The pricing of shares in equity markets with securities class action lawsuits*

Judson Caskey
UCLA - Anderson School of Management
Los Angeles, CA 90095
judson.caskey@anderson.ucla.edu

February 2011

*I would like to thank Daniel Aobida, Dain Donelson, John Hughes, Volker Laux, Michael Minnis, Bugra Ozel, Brett Trueman and workshop participants at the AAA FARS 2011 Conference, Carnegie Mellon, the Danish Center for Accounting and Finance (D-CAF) 2010 Interdisciplinary Accounting Conference, Ohio State, UCLA School of Law, University of Miami and University of Texas for useful comments on earlier drafts.
The pricing of shares in equity markets with securities class action lawsuits

Abstract

This study develops an analytic model of a securities market in which investors can engage in securities class action lawsuits following a firm’s release of news that contradicts a manager’s earlier report. Because all investors in the model have rational expectations, the model takes into account the fact that the buyers of the firm’s shares anticipate litigation, which reduces the price they are willing to pay and amplifies the price reaction to bad news. Litigation insurance provides value in this setting by reducing the need for investors to price protect against litigation. Similar to dividends, the pricing behavior of rational investors eliminates the valuation impact of settlements paid to investors. The valuation impact of litigation, and therefore the ability of litigation to deter misreporting, arises from transaction costs, such as attorney fees, that the firm can mitigate by constraining misreporting.
1 Introduction

Securities class action lawsuits play a major role in the regulation of corporate disclosure. In a class action, the collective group of investors seeks compensation for losses caused by a disclosure that, for example, led them to pay for shares at an inflated price. Under the fraud-on-the-market theory, investors need not demonstrate that they personally relied on any disclosures – they only need to provide evidence that the disclosures distorted market prices (Cornell and Morgan 1990). An important and peculiar feature of securities class actions is that nearly all claims are paid with corporate funds or insurance policies paid for with corporate funds, regardless of whether the suit names managers or the corporation, itself (Alexander 1994).

As expressed in the New York Times Dealbook column (Sorkin 2010), “While the public lusts for the hanging of a corporate executive, the shareholders would also most likely take the big hit in the wallet.” In other words, investors are both plaintiffs and defendants in securities class actions, creating what the legal literature refers to as the ‘circularity problem’ (Coffee 2006). The beneficiaries of misreporting – the investors who sold at inflated prices – are completely absent from the process.

This study develops a model in which investors can sue for losses caused by misleading disclosures and examines the effects of litigation and litigation insurance on the value of the firm, the frequency of litigation, and the incentives to deter misreporting. In the model, investors buy shares after observing a possibly misleading report by the firm’s manager. They later sell shares to new investors after observing new public information that may contradict the manager’s report. The price at this later period anticipates litigation costs, which amplifies the reaction to bad news as investors both incorporate bad news and price protect against possible lawsuits. This, in turn,
amplifies settlements, which are highly correlated with estimates of losses based on the post-correction drop in market price (Cox, Thomas, and Kiku 2005). Litigation insurance removes the investors’ need to price protect against litigation, which alleviates the amplified reaction to bad news and lowers litigation costs. This ability to reduce litigation costs provides a source of value from insurance despite the fact that insurers in the model fairly price their policies and that the model assumes risk-neutrality.

While insurance reduces the magnitude of lawsuits, it increases the likelihood that lawsuits will occur. If the firm faces low fixed costs from litigation, the effect on value dominates so that firm value is increasing in the amount of insurance coverage, consistent with an environment with common insurance coverage and frequent but small lawsuits. In the presence of fixed costs from litigation, any increase in the likelihood of lawsuits becomes relatively costly. If the fixed costs are sufficiently high, it can be optimal to forgo insurance.

The potential merit of cases plays a key role in determining when plaintiffs will file suits. For example, the Private Securities Litigation Reform Act (PSLRA) increased the amount of evidence required of plaintiffs in order to overcome the defendant’s inevitable motion to dismiss (Cox and Thomas 2009). The model incorporates these constraints by allowing lawsuits only when investors who bought the firm based on the manager’s report both suffer a loss and show that public information provides sufficient evidence that the manager over-stated. The required evidence may depend on either the legal system or a plaintiff attorney seeking to pursue only profitable cases.

A portion of the firm’s litigation costs, hereafter referred to as ‘transaction costs,’ do not flow to investors. New investors incorporate anticipated litigation into price, which ultimately prevents the initial investors from passing their losses onto them. Absent

---

3 Attorneys make some attempts to bypass the PSLRA restrictions. For example, suing in state courts reduces the restrictions on pretrial discovery (Cox, Thomas, and Bai 2008) while the theory of reckless, rather than fraudulent, behavior reduces the need to present a “strong inference” that managers deliberately misled investors (Colm and Swick 2010).
transaction costs, litigation resembles a randomly paid dividend and has no effect on firm value in my model of risk-neutral investors. Accordingly, the magnitude of transaction costs borne by the firm determines the effect of litigation on firm value.

Empirically, transaction costs consume a large portion of the firm’s litigation costs. Plaintiff attorneys receive about 32% of any settlements (Martin, Juneja, Foster, and Dunbar 1999) while the firm pays its own defense attorneys an average of 30% of the settlement (Coffee 2006). In other words, for every dollar paid in settlement, the firm spends $1.30, including the costs of its attorney. Attorneys thus receive 48% = ($0.30 + $0.32)/$1.30 of the direct costs paid by the firm. Firms face further costs due to damaged reputation and diverted managerial attention. In a study of SEC enforcement actions, a special and extreme situation that leads to class action lawsuits, Karpoff, Lee, and Martin (2008b) find that indirect costs, adjustment to unmanipulated financial figures, and legal penalties and settlements comprise 66.6%, 24.5% and 8.8%, respectively, of the 38% average loss in market value associated with the enforcement action. Griffin, Grundfest, and Perino (2004) analyze a broader sample of 3,000 suits from 1990 to 2002 and find that the mean (median) ratio of settlements to end-of-class-period market value is 8.1% (2.1%) versus market value declines at the end-of-class period of 16.6% (13.7%).

Prior analytical work on disclosure-related litigation has largely focused on settings in which the corporation’s assets are not at stake in litigation. Analytical work that considers settings where the firm pays litigation costs include Evans and Sridhar (2002), who examine the impact of litigation on the separation of good- and bad-type firms.

\[4\] It is possible that egregious nature of actions that lead to SEC enforcement accounts for the apparently larger contribution of indirect costs in the Karpoff, Lee, and Martin (2008b) study.

\[5\] For example, Kraakman, Park, and Shavell (1994), Hensler (1995) and Trueman (1997) consider settings in which managers or company founders fund litigation from their personal wealth. Hughes and Thakor (1992) focus on the suit of underwriters, but briefly consider the price effects when the company, itself, pays damages. In this latter case, there are no transaction costs so that litigation has zero ex ante impact since any new shareholders will simply reduce their willingness to pay just as they would with stock trading ex-dividend.
in a model where firms tradeoff the reporting impact on financing costs against the cost of attracting competitors. They allow for litigation in cases where investors can be fooled due to pooling or mixed strategy equilibria, but do not examine prices, per se. Spindler (2010) examines a model similar to that in this study and predicts that litigation can result in the separation of good- and bad-type firms; however, the model predicts litigation in which no investor is ‘fooled’ by disclosure.

This study contributes the literature on litigation in several respects. First, I provide a rigorous analysis of the price effects of company-funded lawsuits in a setting where investors can only sue if they demonstrate that they were actually misled. Second, I examine litigation insurance and the conditions under which such insurance increases firm value. Third, I show how litigation provides incentives for ex ante actions that constrain managerial misreporting.

The remainder of the paper proceeds as follows. Section 2 provides background on class action lawsuits and litigation insurance. Section 3 illustrates the key force of price protection against litigation and the importance of transaction costs. Section 4 develops the main model and Section 5 derives the equilibrium. Section 6 examines constraints on misreporting, litigation insurance, and the effect of litigation on expected returns. Section 7 discusses extensions of the model to make litigation a function of both a plaintiff attorney’s objective in addition to investors and to include a fixed cost component of the firm’s litigation costs. Section 8 concludes. All proofs are included in the Appendix.

6The model also relies on an assumption that early investors are trapped by high trading costs that prevent them from selling shares regardless of the litigation costs that can be imposed on them which, although not mentioned in the study, may apply to post-IPO lockup periods that prohibit original owners from selling shares to the extent that limited liability is not binding. The study also does not take into account that some of the litigation behavior predicted by the model would have caused the market to collapse in the trading period where the manager discloses (the disclosure is not misleading because the model predicts separation of good- and bad-types).
2 The litigation environment

Private litigation plays a significant role in the enforcement of US securities laws \(\text{(Cox and Thomas 2009)}\). \(\text{La Porta, Lopez De Silanes, and Shleifer (2006)}\) find that private enforcement of disclosure laws benefits financial development while public enforcement has little impact. Class actions allow shareholders to collectively sue for damages incurred as the result of buying at inflated prices. Total damages in a class action are estimated from prices and trading volume and paid on a \textit{pro rata} basis to shareholders who join the class \(\text{(Alexander 1994)}\). During the 2000-2002 period, the monetary amount of securities class action settlements exceeded the combined total of all public monetary sanctions and that the total of class action settlements and trial awards comprised over 49% of all public and private monetary sanctions \(\text{(Coffee 2006)}\).

Concerns over abuses in securities litigation led to the passage of the Private Securities Litigation Reform Act of 1995 (PSLRA). The fact that the legislation’s passage overrode a Presidential veto testifies to the importance of class actions to the legislature. Most important to this study, the PSLRA introduced requirements intended to disqualify frivolous cases. These include the delay of discovery until the resolution of pretrial motions, intended to reduce ‘fishing expeditions’, and the need to provide evidence of fraudulent or reckless behavior \(\text{(Cox, Thomas, and Bai 2008)}\).

Potential damages in a class action depend on the estimated damages per share multiplied by the estimated shares damaged \(\text{(Thakor 2005)}\). The damages per share typically depend on the end-of-class period share price, which reflects the correction to the allegedly misleading disclosure, with adjustments for market-wide changes and unrelated news. The estimate of shares damaged depends on a model of trading activity \(\text{(Finnerty and Pushner 2003)}\). Settlements are highly correlated with the decline in market value associated with the correction of a prior disclosure \(\text{(Cox, Thomas, and Kiku 2005)}\); however, they are fairly small relative to the alleged damages. Depending
on the estimation method, median settlements ranged from 2.3% to 5.7% of estimated damages in 2009 and from 2.9% to 9.7% in the 2002-2008 period (Ryan and Simmons 2009). Griffin, Grundfest, and Perino (2004) find that the median settlement equals 2.1% of end-of-class-period (i.e., post-correction) market value.

Securities litigation imposes a variety of costs on firms and managers. Rogers and van Buskirk (2009) find that firms reduce disclosure after litigation, possibly due to a perception that attorneys use disclosure as a pretext for litigation. SEC enforcement actions are associated with costs of managerial distraction and other business disruptions worth roughly 25% of market value (Karpoff, Lee, and Martin 2008b).

Most public companies carry Director and Officer (D&O) insurance policies (Towers Watson 2008). These policies reimburse companies for costs of indemnifying managers and cover costs of managers in situations that prohibit the company from indemnifying. Policy limits average $30 million for publicly traded companies and $129 million for companies with assets greater than $10 billion, with corresponding average deductibles of $191 thousand and $3.6 million (Towers Watson 2008). Deductibles average 2% of the coverage limit (Bhagat, Bizjak, and Coles 1998). The policies are not in force if there is a finding of fraud, but most class actions settle out of court (Cox and Thomas 2009). Prior empirical work provides evidence that insurers are very sophisticated and charge premia that take into account the risk of settlements when management is indeed at fault and non-meritorious claims (Core 1997, 2000; Cao and Narayanamoorthy 2005a). In other words, the sophistication of insurers prevents companies from using D&O policies to escape the costs of misreporting – they can only place a fair ex ante bet on those costs.

Susceptibility to litigation varies from firm-to-firm and litigation impacts a small fraction of the entire population of firms. The number of suits during the 1996-2003 period peaked in 2001 with 493 suits filed (Gande and Lewis 2009). Some firms are particularly affected, though. These include bio-pharm firms, which represent between
9% and 14% of securities class actions from 2006 to 2009 (Cohn and Swick 2010). Plaintiffs have successfully alleged reckless disclosure, rather than intent to deceive, and these firms regularly must make forward looking disclosures regarding the progress of their research and clinical tests. D&O insurance premia can be used to measures firms’ litigation risk (Core 1997; Cao and Narayanamoorthy 2005b). Data on D&O insurance is limited, however, so that other methods, such as those suggested by Kim and Skinner (2010), may be needed to identify high litigation risk.

3 General model and timeline

This section describes the model’s timeline and illustrates how the rational anticipation of litigation affects prices. The model occurs in four steps as shown in Figure 1 and Table 1 summarizes the notation used in this study. Investors are risk-neutral and perfectly competitive. Time 0 represents the firm’s inception. At Time 1, the firm’s manager makes a public report \( \hat{r} \) and the firm’s initial owners sell shares to Time 1 investors. The Time 1 investors use the report in conjunction with other information \( y \) to determine the share price \( p_1 \). At Time 2, new public information \( s \) arrives and the Time 1 investors sell to Time 2 investors, a new group. The Time 2 price, \( p_2 \), depends on all public information \( (\hat{r}, y, s) \).

If the Time 2 information indicates that the Time 1 disclosure either omitted material information or provided misleading information, the Time 1 investors can sue in an

---

7 Francis, Philbrick, and Schipper (1994) also identify bio-pharm, among others, as a litigation prone industry.

8 The Appendix illustrates that the assumption of complete share turnover yields the same behavior as assuming that only a (possibly random) subset of investors who purchased at Time 1 must sell at Time 2 and all investors who bought at Time 0 investors can voluntarily sell.

9 The Time 2 information depends on the same underlying information as the manager’s Time 1 report, which allows the model to abstract from issues such as isolating market wide fluctuations from firm-level price changes when contemplating litigation.
attempt to recover their overpayment. At Time 2, investors are unsure of the probability \( \theta \) that litigation will succeed and, if successful, the amount of cost of litigation \( d \) to the company. Both \( \theta \) and \( d \) can be viewed as random variables conditional on Time 2 information. Their respective distributions may depend in an arbitrary fashion on investors’ equilibrium conjectures of the manager’s reporting strategy, the credibility of threats to litigate, and the expected settlement. I defer explicitly modeling these determinants to Section \[4\].

If litigation succeeds, not all of the costs to the company accrue to the suing shareholders. Fraction \( \alpha \) of the loss in value represents transaction costs, such as attorney fees and deadweight costs\[10\]. Similar to the likelihood \( \theta \) of successful litigation and the cost \( d \) of successful litigation, \( \alpha \) may be unknown at Time 2 and viewed as a random variable conditional on Time 2 public information.

Given risk-neutral, competitive investors, the Time 2 price \( p_2 \) is the following where \( v_2 \) denotes the expected value of \( v \) conditional on Time 2 public information \( E[v|\hat{r}, y, s] \):

\[
p_2 = E[v - \theta d|\hat{r}, y, s] = v_2 - E[\theta d|\hat{r}, y, s].
\]  

Expression \[1\] allows for general reactions to news. For example, if Time 2 information indicates a high likelihood of successful litigation, then the Time 2 conditional distribution of \( \theta \) might be shifted to high values. The Time 1 investors price the firm based on what they expect to receive both from litigation and from selling the firm:

\[
p_1 = E[p_2 + \theta(1 - \alpha)d|\hat{r}, y].
\]  

On the surface, it appears that the ability to sue increases the Time 1 price; however, the potential for litigation reduces the price that Time 2 investors are willing to pay.

---

\[10\] Plaintiff attorney fees and expenses account for about 35% of settlements (Martin, Juneja, Foster, and Dunbar 1999) while firms pay fees to their own attorneys that average 30% of settlement amounts (Coffee 2006). Furthermore, firms incur indirect costs from litigation such as diverted time and resources.
Substituting the Time 2 price from (1) into (2) shows that transaction costs reduce the Time 1 price of the firm. The price $p_1 = E[v - \theta d + \theta (1 - \alpha) d | \hat{r}, y] = v_1 - E[\theta d | \hat{r}, y]$, where $v_1$ is the expected value of $v$ conditional on Time 1 public information $E[v | \hat{r}, y]$.

The Time 1 investors’ expected net-of-transaction-costs payout from lawsuits has no impact because the Time 2 investors rationally anticipate any litigation costs.

The damages claimed by investors typically correspond to the price drop $p_1 - p_2$, giving $d = \max\{0, p_1 - p_2\}$. The expected damages are $E[\theta \max\{0, p_1 - p_2\}]$, giving the following Time 2 price:

$$p_2 = E[v - \theta \max\{0, p_1 - p_2\} | \hat{r}, y, s] \Rightarrow p_2 = v_2 - 1_{p_2 < p_1} \frac{E[\theta | \hat{r}, y, s]}{1 - E[\theta | \hat{r}, y, s]} (p_1 - v_2).$$ (3)

Figure 2 plots an example of the price function (3). The key feature of (3) is that the Time 2 investors price protect against expected litigation, which amplifies a price drop when news contradicts the manager’s report and therefore amplifies the Time 1 investors’ losses. The Time 2 price does not reflect the transaction costs $\alpha$ because new investors only concern themselves with the firm’s total costs, rather than the fraction of those costs that flow to the Time 1 investors.

If litigation were to guarantee full recovery ($E[\theta | \hat{r}, y, s] = 1$), then the market for the firm’s shares would completely collapse following any Time 2 information that indicates the manager’s Time 1 report overstated firm value. For example, if the expected value $v_2$ dropped by $100, new investors would lower the price by $100 to reflect the lower.

---

11 Securities litigation typically uses the ‘value-line’ approach to estimate damages, which roughly corresponds to the price drop and equals $p_1 - \hat{\beta} p_2$ where $\hat{\beta}$ is an estimated discount factor from Time 1 to Time 2 based on, for example, the CAPM (Cornell and Morgan 1990), Lev and de Villiers (1994) discuss and critique the practice of using the price drop upon the disclosure of bad news as the starting point for computing damages. Dybvig, Gong, and Schwartz (2000) state that this critique played a role in modifying the maximum damages allowable under the PSLRA to the difference between the investors’ purchase price and the 90-day average price following the correction of the company’s misstatement. I expect that this cap is also correlated with the price drop at Time 2.

In practice, cases typically settle for less than the full price drop (Cox, Thomas, and Kiku 2005). There is no need to add a parameter to reflect this since settlements for partial amounts can be impounded into the success likelihood $\theta$ without loss of generality.
value of the firm’s operations, but also by another $100 to reflect the expected litigation by Time 1 investors. This would cause the Time 1 investors to sue for a $200 price drop, requiring Time 2 investors to price a $100 drop in $v_2$ and a $200 lawsuit. This would cause the Time 1 investors to sue for a $300 price drop, and so on resulting in a collapse in the market for the firm’s shares because there would be no price at which investors would be willing to purchase shares.\footnote{This is reflected in (3) by $1 - E[\theta|\hat{r}, y, s]$ in the denominator of the expected litigation costs.} An equilibrium with trade thus requires that $E[\theta|\hat{r}, y, s] < 1$ to reflect either partial or uncertain recovery in the event that Time 1 investors can sue for misleading Time 1 information.

4 Model setup

While the generic structure in Section 3 allows for showing the existence of an equilibrium at Time 1 under mild conditions, it does not explicitly model the manager’s reporting choice and the need to credibly allege misreporting in order to file a securities class action suit.\footnote{For example, sufficient conditions for the existence of a Time 1 price $p_1 < v_1 = E[v|\hat{r}, y]$ are that $v$ has constant support, the Time 1 and 2 expectations are well defined, and that there is a positive probability of successful litigation for some realizations of Time 2 information.} This section adds additional structure to characterize the manager’s endogenous reporting choice and specifies distributional assumptions to better facilitate analysis while preserving the features from Section 3. The structure follows Fischer and Verrecchia’s (2000) reporting bias model. The timeline follows Figure 1.

All parties share the prior distribution of the firm’s terminal dividend $v$ is normally distributed. The Time 1 public information consists of the manager’s report $\hat{r}$ and other information $y = v + e_y$ where $e_y$ is a mean-zero, normal random variable independent of $v$. The manager bases his report on the signal $r = v + e_r$ where $e_r$ is a mean-zero, normal random variable independent of $v$. Investors do not directly observe the manager’s signal, but instead observe the manager’s report $\hat{r}$ that the manager chooses to satisfy
the following objective function: \begin{equation}
\max_{\hat{r}} E \left[ bp_1 - \frac{c}{2} (\hat{r} - r)^2 | r, b \right],
\end{equation}

where the term \( bp_1 \) reflects the manager’s sensitivity to the Time 1 price and the term \( \frac{c}{2} (\hat{r} - r)^2 \) reflects the manager’s cost of misreporting, as indexed by \( c > 0 \). Investors are unsure of the manager’s sensitivity to price, which prevents them from inferring the manager’s information and thus provides scope for them to be ‘fooled’ by misreporting. The uncertainty can arise from, for example, compensation and option exercises, which yield a preference for higher prices, and factors such as option grants and repurchases that favor lower prices. I assume that investors have the prior belief that \( b \) is normally distributed with precision \( \tau_b \) and independent of all other variables in the model.

At Time 1, investors observe the manager’s report \( \hat{r} \) and the signal \( y \). Investors must form a conjecture of the manager’s reporting strategy in order to extract information from his report. Similarly, the manager must form a conjecture of the price function when determining his report to maximize (4). I denote the respective conjectures by \( \hat{r} \), with coefficients \( (\hat{\rho}_0, \hat{\rho}_r, \hat{\rho}_b) \), and \( \hat{p}_1 \), with coefficients \( (\hat{\pi}_0, \hat{\pi}_r, \hat{\pi}_y) \): \begin{equation}
\hat{r} = \hat{\rho}_0 + \hat{\rho}_r r + \hat{\rho}_b \hat{r} \quad \quad \quad \quad \hat{p}_1 = E[v | \hat{r}, y] + \hat{\pi}_0 + \hat{\pi}_r \hat{r} + \hat{\pi}_y y.
\end{equation}

At Time 2, all investors observe the signal \( s = v + e_s \) where \( e_s \) is a mean-zero, normal random variable independent of \( v \). To the extent that \( s \) contradicts the news conveyed by the manager’s Time 1 report, the Time 1 investors may suffer a loss and can sue to recoup some of their losses. I assume that the covariance matrix is such that higher values of \( s, r \) and \( y \) are interpreted as ‘good news.’ In other words, \( E[v | r, y] \) is increasing

\footnote{I provide further discussion of this objective function in Section 5.4. The general character of the equilibrium is qualitatively the same if the manager has an objective function \( E[p_1 - \frac{c}{2} (\hat{r} - r - \varepsilon)^2 | r, \varepsilon] \) as in Dye and Sridhar (2004) where \( \varepsilon \) denotes a privately observed cost of misreporting.}

\footnote{I abuse notation by using \( \hat{r} \) to denote both the manager’s report and the investors’ conjecture. Also, under the assumption of linear conjectures, \( E[v | \hat{r}, y] \) is linear so that the price conjecture \( \hat{p}_1 \) in (5) is equivalent to an arbitrary linear conjecture.
in both $r$ and $y$ while $E[v|r, y, s]$ is increasing in $r$, $y$ and $s$. This assumption implies that signals are used primarily to interpret firm value rather than to filter noise from other signals and is satisfied, for example, if the errors $e_r$, $e_y$ and $e_s$ are uncorrelated. I also assume that the Time 2 signal $s$ is at least weakly positively associated with the manager’s signal $r$ ($\text{cov}(r, s|y) \geq 0$) so that it is useful in determining the likelihood that the manager misled Time 1 investors.$^{16}$

Two criteria must be met in order for Time 1 investors to file a lawsuit. First, they must have suffered a loss ($p_2 < p_1$) and, second, there must be sufficient evidence that they were misled at Time 1. In particular, if the investors are fooled by the manager overstating firm value, then $v_1 = E[v|\hat{r}, y] > E[v|r, y]$. I specify this second criterion with a threshold likelihood $P$ that $v_1 > E[v|r, y]$. Time 1 investors can therefore sue if $p_1 < p_2$ and $P(v_1 > E[v|r, y]|\hat{r}, y, s) > P$. While the absence of noise trade and risk aversion implies that price drops are directly related to new information that contradicts the manager’s prior report, price drops may not be sufficient to trigger litigation due to factors such as the need for sufficient evidence under the PSLRA (Johnson, Nelson, and Pritchard 2007). The threshold probability $P$ represents these additional factors.

If investors file a suit at Time 2, the firm’s expected costs are $\theta(p_1 - p_2)$ where $\theta \in [0, 1)$ represents the product of the likelihood of the suit succeeding and the fraction of the price drop that the firm pays upon losing a suit. As noted in Section 3, $\theta$ must be less than one in order for an equilibrium to exist. If they file a suit at Time 2, the

$^{16}$ If $\text{cov}(r, s|y) < 0$ and $\text{cov}(v, s|r, y) > 0$, then high values of $s$ indicate that firm value is high, raising the Time 2 price, while increasing the likelihood that the manager misreported at Time 1. I require both a loss ($p_2 < p_1$) and some likelihood that the manager misled investors in order to sue. Under reasonable restrictions, such as requiring that it be more-likely-than-not that the manager over-reported, lawsuits never occur in equilibrium when $\text{cov}(r, s|y) < 0$ (Details available from the author upon request). The absence of litigation makes this case uninteresting in the context of this study and the ‘positive surprise today means you overstated results yesterday’ phenomenon seems pathological, so I restrict the model to cases where $\text{cov}(r, s|y) > 0$ which holds, for example, when error terms are independent. The restriction primarily precludes cases where $v$ has a low variance and the error terms $e_r$ and $e_s$ have a very low correlation but each is highly correlated with the error term $e_y$.

$^{17}$ I discuss in Section 7.2 how the threshold $P$ could arise from a plaintiff attorney’s decision to file suit if the expected payoff exceeds the attorney’s fixed costs.
Time 1 investors expect to receive \( \theta(1 - \alpha)(p_1 - p_2) \) where the parameter \( \alpha \) represents the proportional transaction costs. These costs incorporate any of the expected costs \( \theta(p_1 - p_2) \) to the firm that do not flow to investors. Modeling these as proportional costs reflects both the typical contingency fee arrangement for plaintiff attorneys and the notion that the amount of time and resources managers divert to defending against the lawsuit are likely proportional to the damages sought.\(^{18}\) I assume that the parameters \( \theta \) and \( \alpha \) are constant in order to facilitate the analysis of the model. This assumption does not affect the existence of a linear equilibrium, but does affect the ability to conduct subsequent analysis. Indeed, so long as the Time 2 price is a piecewise linear function of the Time 2 signal, a linear equilibrium will obtain in this setting.

Finally, I assume that at Time 0 the firm can purchase litigation insurance from rational, perfectly competitive, risk-neutral insurers. The policy indemnifies the firm and its managers against litigation costs up to a maximum of \( X \) and the insurer charges a premium \( x \). I assume that there is no asymmetric information between the firm and the insurer at Time 0.\(^{19}\) As in real-world settings, the insurer is perfectly aware that it may pay settlements when the manager indeed misreported. Given the lack of information asymmetry at Time 0, they anticipate the manager’s reporting strategy and incorporate the likelihood of misreporting into the premium \( x \). This level of sophistication has indeed been employed in the empirical literature to allow for the use of litigation insurance premia as a proxy for corporate governance and litigation risk (Core 1997, 2000; Cao and Narayananamoorthy 2005b).

\(^{18}\)Alexander (1996) discusses the prevalence of contingency fees and Coffee (2006) states that defense costs typically range from 25% to 35% of the settlement. These costs exclude losses from the diversion of managerial time and attention and therefore understate the true extent of transaction costs.

\(^{19}\)This assumption is justified on the empirical ground that the providers of D&O insurance are highly sophisticated (Core 2000).
5 Equilibrium

This section derives the equilibrium prices, manager report and insurance premium, beginning with the Time 2 price. At Time 2, investors take as given the Time 1 price and the conjectured reporting strategy \( \hat{r} \) given in (5). They also know the firm’s insurance coverage \( X \), premium \( x \) and the threshold likelihood \( P \).

5.1 Time 2 price

The following lemma establishes the link between the probability that investors were misled at Time 1 and the Time 2 expected value of the firm:

Lemma 1. The Time 2 conditional probability that investors were misled at Time 1, \( P(v_1 > \mathbb{E}[v|\hat{r},y]|\hat{r},y,s) \), exceeds \( P \) if and only if the Time 2 expected value \( v_2 \) is sufficiently low as given by the following where \( \sigma_1 = \text{std}(v_2|\hat{r},y) \) denotes the Time 1 conditional standard deviation of the Time 2 expected value of the firm and \( M \) depends on \( P \) and the equilibrium covariance matrix of \( r, \hat{r}, b, s \) and \( y \):

\[
P(v_1 > \mathbb{E}[v|\hat{r},y]|\hat{r},y,s) > P \iff v_2 < v_1 - \sigma_1 M \equiv v_2.
\]

Lemma 1 states that the Time 2 expected value of the firm provides sufficient evidence to trigger litigation if and only if it falls \( M \) standard deviations below its expected value. The threshold \( P \) enters \( M \) as a proportional factor \( \Phi^{-1}(P) \) where \( \Phi(\cdot) \) is the standard normal distribution and I later use \( \phi(\cdot) \) to denote the standard normal density. If filing a suit merely requires that it is more likely than not that the manager misled at Time 1, then \( P = 1/2 \) so that \( \Phi^{-1}(P) = \Phi^{-1}(1/2) = 0 \) and \( M = 0 \). In this case, a downward revision in beliefs \( (v_2 < v_1) \) provides sufficient evidence that investors were misled. Thus, a price drop combined with a downward revision in beliefs will suffice to file a lawsuit. The term \( \Phi^{-1}(P) \), and therefore \( M \), is increasing in \( P \) so that stricter evidence requirements will necessitate larger downward revisions in beliefs to justify
filing litigation.

Time 2 investors value the firm at its expected value less the insurance premium and the costs of any litigation not covered by insurance. They thus set the price of the firm as:

\[ p_2 = v_2 - x - 1_{v_2 < v_1} 1_{p_1 - p_2 > X} \theta (p_1 - p_2 - X), \]  

(7)

where the first indicator \( 1_{v_2 < v_1} \) reflects the need for evidence that the manager overreported at Time 1 and the second indicator \( 1_{p_1 - p_2 > X} \) reflects a loss that exceeds the firm’s insurance coverage.\(^2^0\) Solving (7) for \( p_2 \) gives:

\[ p_2 = v_2 - x - 1_{v_2 - x < \min\{v_1 - x, p_1 - X\}} \frac{\theta}{1 - \theta} (p_1 - (v_2 - x) - X). \]  

(8)

Figure 3 plots the Time 2 price \( p_2 \) for the case where the firm has no insurance (\( X = x = 0 \)). The second term in (8) reflects the Time 2 investors price protecting for uninsured losses. This amplifies the drop in price when investors expect a large lawsuit, as shown in Figure 3 by the steeper slope of \( p_2 \) as a function of \( v_2 \) when \( p_2 < p_1 \). A high hurdle for filing suits will reduce the likelihood of litigation. This can be seen in Figure 3, Panel B, where more severe bad news (lower \( v_2 \)) is needed to trigger litigation. In the extreme case of \( P = 1 \), \( \Phi^{-1}(P) \) and therefore \( M \) approaches infinity so that requiring certainty that the manager misled investors at Time 1 will preclude litigation altogether.

\(^{20}\)Because the factor \( \theta \) incorporates both the likelihood of Time 1 investors successfully suing and the proportion of loss they recover, the insurance cap \( X \) should be interpreted as the gross loss against which the firm is insured. For example, if a successful suit recovers fraction \( \gamma \) of the price drop \( p_1 - p_2 \), then the maximum payout under the policy is \( \gamma X \). It is possible to recast the model to explicitly separate the likelihood of a successful suit \( \theta \) and fraction of losses paid \( \gamma \) by replacing \( \theta \) with \( \theta \gamma \) and \( X \) with \( X/\gamma \). I do not take this approach because it has no effect on the model and introduces unnecessary notational complexity to an already complex model.
5.2 Time 1 price

Investors at Time 1 value shares based on their expected payoff from selling the shares at Time 2 and the possibility of suing the firm:

\[ p_1 = E[p_2 + 1_{v_2 - x < \min\{v_2, p_1\}} \theta(1 - \alpha)(p_1 - p_2) | \hat{r}, y], \]

where the second term reflects the expected value of suing, net of transaction costs \( \alpha \).

From (8), the only portion of \( p_2 \) unknown at Time 1 is \( v_2 \). Given the linear conjectures (5), \( v_2 = E[v | \hat{r}, y, s] \) is normally distributed with mean \( v_1 = E[v | \hat{r}, y] \) and standard deviation \( \sigma_1 = \text{std}(v_2 | \hat{r}, y) \).

After substituting from (8) for \( p_2 \) into (9), the Time 1 price is:

\[
\begin{align*}
p_1 &= E\left[ \frac{v_2 - x - \theta \alpha}{1 - \theta} 1_{v_2 - x < \min\{v_2, p_1\}} (p_1 - (v_2 - x) - X) \\
&\quad + \theta(1 - \alpha)1_{v_2 - x < \min\{v_2, p_1\}} \min\{X, p_1 - (v_2 - x)\} \right] | \hat{r}, y. \end{align*}
\]

Figure 4 plots the Time 1 investors’ realized payoff as a function of the Time 2 expected value of the firm less the insurance premium, \( v_2 - x \). The graph is such that news that triggers a price drop is insufficient to allow litigation (high \( P \)). The point \( v_2 \) corresponds to where \( P(v_1 > E[v | \hat{r}, y] | \hat{r}, y, s) > P \) and yields a jump in the Time 1 investors’ payoff that reflects their expected payoff from suing. Time 2 investors do not react at this stage because their insurance coverage \( X \) in this example is sufficient to cover small lawsuits. At the point \( p_1 - X \), a successful suit will extinguish the firm’s insurance coverage and new investors must price protect against their share of damages as in the examples from Figure 3. This causes a kink in the price reaction to news.

The following lemma states the Time 1 price taking as given i) the insurance premium
Lemma 2. The Time 1 price $p_1$ equals the following where the constant $z$ is the unique solution to the function $g(z; \theta, \alpha, \sigma_1, M, X) = 0$, defined in the Appendix:

$$p_1 = v_1 - x - \sigma_1 \theta \alpha z.$$  \hspace{1cm} (11)

Comparing (11) to (10), the term $\sigma_1 \theta \alpha z$ equals the net value of litigation to the Time 1 investors. If the transaction costs of uninsured losses exceed the net of transaction cost value of insured losses, then $z > 0$ and vice versa. The price (11) is a linear function of Time 1 news, as reflected in $v_1$, despite the nonlinear Time 2 price. I defer to Section 5.4 the discussion of how this is a special feature of the normal distributions used in the model. In short, the value of the Time 1 investors’ ability to sue, a put option, does not vary with Time 1 information. For example, if the manager makes a very high report $\hat{r}$ that likely includes bias, this does not increase the expected value of litigation because investors unravel any predictable bias and can only sue to the extent to which they were actually fooled. In other words, investors cannot sue if the manager merely lies – they can only sue when the manager lies more than they had anticipated.

5.3 Equilibrium conjectures

The manager’s conjectures given by (5) and his objective function (4) yield the first-order condition:

$$b \left( \frac{\text{cov}(v, \hat{r}|y)}{\text{var}(\hat{r}|y)} + \hat{\pi}_r \right) - c(\hat{r} - r) = 0 \quad \Rightarrow \quad \hat{r} = r + \frac{1}{c} \left( \frac{\text{cov}(v, \hat{r}|y)}{\text{var}(\hat{r}|y)} + \hat{\pi}_r \right) b.$$  \hspace{1cm} (12)

Recall that $\sigma_1 = \text{std}(v_2|\hat{r}, y)$ and $M$ depend only on the covariance matrix, which is constant for normal random variables, and that the insurance coverage $X$ is determined at Time 0.

Recall the condition (6) that the likelihood that the manager successfully misled Time 1 investors must be sufficiently high to allow litigation.
Expressions (11) and (12) imply that the conjectures (5) satisfy \( \hat{\pi}_r = \hat{\pi}_y = \hat{\rho}_0 = 0, \hat{\rho}_r = 1, \hat{\pi}_0 = -x - \sigma_1 \theta \alpha z \) and that \( \hat{\rho}_b \) equals the term multiplying \( b \) in (12).

Lastly, the insurers set the premium \( x \) at Time 0 based on rational expectations of the Time 1 price and reporting behavior and the Time 2 price and litigating behavior. They set the premium \( x \) to cover their expected payout under the policy, giving \( x = \theta E[1_{p_2 < p_1} 1_{v_2 < \Sigma_2} \min\{X, p_1 - p_2\}] \). Combining the preceding results and computing the premium provides the following characterization of the equilibrium:

**Proposition 1.** In equilibrium, the expected losses for which Time 1 investors can sue are:

\[
D(\theta, \alpha, \sigma_1, M, X) = E[1_{p_2 < p_1} 1_{v_2 < \Sigma_2} (p_1 - p_2)],
\]

where the function \( D \) is defined in the Appendix. The Time 1 price \( p_1 \) and the insurance premium are:

\[
p_1 = v_1 - \theta \alpha D, \tag{13b}
\]

\[
x = \underbrace{\theta D}_{\text{Expected total damages}} - \underbrace{\theta E[1_{v_2 < \Sigma_2} 1_{p_1 - p_2 > X} (p_1 - p_2 - X)]}_{\text{Damages paid by firm} = \theta \underbrace{(1 - \alpha)D + \sigma_1 \alpha z}_{\text{Expected total damages}}}. \tag{13c}
\]

The manager reports \( \hat{r} = r + \rho_b b \) where \( \rho_b > 0 \) depends on the manager’s cost \( c \), \( \var(r|y) \), \( \text{cov}(v, r|y) \) and \( \tau_b \) as defined in the Appendix. The threshold \( M \) that corresponds to \( P(v_1 > E[v|r, y]|\hat{r}, y, s) > P \) equals:

\[
M = \Phi^{-1}(P) \sqrt{\frac{1 - \text{corr}(b, s|\hat{r}, y)^2}{\text{corr}(b, s|\hat{r}, y)^2}}. \tag{13d}
\]

Expression (2) in Section 3 shows that the Time 1 price equals the expected firm value less the expected transaction costs from litigation. Expression (13b) shows that insurance does not change this fact. The policy premium \( x \) equals the total expected costs to be paid by the insurer and incorporates whatever investors may hope to gain from payments under the insurance policy. Because the insurance premium lets
insurers breakeven, the remaining impact is the reduction for transaction costs reflecting payments by the insurer that do not flow to investors but are nonetheless incorporated into the premium.

The equilibrium given in Proposition 1 requires that the Time 2 signal provide information about the manager’s bias in order for lawsuits to occur, putting constraints in purely frivolous litigation. The term $M$, given in (13d), reflects the requirement that the likelihood that the manager misled investors be sufficiently high in order for Time 1 investors to sue. The correlation $\text{corr}(b, s|\hat{r}, y)$ represents the new information that the Time 2 signal $s$ provides about the manager’s unknown bias parameter $b$.

**Corollary 1.1.** If litigation requires a higher standard than more-likely-than-not, then the Time 2 signal $s$ must be incrementally informative about the manager’s bias in order for litigation to occur. Formally, if $P > 1/2$ by any amount, then $M \to \infty$ as $\text{corr}(b, s|\hat{r}, y)^2 \to 0$ so that $v_2 \to -\infty$.

### 5.4 Discussion of key assumptions

As I mention in the discussion of Lemma 2, the linearity of the Time 1 price $p_1$ and the constant value of litigation results from the use of normal distributions used in the model. Time 1 investors rationally incorporate all public information into the Time 1 price, including the undoing of any predictable bias in the manager’s report $\hat{r}$. Time 2 prices and beliefs are therefore always centered around the Time 1 beliefs. Normal random variables are special in that they exhibit homoscedasticity – the uncertainty about the manager’s report and the informativeness of signals remain constant regardless of whether realizations are high or low. On the one hand, this provides tractability and ensures that litigation depends only on the extent to which the manager misreports rather than the strength of the underlying news about the company. On the other

---

23The proof of Corollary 1.1 follows immediately from (13d) since $\Phi^{-1}(P) > 0$ for any $P > 1/2$. 

19
hand, as with the entire class of models that utilizes normal distributions, the model abstracts from the fact that the empirical distribution of earnings and news is not normal. This may obscure some interesting phenomena such as whether the risk of subsequent litigation is higher for good or bad news.

Related to the importance of joint normality for deriving an equilibrium, two features of the manager’s objective function (4) play a crucial role in yielding a linear strategy that preserves the normality of the distributions of the underlying signals. First, the manager’s payoff does not directly depend on the Time 2 price. A dependence on the Time 2 price, which is nonlinear with respect to the underlying information, introduces nonlinearities in the manager’s strategy that render the model intractable. This assumption can be viewed as representing a manager with a short horizon due to, for example, liquidating equity incentives or retirement. This case is particularly relevant given Arlen and Carney’s (1992) argument that securities fraud is more likely when the manager fears dismissal and therefore has a short horizon. The assumption of sensitivity to $p_1$, alone, can also be viewed as representing a myopic manager.\(^{24}\)

The second feature of the manager’s objective function that yields a linear strategy is the quadratic cost function. This cost function assumes that the manager faces symmetric misreporting costs. While manager’s may suffer some reputational or other harm from underreporting, managers face relatively severe penalties for overreporting (Karpoff, Lee, and Martin 2008a). The extent to which the manager misleads investors, $v - \mathbb{E}[v|y]$, is approximately linear in the degree of misreporting $\hat{r} - r$ so that the cost function provides a reasonable approximation for the penalties of overreporting.\(^{25}\) The symmetric costs for underreporting are needed to preserve the linear strategy required

\(^{24}\)Manager sensitivity to the Time 2 price would likely diminish, but not eliminate, the incentives to bias. The broader issue of Time 2 investors impounding expected litigation costs and therefore exacerbating price drops from bad news would, of course, remain.

\(^{25}\)Direct computations show that $\mathbb{E}[v|y] - \mathbb{E}[\hat{v}|y]$ depends on $r$ and $\hat{r}$ through a term $\frac{\text{cov}(v,r|y)}{\text{var}(r|y)} r - \frac{\text{cov}(v,r|y)}{\text{var}(r|y) + \rho^2 \tau_0^2} \hat{r}$, which is nearly linear in $\hat{r} - r$. 

20
to render the model tractable.  

6 Applications  

6.1 Effect of litigation on reporting bias  

Within the general context of Section 3 and the equilibrium of Section 5, misleading disclosures affect \textit{ex ante} firm value via their effect on the transaction costs of litigation. Any transfers between investors have no impact on firm value in the risk-neutral setting of this model, analogous to dividends. Litigation becomes costly because it results in the transfer of value to parties other than investors or, in the case of diverted managerial time, results in value that is lost, altogether.

The manager’s reporting strategy in the equilibrium given in Proposition 1 exactly matches that in Fischer and Verrecchia (2000). In other words, litigation only affects the manager’s reporting to the extent that it impacts the \textit{ex ante} choices that determine the manager’s strategy. The manager trades off the marginal response to his report against his expected costs and, in the linear equilibrium of this study, the marginal response is constant. The absence of an \textit{ex post} impact on the manager’s strategy results from the manager’s symmetric cost function discussed in Section 5.4.

Even in this setting, though, litigation can impact reporting choices. From the Time 1 price \( p_1 \) given by (13b), the \textit{ex ante} value of the firm equals \( E[v] - \theta \alpha D \), where the second term \( \theta \alpha D \) reflects expected transaction costs. Viewing this as the value to the firm’s initial owners, litigation provides incentives to implement structures that

\footnote{Basing costs directly on the extent to which investors are fooled, \( E[v|\hat{r}, y] - E[v|r, y] \), rather than \( \hat{r} - r \) results in an equilibrium where no reporting occurs. This also occurs with a cost function similar to Dye and Sridhar (2004). This is related to a technical issue noted in Caskey, Nagar, and Petacchi (2010, footnote 14) whereby a cost function that depends on \( (E[v|\hat{r}, y] - E[v|r, y])^2 \) causes any sensitivity of the manager’s report to his signal \( r \) to exceed the amount conjectured by investors. If investors believe that the manager’s report \( \hat{r} \) is informative with some specific sensitivity \( \hat{\rho}_r \) to his signal \( r \), the actual report will be more sensitive to \( r \) as the manager seeks to reduce his expected cost of misreporting. The only case in which this does not occur is if investors simply ignore the manager’s report.}
constrain misreporting in order to reduce transaction costs. For example, high quality external auditors and an internal audit function that reports directly to the board’s audit committee may constrain misreporting, represented in the model by increase in \( c \).

Detailed reports of the manager’s compensation plans can increase investors’ knowledge of the manager’s incentives, represented by an increase in \( \tau_b \). The following proposition states that both of these increase firm value by reducing expected litigation costs.

**Proposition 2.** Total expected litigation costs \( D \) are decreasing in the manager’s misreporting cost and precision of investors’ knowledge (precision) of the manager’s objective function \( (dD/dc < 0, dD/d\tau_b < 0) \). Ex ante firm value is thus increasing in the misreporting cost and precision.

The cost and precision parameters affect litigation costs through two complementary avenues. First, increases in \( c \) and \( \tau_b \) both reduce the manager’s ability to fool investors. The threshold for litigation given by (13d) imposes a requirement that investors actually be fooled by the manager in order to sue. Improved information about the manager’s objective function (higher \( \tau_b \)) reduces the manager’s ability to mislead investors at Time 1. Furthermore, this dampens the manager’s aggressiveness in misreporting. Both of these effects reduce the likelihood that managers successfully misled Time 1 investors, which results in a higher threshold \( M \) so that litigation becomes less likely.

In addition to affecting the likelihood of litigation, as determined by \( M \), the cost and precision parameters also impact the expected magnitude of litigation. From an *ex ante* perspective, greater uncertainty about firm value leads to a greater likelihood of large price drops. This, in turn, can lead to high litigation costs. By improving the Time 1 investors’ information, increasing the manager’s misreporting costs and information about his incentives reduces the chances of major surprises at Time 2 that could lead to large lawsuits.

\(^{27}\)See the proof of Proposition 2 in the Appendix for the analytic characterization of the effects discussed in this and the following paragraph.
6.2 Effect of insurance on firm value and litigation frequency

When the news at Time 2 contradicts the manager’s Time 1 report and investors expect litigation, they price protect for any uninsured losses. This amplifies the price reaction to news that can trigger litigation sufficiently large to exhaust the firm’s insurance coverage, which amplifies the related transaction costs. This section shows that avoiding this price reaction provides a motivation to purchase litigation insurance, which Coffee (2006) notes is a ubiquitous practice. Investors have no need to price protect for insured losses so that insurance tempers the price reaction to news that contradicts the manager’s report.

The following proposition establishes that the value of the firm is strictly increasing in the amount $X$ of insurance coverage it purchases at Time 0. The model places no restrictions on the amount of coverage that insurers can feasibly offer so that firms would purchase full coverage if such coverage were available. In real settings, insurers may lack the capital needed to credibly provide full insurance, particularly for firms with large market capitalizations.

**Proposition 3.** The ex ante value of the firm $E[p_1] = E[v] - \theta\alpha D$ is strictly increasing in the cap $X$ on insurance coverage. The likelihood of litigation $P(p_2 < p_1, v_2 < v_2)$ is weakly increasing in the cap $X$.

Figure 5 illustrates Proposition 3 by comparing prices for a firm with no insurance to one with unlimited insurance. In Panel A, litigation requires a high likelihood $P$ that the manager overreported at Time 1. In this case, any news sufficiently bad to surpass the threshold $P$ is also sufficiently bad to have caused a price drop, regardless of whether or not the firm has insurance. When news is good, the thick curve for the no-insurance case lies above the thin curve for full-insurance, which reflects the insurance premium that the full-insurance firm must pay. When the Time 2 signal is sufficiently bad to allow for litigation, the thick curve for the no-insurance firm has a steep drop as the investors must price protect against expected litigation whereas investors in the full-insurance
firm have no need to do so since the insurer will bear the costs of litigation. The larger price drop in the no-insurance case amplifies the transaction costs of litigation. Because the Time 1 price equals the expected firm value less the expected transaction costs of litigation, this results in a lower Time 1 price for the uninsured firm as reflected by the horizontal dashed lines.

(Insert Figure 5 about here)

Figure 5, Panel B illustrates a similar comparison between a fully and uninsured firm, but with a more lenient litigation threshold $P$. When the firm has no insurance, news that indicates that the manager misled is insufficient to trigger a price drop. This occurs because, as in the example of Panel A, the Time 1 price $p_1$ includes a fairly large deduction for the expected transaction costs of litigation. If the Time 2 news merely corroborates the Time 1 news, $v_2 = v_1$, there will be a price increase since $p_2$ will equal $p_2 = v_2 = v_1$ whereas the Time 1 price included a discount for expected transaction costs of litigation ($p_1 = v_1 - \theta \alpha D$). The Time 2 news must be sufficiently bad to offset the effect of transaction costs on $p_1$ and trigger a price drop.

If the firm has insurance, the Time 1 price increases because bad news does not induce Time 2 investors to price protect against litigation, which reduces the magnitude of the transaction costs associated with litigation. When the Time 2 news is positive, the Time 2 price is relatively lower for an insured firm since it must still pay the insurance premium. The combination of a lower good-news Time 2 price and a higher Time 1 price combine to make a price drop more likely. In the example of Panel B, a price drop is insufficient to allow litigation for the insured firm and the relevant constraint on litigation becomes the threshold $v_2$ at which there is sufficient evidence that the manager misled investors at Time 1. The insured firm will more likely face litigation because $v_2$ exceeds the value of $v_2$ that triggers a price drop and litigation for the uninsured firm.

The notion that firms can influence the manager’s misreporting, as discussed in Section 6.1, raises the potential that insurance reduces litigation costs and therefore the
incentive to control misreporting. Empirical work suggests that insurers are sufficiently sophisticated to anticipate any such moral hazard (Core 1997, 2000). Assuming this holds, the model’s equilibrium and results remain even if there is the opportunity for ex post moral hazard for a given set of parameters. While firms can increase value by restricting misreporting, moral hazard may reduce the ability to implement constraints because any choices must be preferred after negotiating the insurance contract.

For example, a firm could claim that it will provide extensive reports of managerial compensation plans and the timing of equity grants, which will reduce the manager’s ability to fool investors since they will be more familiar with his incentives. After obtaining insurance, the firm may wish to withhold disclosure if, for example, this would diminish its competitive position in product markets. If so, sophisticated insurers will charge a premium that anticipates that the firm will withhold compensation disclosures.

In practice, insurers will charge a premium that allows them to earn a profit. In such cases, Proposition 3 applies to the gross (of insurer profit) value of insurance. The insurer’s profit will not impact the expected litigation costs.

Insurance creates a surplus that will be divided between the firm and its insurer. The relative bargaining power of the two parties will determine how their respective shares of that surplus. If the insurer demands a premium that consumes more than the value created by insurance, then the firm will be better off forgoing insurance. Core (2000) notes that D&O insurance market is highly competitive, which suggests that firms are able to appropriate much of the value created by obtaining insurance.

6.3 Expected returns

Direct computations show that the expected return from Time 1 to Time 2 is \( E[p_2 - p_1] = -\theta(1 - \alpha)D < 0 \). This is simply the expected net-of-transaction-costs payoff from

\[ \text{This can be seen by noting that an increase in the premium will cause a vertical shift in both } p_2 \text{ (See (8)) and } p_1 \text{ (See (11)).} \]
litigation. Time 1 investors expect to receive two forms of payment – selling their shares and payoffs from litigation. They are risk-neutral and perfectly competitive so that they earn zero total returns, on average. The price return excludes part of the portion their payment supplied by litigation and is thus negative. This relates to the Hughes and Thakor’s (1992) demonstration that expected payouts from litigation can give the appearance of the long-term underperformance of IPOs because the Time 2 price does not reflect the Time 1 investors’ ‘side gain’ from litigation.\footnote{Hughes and Thakor(1992) do not deduct litigation costs from the firm’s cash flows so that damages paid to shareholders appear as an ‘extra’ source of value. If one takes into account the impact on the firm’s cash flows, litigation has a net zero impact on selling investors absent transaction costs. In expectation, shareholders receive a dollar less when selling shares for every dollar they expect to recover in litigation. Nonetheless, their intuition about the effect on stock performance still holds.}

The effect of litigation on expected returns is no different than if one were to exclude dividends from the computation of returns, where litigation behaves like a randomly paid dividend. If investors were risk-averse, they would demand a positive risk premium that would dampen and likely offset the negative return computed for risk-neutral investors. The exclusion of litigation payments from return computations would nonetheless reduce realized returns computed from prices just as excluding dividends would.

As I discuss in Section 2, litigation is fairly uncommon so that the exclusion of litigation likely has little effect on average returns for the broad population. In research settings that involve firms with high litigation risk relative to the general population, such as IPO firms (Lowry and Shu 2002), returns could be affected. The empirical literature offers various means to gauge litigation risk including insurance premia (Core 1997) and predictive models (Kim and Skinner 2010). Such methods can be employed to determine whether a sample of firms faces sufficiently high litigation risk to warrant controlling for its impact on returns.
7 Extensions

7.1 Impact of fixed costs

Litigation can entail substantial uninsurable costs. Insurance policies incorporate deductibles that can be large (Core [1997]). Some costs, such as lost business due to reputational damage, are inherently uninsurable. These costs can dampen or even eliminate the benefits of insurance. This can occur because, as shown in Proposition 3, insurance can increase the likelihood of litigation and thus the likelihood of incurring the fixed costs of litigation. If these costs are high, they dominate the beneficial effects of insurance reducing the variable costs of litigation.

This section considers a setting where the firm incurs an uninsurable cost $C$ in the event of litigation. I continue to require Time 1 investor losses ($p_2 < p_1$) and a sufficiently high likelihood of misleading investors ($P(v_1 > E[v|r,y]|r,y,s) > P$) in order for suits to occur. In this setting, the Time 2 price solves:

$$p_2 = v_2 - x - \underbrace{1_{v_2 < \xi_2}1_{p_2 < p_1}C}_{\text{Fixed costs}} - \underbrace{1_{v_2 < \xi_2}1_{p_1 - p_2 > X}}_{\text{Litigation exceeds insurance cap } X} \theta(p_1 - p_2 - X). \quad (14)$$

The derivation of the equilibrium proceeds in the same manner as in the setting without fixed costs. The following proposition defines the resulting equilibrium:

**Proposition 4.** In equilibrium, the Time 2 price is:

$$p_2 = v_2 - x - \underbrace{1_{v_2 < \min\{\xi_2, p_1\}}C}_{\text{Fixed costs}} - \underbrace{1_{v_2 - x < \min\{\xi_2 - x, p_1 - \max\{0, X-C\}\}}}_{\text{Litigation exceeds cap } X} \frac{\theta}{1-\theta} (p_1 - (v_2 - x) - X + C). \quad (15a)$$

The expected damages for which investors can sue are:

$$D(\theta, \alpha, \sigma_1, M, X, C) = E[1_{p_2 < p_1}1_{v_2 < \xi_2}(p_1 - p_2)]. \quad (15b)$$
where the function $D$ is defined in the Appendix. The Time 1 price and insurance premium are:

$$p_1 = v_1 - \theta \alpha D - P(v_2 < v_2, p_2 < p_1) C,$$

(15c)

$$x = \theta D - \theta E[1_{v_2<v_2, p_2<p_1}(p_1 - p_2 - X)]$$.

(15d)

The manager’s report $\hat{r} = r + \rho \beta b$ and the threshold $M$ are exactly as defined in Proposition 4.

The primary impact of fixed costs on the issues examined in this study is that sufficiently high fixed costs can eliminate the benefits of litigation insurance. The following corollary provides sufficient conditions for total expected litigation costs $\theta \alpha D + P(v_2 < v_2, p_2 < p_1)C$ to be strictly increasing or decreasing in $X$:

**Corollary 4.1.** Assume the threshold $P \geq 1/2$ so that $M \geq 0$. There exist thresholds $\hat{C}_z, \hat{C}_m, \hat{C}_\infty$ and $\hat{C}_0$ such that if $C < \max\{\hat{C}_m, \hat{C}_0\}$ ($C > \max\{\hat{C}_z, \hat{C}_\infty\}$), then total expected litigation costs are everywhere decreasing (increasing) in insurance $X$.

For less extreme $C$ than the conditions in Corollary 4.1, total litigation costs are non-monotonic in $X$. Figure 6 provides examples of how the fixed costs impact the relation between insurance and the firm’s total litigation costs. In two of the examples, costs increase in $X$ for small $X$ and decrease for large $X$. Because insurance increases the likelihood of litigation, if the fixed costs are sufficiently high, then the impact of exposure to litigation dominates the effect of insurance removing the need for investors to price protect. In other words, if litigation will devastate the firm whether or not it carries insurance, the firm may as well forgo insurance and save the cost of the premium and reduce the likelihood of being sued to begin with.

(Insert Figure 6 about here)
There are various ways to quantify the fixed costs of litigation. Grundfest (1995) finds that 40% of securities class actions settle for less than $2.5 million, suggesting a lower bound of costs required to go to trial. Bhagat, Bizjak, and Coles (1998) find that the typical D&O insurance policy has a deductible of 2% of the coverage limit. Firms must also consider indirect costs such as lost or forgone business relationships and disruptions to management. These costs likely include both fixed and variable components. For example, small lawsuits may have relatively small indirect costs whereas Karpoff, Lee, and Martin (2008b) find evidence of large indirect costs associated with SEC enforcement actions.

### 7.2 Litigation threshold \( P \) determined by attorney strategy

The derivation of the equilibrium in Proposition 1 takes as given the minimum required likelihood \( P \) that the manager misled investors at Time 1. In some circumstances, it may be appropriate to view this as an exogenous parameter dictated by securities law and court precedent that sets a minimum level of a plausible claim before initiating litigation. Alternatively, the threshold can be derived by taking the perspective of a plaintiff attorney who faces a fixed cost \( K \) for initiating a filing. Under the assumption that the entire portion of transaction costs \( \alpha \) flow to the attorney, I denote the expected payoff from filing a suit as:

\[
\theta \alpha P(v_1 > E[v|r, y]|\hat{r}, y, s)(p_1 - p_2) - K.
\]  

(16)

If the attorney has zero fixed costs (\( K = 0 \)), then he will file a suit for any price drop regardless of the case’s merits. If the legal system imposes a requirement that \( P(v_1 > E[v|r, y]|\hat{r}, y, s) \) exceed \( P \) and the above payoff is positive for all Time 2 signals \( s \) that satisfy this requirement, then the attorney’s strategic behavior has no impact on the equilibrium. The legal system may provide a binding constraint \( P \) on litigation.
For example, the PSLRA was enacted in response to a perception that attorneys filed frivolous lawsuits and increased the thresholds of what constitutes a valid securities claim (Choi and Thompson 2006). This would be consistent with the legal system providing the relevant constraint on litigation.

In the event that $K$ is sufficiently high that the attorney will not file a suit even when allowed by the legal system, expression (16) can be used to derive an endogenous threshold whereby the attorney will file a suit if $v_2 < v_1 - \sigma_1 M_a$ for some $M_a$ that depends only on parameters known at Time 0 and can thus be anticipated by investors. The form of the threshold is the same as that given in Lemma 1 and used in deriving the equilibrium. The following proposition summarizes the effect of an attorney setting the minimum threshold for litigation.

**Proposition 5.** Given sufficiently high fixed costs $K$, a Time 2 value $v_2 = v_1 - \sigma_1 M$ fails to trigger litigation. The resulting equilibrium is as stated in Proposition 7 with the exception that the threshold for litigation $v_2 = v_1 - \sigma_1 M_a$ where the threshold $M_a > M$ satisfies the following relation:

$$M_a = \Phi^{-1} \left( \frac{K}{\sigma_1 \theta \alpha (M_a - \theta \alpha z)} \right) \sqrt{\frac{1 - \text{corr}(b, s|\hat{r}, y)^2}{\text{corr}(b, s|\hat{r}, y)^2}},$$

(17)

where $z$ is as defined in Lemma 3 and depends on $M_a$, as well.

**8 Conclusion**

In securities class action lawsuits, the firm’s shareholders ultimately both receive and pay damages. This study develops a rational expectations model that incorporates shareholders’ anticipation of lawsuits upon the release of news that indicates that the firm’s managers misreported. The anticipation of litigation amplifies the price reaction to bad news as investors impound both the news about the firm’s operations and the firm’s costs of litigation. This, in turn, exacerbates the magnitude of lawsuits determined
in part by the price reaction to news that reveals misreporting. Litigation insurance provides value in the model by eliminating the need for investors to price protect for litigation. While insurance increases firm value by reducing the magnitude of price drops and lawsuits, it increases the frequency of litigation.

Prices in the model take into account any expected wealth transfers between the firm and investors, including those from litigation. Lawsuits thus have no impact on firm value absent transaction costs such as attorney fees. The transaction costs of litigation provide the firm with incentives to constrain misreporting in order to prevent the slippage of value away from investors. In the model, litigation does not affect the manager’s ex post reporting choices, but may reduce misreporting by encouraging ex ante choices that constrain the manager’s ability and incentives to misreport. Of course, if such choices involve costs, firms can weigh the costs of constraining misreporting against the reduction in transaction costs of litigation.

Despite the complexities involved with determining prices where litigation can occur, the model has a tractable form. This suggests that the model may be useful for future research on settings in which litigation affects share prices and the study leaves much open for future research. The model involves a setting with risk-neutral investors, managers with a short-term focus and conditional uncertainty that does not depend on information. Relaxing these assumptions provides avenues for future research on securities litigation. Risk aversion potentially plays a role in the demand for both litigation and litigation insurance. Managers with long horizons will be more sensitive to the impact their reports have on litigation. In addition, stock prices exhibit substantial information-dependent uncertainty. All of these features would eliminate the tractable linear structure of the model presented here but may provide additional insights into the effects of litigation on managerial and investor behavior.
References


33


Appendix

Effect of relaxing the assumption of forced share turnover

This section illustrates the effect of relaxing the assumption of forced share turnover. Assume that some random fraction $x_{12}$ of the firm’s shareholders who purchase at Time 1 must sell at Time 2 for, say, liquidity reasons. Under this assumption, I show that a suit will be filed when possible and that all investors who bought at Time 0 will sell at Time 1. Denote by $x_1$ the share turnover at Time 1, where only investors who purchased at Time 1 can claim harm from the Time 1 disclosure and sue for damages.

An investor who owns fraction $\beta_t$ of the firm at Time $t$, with $\Delta \beta_t = \beta_t - \beta_{t-1}$ representing net purchases, expects the following payoff from initiating a suit if fraction $x_1$ (known at Time 2) of shares turned over at Time 1:

$$30 \beta_2 E[v - \theta dx_1 | \hat{r}, y, s] + \max\{0, \Delta \beta_1\} E[\theta (1 - \alpha) d | \hat{r}, y, s].$$

(A.1)

The investor’s expected value if no suit is initiated is $\beta_2 E[v | \hat{r}, y, s]$. Comparing to (A.1), the investor will initiate a suit if:

$$\max\{0, \Delta \beta_1\} E[\theta (1 - \alpha) d | \hat{r}, y, s] > \beta_2 x_1 E[\theta d | \hat{r}, y, s].$$

(A.2)

From (A.2), it is clear that any investor who purchased shares at Time 1 and liquidated at Time 2 ($\max\{0, \Delta \beta_1\} > 0$ and $\beta_2 = 0$) will file a suit if it has positive expected value ($E[\theta (1 - \alpha) d | \hat{r}, y, s] > 0$). Only one such investor is needed to trigger the suit, which is a far less restrictive assumption the simplifying assumption in the main text that all shares turnover. So long as some fraction $x_{12}$ has purchased at Time 1 and liquidates

---

30 The expressions for the share of settlements implicitly assume that all eligible investors file claims. If this were not the case, an investor contemplating the initiation of a suit would increase the value of his share of the settlement to account for the potential that his pro rata share of the payout could exceed his share of the class of potential claimants. This, of course, would make suits more likely.
at Time 2, this will hold. Because a suit will be filed if possible by investors who sold at Time 2 for liquidity reasons, the Time 2 price is $E[v - \theta dx_1 | \hat{r}, y, s]$ so that investors who do not have a liquidity shock are indifferent between holding and selling.

An investor who purchases at Time 1 perceives the following value where $x_1$ again denotes the Time 1 turnover of shares, which is possibly unknown at Time 1:

\[
E[x_{12}p_2 | \hat{r}, y] + E[(1 - x_{12})(v - \theta dx_1) | \hat{r}, y] + E[\theta (1 - \alpha) d | \hat{r}, y] = E[p_2 | \hat{r}, y] + E[\theta (1 - \alpha) d | \hat{r}, y]. \tag{A.3}
\]

An investor who had purchased at Time 0 can either sell at Time 2, receiving $E[p_2 | \hat{r}, y]$ or hold at Time 2, receiving $E[v - \theta dx_1 | \hat{r}, y]$, which again equals $E[p_2 | \hat{r}, y]$. This is less than what Time 1 purchasers are willing to pay, given by (A.3), so that all Time 0 shareholders will sell regardless of whether a liquidity shock induces them to do so.\footnote{This complete turnover ignores frictions such as taxes, trading costs and hedging benefits which would offset the incentive to sell at Time 1 in real settings.}

In other words, the Time 1 turnover $x_1 = 1$ so long as there is positive positive probability of a positive net settlement to Time 1 purchasers ($E[\theta (1 - \alpha) d | \hat{r}, y] > 0$). Thus, within the context of the model, the assumption that some fraction of Time 1 purchasers liquidate at Time 2 is sufficient to yield identical pricing effects.

\begin{proof}
Given the linear conjectures (5) and the assumption of normal random variables, $E[v | r, y]$ is normally distributed conditional on $(\hat{r}, y, s)$ giving:

\[
P(v_1 > E[v | r, y, s] | \hat{r}, y, s) = \Phi \left( \frac{v_1 - E[E[v | r, y] | \hat{r}, y, s]}{\text{std}(E[v | r, y] | \hat{r}, y, s)} \right). \tag{A.4}
\]
\end{proof}
Because \( \hat{r} \) is a noisy version of \( r \), this gives \( \mathbb{E}[\mathbb{E}[v|r, y]|\hat{r}, y] = \mathbb{E}[v|\hat{r}, y] \) and:

\[
\mathbb{E}[\mathbb{E}[v|r, y]|\hat{r}, y, s] = \mathbb{E}[v|\hat{r}, y] + \frac{\text{cov}(\mathbb{E}[v|r, y], s|\hat{r}, y)}{\text{var}(s|\hat{r}, y)} (s - \mathbb{E}[s|\hat{r}, y]).
\]  

(A.5)

The assumptions that \( r \) is good news (\( \text{cov}(v, r|y) > 0 \)) and \( s \) is informative about \( r \) (\( \text{cov}(r, s|y) > 0 \)) imply that \( \mathbb{E}[v|r, y, s]|\hat{r}, y, s \) is increasing in \( s \). Thus, there is a value \( s = \bar{s} \) so that \( \mathbb{P}(v_1 > \mathbb{E}[v|r, y, s]|\hat{r}, y, s) > P \) for all \( s < \bar{s} \) where \( \bar{s} \) is given by:

\[
\bar{s} = \mathbb{E}[s|\hat{r}, y] - \frac{\text{var}(s|\hat{r}, y) \text{std}(\mathbb{E}[v|r, y]|\hat{r}, y, s)}{\text{cov}(\mathbb{E}[v|r, y], s|\hat{r}, y)} \Phi^{-1}(P).
\]  

(A.6)

The assumption that \( \text{cov}(v, s|\hat{r}, y) > 0 \) implies that \( \mathbb{E}[v|\hat{r}, y, s] = \mathbb{E}[v|\hat{r}, y] + \frac{\text{cov}(v, s|\hat{r}, y)}{\text{var}(s|\hat{r}, y)} (s - \mathbb{E}[s|\hat{r}, y]) \) is increasing in \( s \). Substituting from (A.6) then gives the condition in Lemma 1 that \( \mathbb{P}(v_1 > \mathbb{E}[v|r, y, s]|\hat{r}, y, s) > P \iff s < \bar{s} \iff v_2 < v_2 = v_1 - \sigma_1 M \) where:

\[
M = \frac{\text{cov}(v, s|\hat{r}, y)}{\text{cov}(\mathbb{E}[v|r, y], s|\hat{r}, y)} \frac{\text{std}(\mathbb{E}[v|r, y]|\hat{r}, y, s)}{\sigma_1} \Phi^{-1}(P).
\]  

(A.7)

\[\blacksquare\]

Proof of Lemma 2

The Time 2 expected value \( v_2 \) is the only random variable in (10) conditional on Time 1 information. Given the linear conjectures (5), \( v_2 \) is normally distributed with mean \( v_1 \) and standard deviation \( \sigma_1 \). The expectations in (10) can therefore be computed using the formulas \( \mathbb{E}[1_{a < \alpha < \bar{a}}] = \mu_a \left( \Phi\left( \frac{\bar{a} - \mu_a}{\sigma_a} \right) - \Phi\left( \frac{a - \mu_a}{\sigma_a} \right) \right) - \sigma_a \left( \phi\left( \frac{\bar{a} - \mu_a}{\sigma_a} \right) - \phi\left( \frac{a - \mu_a}{\sigma_a} \right) \right) \)

and \( \mathbb{E}[1_{a < \alpha < \bar{a}}] = \phi\left( \frac{\bar{a} - \mu_a}{\sigma_a} \right) - \Phi\left( \frac{a - \mu_a}{\sigma_a} \right) \) for \( a \sim \mathcal{N}(\mu_a, \sigma_a) \) where \( \Phi \) and \( \phi \) denote the distribution and density of a standard normal variable. Computing the expectations in (10), rearranging and substituting \( \theta \alpha \hat{z} = \frac{v_1 - x - p_1}{\sigma_1} \) gives the following condition that
is equivalent to (10):

\[
0 = \left(1 + \frac{\theta[1-\theta(1-\alpha)]}{1-\theta}\Phi\left(-\max\{M, \theta\alpha\hat{z} + \frac{X}{\sigma_1}\}\right) - \theta(1-\alpha)\Phi\left(-\max\{M, \theta\alpha\hat{z}\}\right)\right) \theta\alpha\hat{z}
- \frac{\theta[1-\theta(1-\alpha)]}{1-\theta}\phi\left(\max\{M, \theta\alpha\hat{z} + \frac{X}{\sigma_1}\}\right) + \theta(1-\alpha)\phi\left(\max\{M, \theta\alpha\hat{z}\}\right)
+ \frac{\theta[1-\theta(1-\alpha)]}{1-\theta}\Phi\left(-\max\{M, \theta\alpha\hat{z} + \frac{X}{\sigma_1}\}\right) \frac{X}{\sigma_1} \equiv g(\hat{z}; \theta, \alpha, \sigma_1, M, X). \tag{A.8}
\]

Because of the normal distributions of the variables in the model, the Time 1 price \(p_1\) and expected value \(v_1\) only enter expression (A.8) via the term \(\hat{z}\). Given a \(z\) such that \(g(z) = 0\), the price thus equals \(p_1 = v_1 - x - \sigma_1\theta\alpha z\). What remains is to show that a solution exists. Direct computations show that \(\frac{\partial g}{\partial z} > 0\), \(g \to \infty\) as \(z \to \infty\) and \(g \to -\infty\) as \(z \to -\infty\), which, along with the continuity of \(g\) in \(z\), proves there exists a unique \(z\) such that \(g(z) = 0\).

**Proof of Proposition 1**

**Manager’s conjectures**

From (12), the conjectures (5) and Lemma 2, which implies that \(\hat{\pi}_r = \hat{\pi}_y = 0\), the manager’s reporting strategy solves \(\rho_b = \frac{1}{c} \frac{\text{cov}(v, r|y)}{\text{var}(r|y)} = \frac{1}{c} \frac{\text{cov}(v, r|y)}{\text{var}(r|y) + \rho^2_b \tau_b^{-1}}\), which implies that \(\rho_b\) must solve the following cubic equation:

\[
\rho^3_b + \tau_b \text{var}(r|y)\rho_b - \frac{\tau_b}{c} \text{cov}(v, r|y) = 0. \tag{A.9}
\]

(A.9) is strictly increasing in \(\rho_b\), approaches infinity (negative infinity) as \(\rho_b\) approaches infinity (negative infinity), and at \(\rho_b = 0\) equals \(-\frac{\tau_b}{c} \text{cov}(v, r|y) < 0\) under the assumption that \(r\) is good news (\(\text{cov}(v, r|y) > 0\)). Thus the equilibrium \(\rho_b\) exists and is greater than zero. The linear conjectures are satisfied so that the joint normality assumptions used in deriving prices are valid in equilibrium.

**Insurance premium and expected losses**

The insurance premium \(x\) cancels out of the price difference \(p_1 - p_2\) when substituting
the Time 1 price from (11) into the Time 2 price from (8). Thus the expected claimed damages $D$ can be computed after these substitutions without having computed the insurance premium:

$$D \equiv E[1_{v_2 < v_1} \mathbb{1}_{p_2 < p_1} (p_1 - p_2) | \hat{r}, y] = \frac{\sigma_1^2}{1 - \theta(1 - \alpha)} \left( \phi(\max\{M, \theta \alpha z\}) + \Phi(\max\{M, \theta \alpha z\}) \right),$$
(A.10)

which depends on $\theta$, $\alpha$, $\sigma_1$, $M$ and $z$ which, from Lemma 2, is itself a function of $\theta$, $\alpha$, $\sigma_1$, $M$ and $X$. The computation uses a substitution from the equilibrium relation from Lemma 2, $g(z) = 0$ and the last expression depends only on parameters known at Time 0. Similarly, direct computations after substituting (11) into the Time 2 price from (8) and using $g(z) = 0$ give the expected uninsured losses:

$$E[1_{v_2 < v_1} \mathbb{1}_{p_1 - p_2 > X} (p_1 - p_2 - X)] = (1 - \alpha)D + \sigma_1 \alpha z. \quad (A.11)$$

Insurers set the premium to equal their expected payout, which can be computed using (A.10) and (A.11):

$$x = \theta E[1_{v_2 < v_1} \mathbb{1}_{p_2 < p_1} \min\{X, p_1 - p_2\}] = \theta E[1_{v_2 < v_1} \mathbb{1}_{p_1 - p_2} > X (p_1 - p_2 - X)] - \theta E[1_{v_2 < v_1} \mathbb{1}_{p_1 - p_2} > X (p_1 - p_2 - X)]$$

$$= \theta D - \theta [(1 - \alpha)D + \sigma_1 \alpha z]. \quad (A.12)$$

Substituting (A.12) back into price (11) gives:

$$p_1 = v_1 - \theta \alpha D. \quad (A.13)$$

**Litigation threshold $M$**

From (13d) and the joint normality of the model’s variables:

$$\Phi^{-1}(F_{\mathcal{E}}) = \frac{\text{cov}(v, s | \hat{r}, y)}{\text{cov}(E[v | r, y, s | \hat{r}, y])} \sqrt{\frac{\text{var}(E[v | r, y, s | \hat{r}, y])}{\text{var}(E[v | \hat{r}, y])}}. \quad (A.14)$$

Given the manager’s report $\hat{r} = r + \rho b$, the independence of $b$ and the assumptions
cov(v, r|y) > 0, cov(v, s|\hat{r}, y) > 0 give:

$$\frac{M}{\Phi^{-1}(P)} = \frac{\text{cov}(v,s|\hat{r},y)}{\text{var}(r|y)} \cdot \frac{\text{cov}(r,s|\hat{r},y)}{\text{cov}(r,s|\hat{r},y)} = \frac{\text{var}(r|\hat{r},y,s) \text{var}(s|\hat{r},y)}{\text{cov}(r,s|\hat{r},y)}.$$  \hfill (A.15)

Direct computations show that \( \text{cov}(r, s|\hat{r}, y) = \text{cov}(r, s|y) \frac{\rho_b^2 \tau_b^{-1}}{\text{var}(r|y) + \rho_b^2 \tau_b} \) so that the assumption \( \text{cov}(r, s|y) > 0 \) implies that \( \text{cov}(r, s|\hat{r}, y) > 0 \), giving:

$$\frac{M}{\Phi^{-1}(P)} = \sqrt{\frac{\text{var}(r|\hat{r},y,s) \text{var}(s|\hat{r},y)}{\text{cov}(r,s|\hat{r},y)^2}}.$$  \hfill (A.16)

Substituting \( r = \hat{r} - b \) then gives expression (13d):

$$\frac{M}{\Phi^{-1}(P)} = \sqrt{\frac{\text{var}(\hat{r} - \rho_b b|\hat{r},y,s) \text{var}(s|\hat{r},y)}{\text{cov}(\hat{r} - \rho_b b|\hat{r},y,s)^2}} = \sqrt{\frac{\text{var}(b|\hat{r},y,s) \text{var}(s|\hat{r},y)}{\text{cov}(b|\hat{r},y,s)^2}} = \sqrt{\frac{1 - \frac{\text{cov}(b,s|\hat{r},y)^2}{\text{var}(b|\hat{r},y,s) \text{var}(s|\hat{r},y)}}{\frac{\text{var}(b|\hat{r},y,s) \text{var}(s|\hat{r},y)}{\text{cov}(b|\hat{r},y,s)^2}}}.$$  \hfill (A.17)

\[\blacksquare\]

Proof of Proposition 2

The parameters \( c \) and \( \tau_b \) only affect \( D \), given by (A.10), through their impact on \( M \) and \( z \). The parameters affect \( M \), given by (13d), via \( \text{corr}(b, s|\hat{r}, y)^2 \) and affect \( z \) via \( \sigma_1 = \text{std}(E[v|\hat{r}, y, s]|\hat{r}, y) \). Their impact on both of these come solely through the their effect on the variance of the manager’s bias, \( \rho_b^2 \tau_b^{-1} \). In particular, \( \sigma_1 \) depends on \( c \) and \( \tau_b \) via \( \text{var}(\hat{r}|y) = \text{var}(r|y) + \rho_b^2 \tau_b^{-1} \) while direct computations give:

$$\text{corr}(b, s|\hat{r}, y)^2 = \frac{\text{cov}(b,s|\hat{r},y)^2}{\text{var}(b|\hat{r},y) \text{var}(s|\hat{r},y)} = \text{corr}(r, s|y)^2 \frac{\rho_b^2 \tau_b^{-1}}{\text{var}(r|y,s) + \rho_b^2 \tau_b}.$$  \hfill (A.18)

To reduce notation, define \( w = \rho_b^2 \tau_b^{-1} \). The proof first shows that \( w \) is decreasing in \( c \) and \( \tau_b \) and then shows that damages are increasing in \( w \). From the manager’s strategy (A.9):

$$\frac{d\rho_b}{d\tau_b} = -\frac{1}{\tau_b} \frac{\rho_b^2}{3\rho_b^2 + \tau_b \text{var}(r|y)} < 0 \quad \frac{d\rho_b}{dc} = -\frac{\rho_b^2}{c^2} \frac{\text{var}(v, r|y)}{3\rho_b^2 + \tau_b \text{var}(r|y)} < 0,$$  \hfill (A.19)

where the inequalities follow from the assumption \( \text{cov}(v, r|y) > 0 \), which implies that
\( \rho_b > 0 \). Expression (A.19) implies \( \frac{dw}{dw} = \frac{\rho_b}{\tau_b} \left( 2\frac{d\rho_b}{d\tau_b} - \frac{\rho_b}{\tau_b} \right) < 0 \) and \( \frac{dw}{dw} = 2\frac{\rho_b}{\tau_b} \frac{d\rho_b}{d\tau_b} < 0 \).

The change in damages with respect to \( w \) is:

\[
\frac{dD}{dw} = \frac{dD}{dM} \frac{dM}{dw} + \left( \frac{\partial D}{\partial z} \frac{dz}{d\sigma_1} + \frac{\partial D}{\partial \sigma_1} \right) \frac{d\sigma_1}{dw},
\]

where the first term pertains to the effect on the likelihood of litigation referred to in the discussion of Proposition 2 and the second term pertains to the effect on price drops.

For the first part \( \frac{dD}{dM} = \frac{\partial D}{\partial M} + \frac{\partial D}{\partial z} \frac{dz}{dM} \) and direct computations give:

\[
\frac{dD}{dM} = 0, \quad \text{if } M < \theta \alpha z
\]

\[
\frac{dD}{dM} = -\frac{\sigma_1 \phi(M)}{1 - \theta} \frac{\left( 1 + \frac{\theta}{1 - \theta} \right) \Phi(-\theta \alpha z - \frac{X}{\sigma_1})}{\left( 1 - \theta \alpha z - \frac{X}{\sigma_1} \right) - \theta(1 - \alpha) \phi(-M)} < 0, \quad \text{if } \theta \alpha z < M < \theta \alpha z + \frac{X}{\sigma_1} \quad (A.21)
\]

\[
\frac{dD}{dM} = -\frac{\sigma_1 \phi(M)}{1 - \theta} \frac{M - \theta \alpha z - \theta \phi(M) \frac{X}{\sigma_1}}{1 + \theta \alpha z - \frac{X}{\sigma_1} \phi(-M)} < 0, \quad \text{if } M > \theta \alpha z + \frac{X}{\sigma_1}
\]

where the first inequality follows from \( M > \theta \alpha z \) and the second follows from \( M > \theta \alpha z + \frac{X}{\sigma_1} \). The threshold \( M \) only affects expected damages \( D \) when it is a binding constraint on litigation. When \( M < \theta \alpha z \), news that satisfies the likelihood of misreporting represented by \( M \) is insufficient to trigger a price drop. Thus, \( M \) is not a binding constraint on litigation and small changes do not impact \( D \). When \( M \) is larger, corresponding to a higher threshold likelihood \( P \) for misreporting, then further increases in \( M \) reduce the incidence of litigation and therefore reduce \( D \). Expression (A.18) implies that \( dM/dw > 0 \), thus \( \frac{dD}{dM} \frac{dM}{dw} < 0 \).

For the second part, \( \frac{\partial D}{\partial \sigma_1} = \frac{1}{\sigma_1} D > 0 \) and \( \frac{\partial D}{\partial z} = \frac{\sigma_1}{1 - \theta(1 - \alpha)} \phi \left( \max \{ M, \theta \alpha z \} \right) \theta \alpha > 0 \). Because \( \frac{\partial D}{\partial z} > 0 \) and \( \frac{\partial D}{\partial \sigma_1} = -\frac{\theta(1 - \theta(1 - \alpha))}{1 - \theta} \phi \left( -\max \left\{ M, \theta \alpha z + \frac{X}{\sigma_1} \right\} \right) \frac{X}{\sigma_1} < 0 \), \( \frac{dD}{d\sigma_1} > 0 \).

Thus, \( \frac{\partial D}{\partial z} \frac{dz}{d\sigma_1} + \frac{\partial D}{\partial \sigma_1} > 0 \). Under the assumption of positive conditional covariances \( \text{cov}(v, r|y) > 0, \text{cov}(v, r|y, s) > 0 \), \( \sigma_1 \) is increasing in \( \text{var}(r|y) = \text{var}(r|y) + w \) which is increasing in \( w \). This implies that the second part of (A.20) is positive, as well.

---

32 In order to see that \( z \) determines the effect on price drops, compute \( p_1 - p_2 \) using expression (11) for \( p_1 \) and expression (7) for \( p_2 \).
Proof of Proposition 3

The expected value of the firm $E[p_1]$ is increasing in $X$ if and only if $D$ is decreasing in $X$. Expression $D$ incorporates the effect of $X$ on the insurance premium. Expression (A.10) defines $D$, giving $\frac{dD}{dX} = \frac{\partial D}{\partial z} \frac{dz}{dX}$ where $g$ is the function given by (A.8) and defines $z$. Direct computations give $\frac{dD}{dX} = -\frac{\sigma_1}{1-\theta(1-\alpha)} \Phi(\max\{M, \theta_\alpha z\}) \theta_\alpha > 0$ while the proof of Lemma 2 gives $\frac{dg}{dz} > 0$. Thus $\frac{dD}{dX} \propto -\frac{dg}{dX}$. Direct computations give $\frac{dg}{dX} = \frac{\theta (1-\theta(1-\alpha))}{1-\theta} \frac{1}{\sigma_1} \Phi(-\max\{M, \theta_\alpha z + \frac{X}{\sigma_1}\}) > 0$. Thus $D$ is decreasing in $X$ and $E[p_1]$ is increasing in $X$.

Now turning to the likelihood of litigation, litigation occurs when $v_2 - x < \min\{v_2 - x, p_1\}$. Substituting $v_2 = v_1 - \sigma_1 M$ and $p_1 = v_1 - x - \sigma_1 \theta_\alpha z$ gives $P(\text{Litigation}) = P(v_2 - x < \min\{v_2 - x, p_1\}) = \Phi(-\max\{M, \theta_\alpha z\})$. The effect of the insurance cap $X$ on the probability of litigation is then $\frac{dP(\text{Litigation})}{dX} = -1_{M < \theta_\alpha z} \theta_\alpha \phi(\theta_\alpha z) \frac{dz}{dX} > 0$, where the inequality follows from the previous results that $\frac{dg}{dz}, \frac{dg}{dX} > 0$ so that $\frac{dz}{dX} < 0$.

Proof of Proposition 4

The proof is very similar to that of Proposition 1, so I just state key steps. Expression (15a) for the Time 2 price $p_2$ follows from solving (14) for $p_2$ where the term $\max\{0, X - C\}$ in the litigation indicator function accounts for the fact that $C$ could be sufficiently large that any litigation exceeds the insurance coverage. Similar to Lemma 2, the Time 1 price $p_1$ satisfies the following relation where $\theta_\alpha z = \frac{v_1 - x - p_1}{\sigma_1}$ and equals (A.8) when
\[ C = 0: \]

\[ 0 = g(z; \theta, \alpha, \sigma_1, M, X, C) \]

\[ = \left( 1 + \frac{\theta(1-\theta(1-\alpha))}{1-\theta} \Phi \left( -\max \left\{ M, \theta \alpha z + \max \left\{ 0, \frac{X-C}{\sigma_1} \right\} \right) \right) \right) - \theta(1-\alpha) \Phi \left( -\max \left\{ M, \theta \alpha z \right\} \right) \theta \alpha z \]

\[ - \theta(1-\alpha) \Phi \left( \max \left\{ M, \theta \alpha z + \max \left\{ 0, \frac{X-C}{\sigma_1} \right\} \right) \right) \]

\[ + \theta(1-\alpha) \Phi \left( \max \{ M, \theta \alpha z \right) - (1-\theta(1-\alpha)) \Phi \left( -\max \left\{ M, \theta \alpha z \right\} \right) \frac{X-C}{\sigma_1} \]

\[ + \theta(1-\theta(1-\alpha)) \phi \left( -\max \left\{ M, \theta \alpha z + \max \left\{ 0, \frac{X-C}{\sigma_1} \right\} \right) \right) \theta \alpha z. \]

\[(A.22)\]

Direct computations show that \( g \) is strictly increasing in \( z \) and approaches positive (negative) infinity as \( z \) approaches positive (negative) infinity. Thus, a unique \( z \) solves \( (A.22) \) and we can define \( p_1 = v_1 - x - \sigma_1 \theta \alpha z \).

Substituting \( p_1 = v_1 - x - \sigma_1 \theta \alpha z \) into the insurance premium and computing gives:

\[ x = E[1_{v_2 \in \mathbb{E}_2}1_{0 < p_1 - p_2 < X} \theta(p_1 - p_2)] + \theta E[1_{v_2 \in \mathbb{E}_2}1_{p_1 = p_2 > X}] \]

\[ = \theta D - \theta((1-\alpha)D + \sigma_1 \alpha z) - \Phi(-\max\{M, \theta \alpha z\})C, \]

\[(A.23)\]

where \( D \) is defined by \( (A.10) \) and depends on \( \theta, \alpha, \sigma_1, M, X \) and \( C \) either directly or indirectly via \( z \). Substituting the for \( x \) then gives \( (15c) \). Direct computations show that expected total damages \( E[1_{v_2 \in \mathbb{E}_2}1_{p_1 = p_2 > X}] = D \). The equality \( \theta E[1_{v_2 \in \mathbb{E}_2}1_{p_1 = p_2 > X}(p_1 - p_2 - X)] = \theta((1-\alpha)D + \sigma_1 \alpha z) - \Phi(-\max\{M, \theta \alpha z\})C \) in \( (15d) \) follows from rewriting the first line of \( (A.23) \) as \( x = \theta E[1_{v_2 \in \mathbb{E}_2}1_{p_1 = p_2 > X}(p_1 - p_2 - X)] \) and setting in equal to the second line. The marginal impact of the manager’s report on price is the same as in the equilibrium with no fixed costs, which implies that the manager’s reporting strategy and therefore the threshold \( M \) are the same. \( \square \)
Proof of Corollary 4.1

Denote total expected litigation costs by \( T = \theta \alpha D + \Phi(-\max\{M, \theta \alpha z\})C \) where \( \Phi(-\max\{M, \theta \alpha z\}) \) equals the probability of litigation \( P(v_2 < v_2, p_2 < p_1) \). \( D \), given by (A.10), depends on \( X \) only via \( z \) giving:

\[
\frac{dT}{dX} = \theta \alpha \left( \frac{\partial D}{\partial z} - 1_{M < \theta \alpha z} \phi(\theta \alpha z)C \right) \frac{dz}{dZ} \propto 1_{M < \theta \alpha z} \phi(\theta \alpha z)C - 1_{M > \theta \alpha z} \frac{\sigma_1 \theta \alpha}{1 - \theta (1 - \alpha)} \Phi(M),
\]

(A.24)

where the proportionality follows from \( \partial g/\partial X > 0 \) which implies \( dz/dX < 0 \). \( T \) is decreasing in \( X \) if \( \theta \alpha z > M \) and \( B > 0 \), where \( B > 0 \) if and only if \( C > \frac{\sigma_1 \theta \alpha}{1 - \theta (1 - \alpha)} \phi(\theta \alpha z) \equiv \tilde{C} \).

**Sufficient conditions for \( T \) decreasing for all \( X \)**

\( T \) can only be increasing in \( X \) if \( B > 0 \) and \( M < \theta \alpha z \), which is the condition that price drops rather than the likelihood of manipulations be the binding constraint on litigation. This requires both a low \( P \) and high fixed costs \( C \). Because \( z \) is decreasing in \( X \), a necessary condition for \( T \) increasing in \( X \) is that \( M < \theta \alpha z \) at \( X = 0 \) since, if is not, \( M < \theta \alpha z \) for all \( X \). Because \( g \) is increasing in \( z \) and equals zero in equilibrium, \( \theta \alpha z > M \) at \( X = 0 \) if and only if \( g(z = M/\theta \alpha; X = 0) < 0 \). Substituting this condition into (A.22) and rearranging gives the condition \( \theta \alpha z_{X=0} > M \) which holds if and only if \( C > \sigma_1 \left( M + \frac{(1-\theta)\Phi(M)(M-\theta \alpha \phi(M))}{(1-\theta)(1-\alpha)\Phi(M)} \right) \equiv \tilde{C}_0 \). If \( C < \tilde{C}_0 \), then \( \theta \alpha z < M \) for all \( X \) so that \( T \) is strictly decreasing in \( X \). If \( C > \tilde{C}_0 \), then \( \theta \alpha z > M \) for at least small \( X \), and possibly for all. The term \( B \) in (A.24) is decreasing in \( z \), which can be no smaller than \( \theta \alpha z \) without setting the price drop indicator \( 1_{M < \theta \alpha z} = 0 \). If \( C < \tilde{C} \) at \( \theta \alpha z = M \), then \( B < 0 \) for all \( z \) such that \( \theta \alpha z > M \). This gives the condition \( C > \frac{\sigma_1 \theta \alpha}{1 - \theta (1 - \alpha)} \phi(M) \Phi(M) \equiv \tilde{C}_m \). If \( C \) is less than either of \( \tilde{C}_0 \) or \( \tilde{C}_m \), then \( T \) is decreasing in \( X \) for all \( X \).

**Sufficient conditions for \( T \) increasing for all \( X \)**
Because $M < \theta \alpha z$ is a necessary condition for $T$ increasing in $X$ and $z$ is decreasing in $X$, $\theta \alpha z > M$ for all $X$ if and only if that holds for $X \to \infty$. Because $g$ is increasing in $z$ and equals zero in equilibrium, $\theta \alpha z > M$ at $X \to \infty$ if and only if $g(z = M/\theta \alpha; X \to \infty) < 0$. Substituting this condition into (A.22) and rearranging gives the condition $\theta \alpha z > M$, which holds if and only if $C > \sigma_1 M + \Phi(M) M + \phi(M) (1 - \theta(1 - \alpha)) \phi(-M)$, $\theta \alpha z > M$ for all $X$. Because $g$ is increasing in $z$ and equals zero in equilibrium, $\theta \alpha z > M$ at $X \to \infty$ if and only if $g(z = M/\theta \alpha; X \to \infty) < 0$. Substituting this condition into (A.22) and rearranging gives the condition $\theta \alpha z > M$, which holds if and only if $C > \sigma_1 M + \Phi(M) M + \phi(M) (1 - \theta(1 - \alpha)) \phi(-M)$, $\theta \alpha z > M$ for all $X$. Because $C$ is decreasing in $z$ and $z$ is decreasing in $X$, $C$ must exceed $C_0$ at $X = 0$ for $T$ increasing in $X$ for all $X$. Denoting by $z_0$ the $z$ that solves the equilibrium relation $g(z_0; X = 0) = 0$, this gives the condition $C > \sigma_1 \phi(z_0) (1 - \phi(z_0)) \phi(-z_0)$, $\theta \alpha z > M$ for all $X$.

Proof of Proposition 5

The investors’ trading behavior at Times 1 and 2 and the manager’s reporting behavior proceed exactly as previously discussed except that they must conjecture a minimum threshold for which the attorney will initiate litigation. Similar to Lemma 1, this corresponds to a belief that the attorney will file suit for $v_2 < v_1 - \sigma_1 \hat{M}_a$ where $\hat{M}_a$ denotes the conjecture of the attorney’s strategy.

The following shows that the attorney’s payoff can be expressed as a function of $(v_1 - v_2)/\sigma_1$, which will be used to determine the threshold for filing suit. The proof of Lemma 1 shows that $E[v_1 - E[v|\hat{r}, y, s]]$ equals $\frac{\text{cov}(E[v|\hat{r}, s]|\hat{r}, y)}{\text{var}(s|\hat{r}, y)} (s - E[s|\hat{r}, y])$. Because $v_1 - v_2 = E[v|\hat{r}, y] - E[v|\hat{r}, y, s] = \frac{\text{cov}(v, s|\hat{r}, y)}{\text{var}(s|\hat{r}, y)} (s - E[s|\hat{r}, y])$, the probability that the manager misled can be written as:

$$P(v_1 > E[v|\hat{r}, y]|\hat{r}, y, s) = \Phi\left(\frac{\text{cov}(E[v|\hat{r}, y]|\hat{r}, y)}{\text{cov}(v, s|\hat{r}, y)} \text{std}(E[v|\hat{r}, y]|\hat{r}, y, s) (v_1 - v_2)}{\sigma_1 \sqrt{1 - \text{corr}(b, s|\hat{r}, y)^2}}\right),$$

where the second inequality follows from the derivations of the expression for $M$ in (A.14).

$\hat{C}_\infty > \hat{C}_0$ if and only if $\Phi(M) M + \phi(M) > 0$, which holds even without a restriction that $M > 0$. 

46
through (A.17). Substituting expressions (11) and (8) for the Time 1 and 2 prices and writing $m_a = (v_1 - v_2)/\sigma_1$ gives the following expression for the attorney’s payoff:

$$
\theta \alpha P(v_1 > E[v|r,y]|\hat{r},y,s)(p_1 - p_2) - K
= \theta \alpha \Phi \left( m_a \sqrt{\frac{\text{corr}(b,s|\hat{r},y)^2}{1 - \text{corr}(b,s|\hat{r},y)^2}} \right) \left( 1 + \frac{1}{m_a > \max\{M_a, \theta \alpha z + \frac{X}{\sigma_1}\}} \frac{\theta}{1 - \theta} \right) \sigma_1 (m_a - \theta \alpha z)
- \frac{1}{m_a > \max\{M_a, \theta \alpha z + \frac{X}{\sigma_1}\}} \frac{\theta}{1 - \theta} X - K.
$$

(A.26)

Direct computations show that the payoff is negative for $m_a < \theta \alpha z$, which corresponds to filing suit when $p_2 > p_1$, and that the payoff is otherwise increasing in $m_a$ and approaches $\infty$ as $m_a \to \infty$. Thus, there is a unique $m_a = M_a$ that sets the payoff (A.26) equal to zero. Because $M_a$ depends only on parameters known at Time 0, investors can anticipate it so that the conjecture $\hat{M}_a$ that appears in (A.26) both directly and indirectly through the term $z$ must be correct. Setting $\hat{M}_a = M_a$ and using the fact that $M_a$ can never exceed $\max\{M_a, \theta \alpha z + \frac{X}{\sigma_1}\}$ so that the indicators in (A.26) equal zero gives the following expression that determines $M_a$:

$$
0 = \theta \alpha \Phi \left( M_a \sqrt{\frac{\text{corr}(b,s|\hat{r},y)^2}{1 - \text{corr}(b,s|\hat{r},y)^2}} \right) \sigma_1 (M_a - \theta \alpha z) - K,
$$

(A.27)

which can be rearranged to give (17). Equilibrium in this case requires that both the $g(z) = 0$ condition from Lemma 2 and that (A.27) be satisfied. In order for this equilibrium to be relevant, the resulting $M_a$ must exceed the exogenous level defined by (13d) to represent court and legal requirements and must exceed the resulting $\theta \alpha z$ so that the attorney constraint $M_a$ is more binding than a price drop. ■
Table 1: Notation

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>$v, v_1, v_2$</td>
<td>Terminal value of the firm, gross of any litigation costs; $v_1 = \mathbb{E}[v</td>
</tr>
<tr>
<td>$r = v + e_r, \hat{r}$</td>
<td>Manager’s Time 1 signal of firm value ($r$) and the manager’s report ($\hat{r}$) where $e_r$ is a mean zero noise term.</td>
</tr>
<tr>
<td>$y = v + e_y, s = v + e_s$</td>
<td>Public information available to investors at Time 1 and Time 2, respectively, in addition to the manager’s report $\hat{r}$ where $e_y$ and $e_s$ are mean zero noise terms.</td>
</tr>
<tr>
<td>$p_0, p_1, p_2$</td>
<td>Price of firm’s shares at Times 0, 1 and 2.</td>
</tr>
<tr>
<td>$\theta$</td>
<td>Product of the likelihood of the firm losing a lawsuit and the proportion of the price drop that will be paid in the event of losing a lawsuit.</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>Transaction costs, which are the fraction of firm’s litigation costs that do not flow to Time 1 investors.</td>
</tr>
<tr>
<td>$X, x$</td>
<td>The maximum litigation costs paid by the firm’s insurer ($X$) and the premium charged by the insurer ($x$).</td>
</tr>
<tr>
<td>$\sigma_1$</td>
<td>Standard deviation of the Time 2 expected firm value conditional on Time 1 information ($\text{std}(v_2</td>
</tr>
<tr>
<td>$P, v_2, M$</td>
<td>A constraint on filing lawsuits that requires at least a minimum probability, conditional on Time 2 information, that investors were misled by the manager; Require $P(\mathbb{E}[v</td>
</tr>
<tr>
<td>$b$</td>
<td>Manager’s privately observed sensitivity to price, where $b$ is normally distributed with precision $\tau_b$.</td>
</tr>
</tbody>
</table>
Figures

Figure 1: Timeline

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm’s inception</td>
<td>Manager reports ( \hat{r} ), investors observe ( \hat{r} ) and ( y ), Time 1 investors buy at price ( p_1 )</td>
<td>Time 2 information released, Time 2 investors buy at price ( p_2 )</td>
<td>Terminal dividend ( v ) realized, if Time 1 investors successfully sue, they investors receive ( 1 - \alpha ) times the firm’s costs</td>
</tr>
</tbody>
</table>
Figure 2: Time 2 price as a function of the Time 2 expected value $v_2$

Figure 2 plots the Time 2 price $p_2$ as a function of the Time 2 expected value $v_2 = E[v|\hat{r}, y, s]$. The random variables $\theta$ and $\gamma$ represent the likelihood of plaintiffs successfully suing and the proportion of damages a successful suit will pay, respectively. The price as plotted assumes that a price drop is a necessary condition for investors to successfully sue ($E[\theta\gamma|\hat{r}, y, s, p_2 > p_1] = 0$).
Figure 3: Time 2 price as a function of $v_2$

Figure 3 plots the Time 2 price $p_2$ as a function of the expected value $v_2 = E[v|\hat{r}, y, s]$ and given the Time 1 price $p_1$. In Panel A, the minimum likelihood that the manager misled, $P$, is such that a price drop is sufficient to allow for litigation so that Time 2 investors price protect against lawsuits when news is sufficiently bad to cause a price drop. In Panel B, $P$ is sufficiently high that news must be worse than what would trigger a price drop in order to trigger litigation.
Figure 4: Payoff to Time 1 investors as a function of $v_2$

Figure 4 plots the Time 2 price $p_2$ and the payoff to Time 1 investors as a function of the expected value $v_2 = E[v|\hat{r}, y, s]$ less the insurance premium $x$. The black line denotes the Time 2 price and the thick dashed line denotes the Time 2 expected payoff to Time 1 investors. The graph plots the case where the minimum likelihood that the manager misled, $P$, is sufficiently high that a price drop, which occurs at the intersection of $p_1$ and $p_2$, is insufficient to allow litigation. The point $v_2$ denotes the value of $v_2$ that corresponds to the likelihood exceeding $P$ so that litigation can occur. The point $p_1 - X$ corresponds to where a successful suit will extinguish the firm’s insurance coverage $X$. 
Figure 5: Time 2 price as a function of $v_2$

Figure 5 plots the Time 2 price $p_2$ as a function of the expected value $v_2 = \mathbb{E}[v|\hat{r}, y, s]$ and given the Time 1 price $p_1$. In Panel A, litigation requires a high likelihood $P$ that the manager misled investors at Time 1, which translates into a low value $v_2$ below which $v_2$ must fall to allow for litigation. The threshold is fairly low in Panel B, which translates into a higher value $v_2$ below which $v_2$ must fall to allow for litigation. The thick lines denote prices for a firm with no insurance and the thin lines correspond to a firm with unlimited insurance. The black dots denote the values of $v_2$ below which litigation occurs, which is the minimum of $v_2$ and the point at which Time 1 investors incur losses ($p_2 < p_1$).
Figure 6: Total expected litigation costs as a function of insurance coverage $X$

Figure 6 to firm’s total expected litigation costs, comprised of lawsuits and fixed costs, as a function of insurance coverage $X$. The curved lines plot the total litigation costs and the horizontal dotted lines correspond to the costs with unlimited coverage ($X \to \infty$). The points denoted by the vertical dotted lines correspond to the level $X = \hat{X}$ for which price drops no longer place a binding constraint on litigation, which depend on the likelihood that the manager misled for sufficiently high $X$. 