+^h))\}$$

$$= E_0(1 \cdot v_h(R_{hl}(A_+^h)))$$

$$= \mu_h(1 - \tau_c)\left(1 + \frac{1}{1 + r}\right) - \tau_c(\delta_{\min} + e_h^+)\left(\frac{r}{1 + r}\right)$$

$$= V_{hl}^*$$

where $\delta_h^+ = \delta_{\min} + e_h^+$. This completes the proof.

The perfectly informative equilibrium

We propose that, in a perfectly informative equilibrium, the high-value manager perfectly smoothes around $\mu_h + \delta_{\min} + e_h^*$. That is,

$$A_h^* = (1, \delta_{\min} + e_h^*)$$

If the high-type over-reports earnings by $e_h^*$, the low-value manager finds the first-best reporting strategy incentive compatible and reports

$$A_l^* = (\gamma_l^*, \delta_{\min})$$

where $\gamma_l^* \in [\gamma_{min}, 1]$ and $e_l^* = 0$. Since the low-value manager's expected compensation is independent of $\gamma_l$, any feasible $\gamma_l$ is equivalent. Proposition 1 shows that regardless of the beliefs that investors place on $\gamma_l$, $A^*$, satisfies the CKIC.

Proposition 1: Given assumptions (A1) through (A10), the perfectly informative equilibrium characterized by $A^*$ satisfies the CKIC.

Proof: By definition of $e_h^*$, the proposed equilibrium is incentive compatible for a low-type manager. Lemma 1 establishes that $A_l^*$ is incentive compatible for a high-type manager. Lemma 2 establishes that $A^*$ is perfectly informative. To prove that the proposed equilibrium satisfies the CKIC, we must consider the market's best response to different levels of $\gamma_l$.

We examine two cases: $\gamma_h = 1$ and $\gamma_h \neq 1$. We prove our results for the case $e_h^* > 0$. The proof for the case $e_h^* = 0$ is similar.

Case 1 ($\gamma_l = 1$ and $\gamma_h = 1$):

In this equilibrium, both firms perfectly smooth reported income with probability one, i.e.,

$$R_{hl}(e_l^*) = \mu_l + \delta_{\min}$$

$$R_{hl}(e_h^*) = \mu_h + \delta_{\min} + e_h^*$$

To evaluate the proposed equilibrium, consider the following figure:
where $R_{\text{max}} = \mu_h + \delta_{\text{max}}$. First note that, if both firms perfectly smooth income, a possible defection from either $\tilde{R} < R_{l1}(\epsilon^{*,*})$ or $\tilde{R} > R_{\text{max}}$ is infeasible. To establish that this equilibrium satisfies the CKIC, consider how the market would respond to feasible defections, $\tilde{R} \in [R_{l1}(\epsilon^{*,*}), \mu_h + \delta_{\text{min}})$.

First, consider a defection $\tilde{R} \in [R_{l1}(\epsilon^{*,*}), \mu_h + \delta_{\text{min}})$. Since this response is infeasible for the high-value firm, the market would assign the belief that

$$Pr(\text{defector is high-value}|\tilde{R} \in [R_{l1}(\epsilon^{*,*}), \mu_h + \delta_{\text{min}})) = 0$$

and the defector would be priced as a low-value firm. Hence, defections over the interval $\tilde{R} \in [R_{l1}(\epsilon^{*,*}), \mu_h + \delta_{\text{min}})$ satisfy the CKIC.

Next, consider a defection $\tilde{R} \in [\mu_h + \delta_{\text{min}}, R_{h1}(\epsilon^{*,*})]$. If investors assign the belief that

$$Pr(\text{defector is high-value}|\tilde{R} \in [\mu_h + \delta_{\text{min}}, R_{h1}(\epsilon^{*,*})]) = 1$$

the defector is valued as a high-type firm. When this occurs, we cannot rule out either firm as a potential defector. Thus, defections over this interval satisfy the CKIC.

Finally, consider a defection $\tilde{R} \in (R_{h1}(\epsilon^{*,*}), R_{\text{max}}]$. Clearly, no firm would wish to defect at levels in excess of $R_{h1}(\epsilon^{*,*})$. This follows because such a report is not incentive compatible for the low-value firm and the high-value firm strictly prefers to report $A_h(\epsilon^{*,*})$. Hence, defections over this interval satisfy the CKIC.

Taken together, these results demonstrate that this equilibrium survives the CKIC if the market believes that both firms smooth income with probability one.

Case 2 ($\gamma_l \neq 1$ and $\gamma_h = 1$):

Under this second scenario, only the high-value firm perfectly smoothes reported income. As a result, investors expect to observe earnings reports over the entire support of the distribution for economic earnings. However, since there are no off-equilibrium earnings reports ($R_{l1}(\epsilon^{*,*}) \in (-\infty, \infty)$), the market infers that

$$Pr(\text{defector has low-value}|\tilde{R} \neq R_{h1}(\epsilon^{*,*})) = 1$$

for any report $\tilde{R} \neq R_{h1}(\epsilon^{*,*})$ and

$$Pr(\text{defector has low-value}|\tilde{R} = R_{h1}(\epsilon^{*,*})) = 0$$

for any report $\tilde{R} = R_{h1}(\epsilon^{*,*})$. This implies that the low-value firm will be mistaken for a high-value firm when it reports $\tilde{R} = R_{h1}(\epsilon^{*,*})$. Since this event ($\tilde{R} = R_{h1}(\epsilon^{*,*})$) has measure zero under the equilibrium reporting strategy, the low-value manager's expected compensation is unaffected even though it
receives the same valuation as the high-type firm when \( R = R_h(e^* h) \). Hence, the low-value manager finds \( \Lambda^*_l \) optimal, and the proposed equilibrium trivially satisfies the CKIC. This demonstrates that, for the case where \( \gamma_l \neq 1 \), the proposed equilibrium \( \Lambda^*_l \) satisfies the CKIC. This completes the proof.

7. Appendix B

This appendix establishes that an uninformative equilibrium does not satisfy the CKIC. An uninformative equilibrium results when both firm types send earnings reports with same conditional mean and variance. In this manner, a low-type firm blocks the information content of a high-type firm’s earnings report. This implies that, if a high-type firm adopts the income reporting strategy

\[
\Lambda^*_h = \left( \gamma^*_h, \delta_{\min} + \epsilon^*_h \right),
\]

a low-value firm must use the income reporting strategy

\[
\Lambda^*_l = \left( \left( \frac{\sigma_h}{\sigma_l} \right) (1 - \gamma^*_l), \delta_{\min} + \epsilon^*_l \right),
\]

where \( \epsilon^*_l = \mu_h - \mu_l + \epsilon^*_h \) and \( \gamma^*_h \) is any feasible value.

Since the strategy \( \Lambda^*_l \) renders earnings reports uninformative (the prior and posterior distributions are the same), the (time 0) expected market value of a type j firm is

\[
p_j V_{h1}^* + p_h V_{h1}^* - p_1 \epsilon^*_h \theta_2 - p_h \epsilon^*_l \theta_2
\]

Substituting in \( \epsilon^*_l \) yields:

\[
p_j V_{h1}^* + p_h V_{h1}^* - p_1 (\mu_h - \mu_l) - \epsilon^*_h \theta_2.
\]

It is clear that, in an uninformative equilibrium, the high-value manager does not over-report earnings (firm value is strictly decreasing in \( \epsilon^*_h \)). As a result, a high-type manager selects his first-best reporting strategy and sets \( \epsilon^*_h \) equal to zero \( \Lambda^*_h = (\gamma^*_h, \delta_{\min}) \). The manager of the low-value firm blocks communication by selecting

\[
\Lambda^*_l = \left( (\sigma_h / \sigma_l) (1 - \gamma^*_l), \delta_{\min} + \mu_h - \mu_l \right).
\]

In the resulting equilibrium, both firm-types have a (time 0) expected value of

\[
p_j V_{h1}^* + p_h V_{h1}^* - p_1 (\mu_h - \mu_l) \theta_2.
\]

Having characterized the uninformative equilibrium, we now show that it fails to satisfy the CKIC.

Proposition: Given assumptions (A1) through (A10), the proposed uninformative equilibrium characterized by \( \Lambda^*_l \) does not satisfy the CKIC.
Proof: Let $\epsilon' = \mu_h - \mu_1 + \epsilon_h'$ denote the level of over-reporting such that a low-value manager will not wish to defect from the equilibrium characterized by $\Lambda_h^{ui}$ even if investors believe with probability one that the defector is good, i.e.

$$\Pr(\text{defector has high-value}|\epsilon_h^{ui} \in (0, \epsilon_{\text{max}}]) = 1$$

where is $\epsilon_{\text{max}}$ the maximum level of over-reporting.

That is, find $\epsilon_h'$ such that the low-value manager is indifferent between the market value in an uninformative equilibrium and the market value if income is over-reported by $\epsilon_h'$ and investors believe the firm has high-value with probability one, i.e.,

$$p_l V_{h1}^* + p_h V_{h1}^* - p_l (\mu_h - \mu_1) \theta_2 = V_{h1}^* - (\mu_h - \mu_1 + \epsilon_h') \theta_2.$$

Since the effective cost to a high-type firm from over-reporting by $\epsilon_h'$ is only $\epsilon_h' \theta_2$, the high-value firm is worth

$$V_{h1}^* - \epsilon_h' \theta_2.$$  

This implies that

$$p_l V_{h1}^* + p_h V_{h1}^* - p_l (\mu_h - \mu_1) \theta_2 < V_{h1}^* - \epsilon_h' \theta_2.$$

Thus, a high-value manager would strictly prefer to defect from this equilibrium. To ensure that the market realizes such a defection has taken place, a high-type firm would also perfectly smooth reported earnings. According to the CKIC, the probability that the defector is low-value has probability zero. Thus, the only admissible posterior belief is that the firm has high-value with probability one. The market’s best response is to price the firm as if it has high-value. Thus, the high-value firm will defect, and the uninformative equilibrium characterized by $\Lambda_h^{ui}$ fails the CKIC.

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