

**LAW AND ECONOMICS SEMINAR  
Fall Term 2008**

**Professor Polinsky**

**Thursday, November 13, 2008  
4:15 - 5:45 p.m.  
Stanford Law School  
Room 272**

**“Vicarious Liability for Bad Corporate  
Governance: Are We Wrong About 10b-5?”**

**by**

**James Spindler**

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**Note: It is expected that you will have reviewed the speaker's paper before the seminar. This paper is based on a formal model that may be challenging for some participants in the seminar. Professor Spindler has provided a four page distillation of it that is attached starting on the next page. He has indicated that he will give a non-mathematical presentation at the seminar.**

## A Note on Spindler's Vicarious Liability

November 7, 2008

This note is intended to help law students in Professor Polinsky's class to understand the model employed in my paper, *Vicarious Liability for Bad Corporate Governance: Are We Wrong About 10b-5?* While an understanding of the formal model is not necessary to grasping the intuition of the model's results, I do believe that students who wish subsequently to engage in policy analysis or academic research on capital markets regulation and disclosure rules must at least be comfortable in reading such models. I therefore provide a section by section discussion of what the model is doing.

Before getting to that, it may be useful to briefly describe what the point of this paper is, and how it is situated vis a vis the current securities law literature. This paper is a defense of private securities litigation, which has been rather widely condemned amongst securities law academics and regulators as being over-deterrent, non-compensatory, and composed largely of nuisance suits.<sup>1</sup> Instead, common proposals are that private securities litigation be eliminated or capped, to be replaced with regulatory oversight and fines and jail terms levied against individual firm managers.

The model that I present shows that fraud arises from shareholder incentives, that vicarious liability is a well-functioning deterrent mechanism for this sort of fraud, and that the proposed alternatives are unlikely to work well. In contrast to most other literature on corporate fraud, I assume that shareholders can write complete but unobservable contracts with management, which is equivalent to an assumption of managerial "altruism" vis a vis the current shareholders of the firm. Thus, there is no agency cost per se. Indeed, a major purpose of this paper is to show that the current fetishization of managerial agency costs is misguided: fraud arises even in the complete absence of agency costs.<sup>2</sup> To the extent that we believe managerial compensation is endogenously determined by the shareholders, some form of shareholder-based liability will be appropriate, while manager-based penalties are misguided and very difficult to implement effectively.<sup>3</sup>

### The Economy

Section 2.1.1 describes a very simple firm, with a project that is essentially a random payoff of cash. Firms can either be of high type (H), or low type (L); high type firms are more valuable than low type firms. The following example illustrates: suppose that  $H = 8$  and  $L = 1$ . If that is the case, then a high type firm's cash flow is a number chosen randomly between 0 and 8, while a low type draws a payoff between 0 and 1. The expected value of a high type firm is therefore 4, and the expected value of a low type firm is  $\frac{1}{2}$ .

Section 2.1.2 describes shareholders in the model. A slight simplification is this: each shareholder has some probability of selling her share (denoted by  $\pi$ ). If a share is not sold, it is held, which occurs with probability  $1 - \pi$ . Shareholders who sell receive the then-current market price for the share,  $p$ . Non-selling shareholders receive the firm's subsequent cash flows, denoted as  $v$ . However, in the event that the firm is found liable for fraud, a non-selling shareholder will see the value of her share diminished by the firm's liability. In particular, in the event that liability is assessed, the non-selling shareholder receives the firm's cash flows minus her proportionate share of the firm's liability (denoted as  $l$ ): the non-selling shareholder's payoff is thus  $v - l$ . Behind the veil of ignorance, where a shareholder does not know whether she will be a seller or a non-seller, her expected payoff will be  $\pi p + (1 - \pi)(v - l)$ , which is the probability weighting of each possible payoff.

The liquidation costs that are discussed in 2.1.2 and 2.1.6 are there to provide some heterogeneity among shareholders. If all shareholder were the same, they would all choose to do the same thing. By assuming that shareholders have different costs of selling their shares – such as unrealized capital gains, transaction and trading costs, a sudden need for capital, and etc. – we get an equilibrium where some shareholders may

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<sup>1</sup>Students who would like to see a good and concise statement of many of these arguments may wish to read Richard Booth's article, "The End of Securities Fraud Class Action?" (available at <http://www.cato.org/pubs/regulation/regv29n2/v29n1-8.pdf>)

To get an idea of the pervasiveness of these arguments, students might also wish to view an open letter written from several very prominent securities law professors to SEC Chairman Cox in August of 2007 (available at <http://www.the10b-5daily.com/archives/Chairman%20Cox%20SEC%20Letter.pdf>)

<sup>2</sup>While I do not show this result in the paper, the presence of managerial agency costs can actually lessen the amount of fraud perpetrated. Constraints on managerial activity that seek to align managerial and shareholder incentives (such as fiduciary duties owed to shareholders) can therefore *increase* the incidence of securities fraud.

<sup>3</sup>In the complete contracting framework, for instance, shareholders will simply agree to indemnify the manager for fines incurred in the commission of fraud where it benefits current shareholders.

sell while others may not. Hopefully this approximates the real world, where shareholders may choose to sell or not at different times.

Section 2.1.3 describes the manager, who acts as an altruist with regard to shareholders of the firm. That is, the manager seeks to maximize the payoffs of his current shareholders. Since some of his shareholders sell, and some do not, the manager maximizes a weighted average of selling shareholder payoffs and non-selling shareholder payoffs. As one can see, the manager's payoff function,  $\pi p + (1 - \pi)(v - l)$ , is equivalent to the expected payoff function of a shareholder who does not know whether she will be a seller or a non-seller. This is because the manager expects proportion  $\pi$  of his shareholders to be sellers who receive  $p$ , and proportion  $1 - \pi$  to be non-sellers who receive cash flows net of liability,  $v - l$ .

The manager has two roles within the firm. First, he can observe whether the firm is a good firm (that is, of high type  $H$ ) or a bad firm (of low type  $L$ ). This represents the manager's access to inside information to which neither shareholders nor the wider marketplace are privy. Second, the manager makes a disclosure to the marketplace, and this disclosure takes the form of saying whether the firm is of high or low type. The manager can tell the truth, or he can lie.

Section 2.1.4 describes purchasers (those who purchase the shares from the selling shareholders). Purchasers determine the price at which selling shareholders sell. Once a purchaser buys her share, she receives the firm's cash flows, but diminished by any liability assessed against the firm. She does, however, receive a transfer as a plaintiff in the event that liability is assessed; this transfer to each purchaser is denoted as  $t$ .

Purchasers here are rational and strategic, which means two things. First, they can figure out whether the incentives are such that managers will tell the truth or lie. Second, in expectation, purchasers must always break even. So, for example, suppose that the following are all true: purchasers believe that the manager of a low type firm will always lie, the background probability of a firm being a high type firm is 50%,  $H = 8$ ,  $L = 1$ , and there is no liability mechanism in place (suppose that Obama eradicates private securities litigation). Then, the price that a purchaser would pay for the share is  $.5 * 4 + .5 * .5 = 2.25$ .

Section 2.1.5 describes a type of antifraud liability mechanism (namely, damages under Rule 10b-5 of the Securities Exchange Act). The basic rule is that purchasers are entitled to recover the difference between the purchase price paid and the share price after the revelation of the fraud (denoted as  $t = p - p'$ ). For instance, if the purchaser bought at \$4, and the price declines to \$2, the purchaser may recover \$2. Also, it is the case that plaintiffs recover what the firm loses in liability, such that the total fine assessed against the firm equals the total recovery received by the plaintiff class:<sup>4</sup>  $Nl = N\pi t$ , where  $N$  is the number of shares outstanding and  $N\pi$  is the number of purchasers. Finally, by observing that post-revelation share price must take into account prospective liability in an efficient market ( $p' = v - l$ ), we can combine these three conditions to get the algebraic result of Proposition 1, which is that 10b-5 remedy is perfectly compensatory. This is counter to commonly made arguments that 10b-5 either overcompensates or undercompensates plaintiffs.

## Equilibrium

Section 2.3 describes equilibrium in this model. There are two sorts of equilibria that we consider: those where the manager will tell the truth, and those where he will not. Whether the manager tells the truth depends on whether he is better off telling the truth than lying, and this in turn depends upon the penalty levied upon shareholders, since the manager internalizes the payoffs of his current shareholders.

Eq (6) gives the manager's objective function, which is to maximize shareholder payoffs through his choice of whether or not to lie.  $IR_P$  states that purchasers will always break even in expectation, given the information that they have in their possession. In order for a "separating" or truth-telling equilibrium to result, it must be that managers of both high and low type firms must prefer to tell the truth.  $IC_L$  states the condition such that a manager of a low-type firm prefers to tell the truth than to lie; the left hand side gives payoffs from telling the truth, and the right hand side gives payoffs from lying.  $IC_H$  does the same for a manager of a high type firm.

The way that we check to see whether a separating equilibrium results is as follows. First, we check to see what prices the purchaser would be willing to pay for a high type firm and for a low type firm (we are assuming for the moment that managers will tell the truth). This is done by working through the break-even constraint,  $IR_P$ . Then, we check to see whether, given these prices, managers of both high and low type firms would indeed choose to tell the truth.

<sup>4</sup>This is not quite true, of course, where plaintiffs' attorneys' fees are paid out of plaintiffs' recovery. This is a distortion that undercompensates plaintiffs and potentially underdeters the firm from committing fraud. As far as this model is concerned, it is probably better to have the firm pay plaintiffs' attorneys' fees.

It may be useful to consider a very simple example of a truth telling equilibrium. Suppose that  $H = 8$ ,  $L = 1$ ,  $\pi = .2$ , and the liability mechanism is that fraud is always detected when low type firms lie (and not otherwise) and a fine of 7 is levied against the firm in such cases (note that this is *not* a description of 10b-5). In such a case, assuming truth telling, there will never be a fraud penalty imposed, and so  $E[v + \theta(t-l) | H] = E[v | H] = p_H$  and  $E[v + \theta(t-l) | L] = E[v | L] = p_L$ ; that is, the price paid will simply be the expected value of the firm in each case. The expected value of a high type firm is 4, so  $p_H = 4$ , while the expected value of a low type firm is  $p_L = \frac{1}{2}$ .

We can then plug these values into the manager's incentive compatibility constraints to check whether the manager really would choose to tell the truth given these prices and given the particular liability mechanism.

$$\begin{aligned}
 IC_L & : E[\pi p_L + (1 - \pi)(v - \theta l) | L \cap L'] \geq E[\pi p_H + (1 - \pi)(v - \theta l) | L \cap H'] \\
 \text{plugging in} & : .2 * \frac{1}{2} + (1 - .2) * \frac{1}{2} \geq .2 * 4 + (1 - .2) * \left(\frac{1}{2} - 7\right) \\
 \text{computing} & : \frac{1}{2} \geq -4.4, \text{ which is true.}
 \end{aligned}$$

Hence the manager of a low type firm would choose to tell the truth under these circumstances. (Had the inequality been false, lying would be preferable).

We then do the same for the high type manager:

$$\begin{aligned}
 IC_H & : E[\pi p_H + (1 - \pi)(v - \theta l) | H \cap H'] \geq E[\pi p_L + (1 - \pi)(v - \theta l) | H \cap L'] \\
 \text{plugging in} & : .2 * 4 + (1 - .2) * 4 \geq .2 * \frac{1}{2} + (1 - .2) * 4 \\
 \text{computing} & : 4 \geq 3.3, \text{ which is true.}
 \end{aligned}$$

Hence the manager of a high type firm will also choose to tell the truth. We have then confirmed that such a liability mechanism (whether or not it is implementable) would result in a separating or truth-telling equilibrium.

One could check, if one wanted, to see that under an alternative liability mechanism where the fine of 7 is always imposed whenever a high disclosure is made, that low type firms would choose to tell the truth but high types would not.

Of course, these are trivial examples, but they do illustrate the basic method of determining what sort of equilibrium exists.

### Section 3: Deviant Corporate Governance and Vicarious Liability

This section presents the most general results of the paper. First, Proposition 3 states that fraud arises from the incentives of shareholders. Intuitively, this is because the current set of shareholders must, on net, be sellers of securities; sellers of any asset have an incentive to inflate prices. Thus, when shareholders are contracting with the manager, they will tend to prefer incentives or policies that lead to higher statements of value. One can imagine that this is reflected in reality, for example, by the pressure that managers face to make their quarterly numbers; this short term pressure is widely thought to be one of the driving forces behind the growth of private equity.

Second, Proposition 5 demonstrates that vicarious liability can be a perfect deterrent to this sort of fraud. The reasoning is simple: so long as not all shareholders sell and fraud can be detected, the regulator can impose such a great fine on the firm, which is then borne partly by the non-selling shareholder(s), such that the harm to the non-selling shareholder will outweigh the fraudulent gains to all shareholders who did sell.

Of course, we do not believe that courts are perfect in detecting fraud, which means that this scheme of vicarious liability is not implementable in practice. The next section considers readily implementable schemes.

### Section 4: Effectiveness of 10b-5

This section focuses on 10b-5 remedies in particular, and considers three main cases: Section 4.1 assumes that courts can observe nothing but stock prices; Section 4.2 looks at a Bayesian court that can observe priors, distributions, and prices; and Section 4.3 considers the case where the court is omniscient. What is

most surprising, perhaps, is the result in Section 4.1, which is that 10b-5 is perfectly deterrent even where courts have very little information and impose liability simply based on stock price declines. This is contrary to much of the current academic literature.

An additional important point to take away from this section is that alternatives to 10b-5, such as jail terms for managers or damages caps, either cannot work or else require much more information than does 10b-5 to function effectively.

# Vicarious Liability for Bad Corporate Governance: Are We Wrong About 10b-5?

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## Abstract

I formulate a rational expectations signaling model of vicarious liability for securities fraud, particularly the much-criticized "fraud on the market" private class action arising under Rule 10b-5. I show that fraudulent misreporting by managers occurs in the absence of managerial moral hazard – i.e., where managers simply maximize shareholder payoffs – and that vicarious liability can serve as an appropriate deterrent, creating separating equilibrium. I then show that the particular remedy under Rule 10b-5 can perfectly deter fraud and perfectly compensate purchasers, and that, therefore, many of the current criticisms of Rule 10b-5 class actions are ill-founded.

## 1 Introduction

Under the American system of securities regulation, the chief anti-fraud enforcement mechanism is the private class action arising under Rule 10b-5 of the Securities Exchange Act of 1934 (also known as the "fraud on the market" class action). Liability for securities fraud is vicarious, as it is the firm and not the bad actor (ostensibly management) that bears the cost of the remedy under the fraud on the market action. Since shareholders of the firm at the time of the fraud suit are the ones who ultimately bear these costs, the fraud on the market remedy has a curious property in terms of who is punished: it neither punishes the persons who benefit from the fraud (selling shareholders and possibly managers), nor the natural persons who committed the fraud (management), but instead the rule punishes those trusting shareholders who held their shares through thick and thin. What is worse, purchasers of the firm's shares, who were duped by the fraud, must also participate in funding the firm's liability since they are now holders of shares. This scandalous quality has, especially of late, provoked considerable outrage among legal scholars who claim, variously, that fraud on the market fails at deterrence, fails at compensation, amounts to the plaintiffs suing themselves, severely overpunishes relative to the harm

caused, and, in a triumph of unfairness, lets the bad guys – managers – off scot free.<sup>1</sup>

Unfortunately, as I show in this paper, these criticisms are not well-founded. I first show, using a signaling model of a manager's decision to disclose his private information to the market, that fraud occurs even where – in fact, *because* – the manager maximizes current shareholders' aggregate welfare with selfless abandon.<sup>2</sup> This is because current shareholders are always going to be net sellers of the firm's shares in aggregate; hence the manager who maximizes aggregate shareholder welfare will prefer, *ceteris paribus*, to falsely inflate the trading price of the firm's shares. Put another way, the most fundamental conceit of the anti-vicarious liability critics – that fraud must be the product of managerial agency costs – is incorrect. Shareholders themselves might prefer "bad" corporate governance that causes managers to inflate firm value.

I next show that, given this incentive for the manager to commit fraud, there exists some level of vicarious liability that is perfectly deterrent (i.e., that neither over- nor under-deters) so long as not all shareholders sell their shares during the period of fraudulent price inflation. This is so because the manager maximizes aggregate shareholder payoffs, and since so long as the punishment reaches at least one shareholder, the enforcer can make threatened penalties arbitrarily large until the expected penalty balances out against the gain from fraud.<sup>3</sup>

I then turn to the properties of the particular form of vicarious liability that we have under Rule 10b-5 class actions. I begin by showing that Rule 10b-5 remedies are, when awarded, always perfectly compensatory in the sense that purchasers' net payoff is always zero.<sup>4</sup> This is true even though the expected penalty feeds back into stock price declines, such that the total price decline is greater than the shortfall in the firm's cash flows, and even though purchasers must participate in funding their own recovery. Additionally, I show that the 10b-5 remedy remains perfectly compensatory even where there are foreseeable costs of litigation that are borne by the firm; costs borne by the plaintiff (such as plaintiffs' attorneys' fees) do, however, make the remedy under-compensatory.

I next consider how the 10b-5 mechanism functions depending upon what information is verifiable in court. Perhaps most surprisingly, I show that the 10b-5 remedy is perfectly deterrent and compensatory in the case where the court can observe nothing except stock prices, and imposes liability for any stock price decline, whether or not fraudulent. The reason is that a rescissionary measure (which 10b-5 essentially is) is perfectly deterrent when always imposed

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<sup>1</sup>A more detailed review of these claims is included in the literature review of Section 1.2.

<sup>2</sup>Note that current shareholders are distinct from future shareholders who are not also current shareholders – whom I denote "purchasers" – whose payoffs managers do not internalize.

<sup>3</sup>This begs the question of why we care about deterring securities fraud in the first place. The short answer is that it can distort capital allocation, cause suboptimal ex ante investment in projects, and encourage superoptimal investments in fraud and anti-fraud technologies. These issues are well-described in Kahan (1992) and Mahoney (1996), and, as regarding deterring crime generally, Becker (1968).

<sup>4</sup>This is also (trivially) true in the ex ante sense, since, under rational expectations, purchasers are assumed to break even in expectation on their investments.

in the event of fraud, and given an inability to detect fraud, courts can deter fraud only by imposing the penalty always. I also show that the compensatory nature of the remedy is necessary to preserving fraud deterrence; in a regime where, say, the government keeps the fraud penalties, fraud is never deterred. The reason is that, when the compensatory element is removed, ex ante prices fall, which means that the low type firm now has more to gain from mimicking the high type of firm.

In the case where the court has some information about whether fraud was committed, and imposes fraud sanctions only where it is more likely than not that fraud occurred, deterrence is less than complete in that firms of low quality employ a mixed strategy of sometimes lying and sometimes not. Finally, I show that where courts are omniscient, 10b-5 is again perfectly deterrent and compensatory.

These findings have important implications for current proposals for securities litigation reform. First of all, the current focus on increasing sanctions on managers (as recent legislation such as Sarbanes Oxley has already done) is misplaced; fraud can arise from shareholder incentives. Second, centrally administered sanctions require that the government possesses a great deal of information about the firm in order to avoid over- or under-deterrence, which is almost certainly not true. In contrast, current remedies under 10b-5 are market-driven and, to a great extent, automatically adjust to preserve deterrence even where courts are highly incompetent. Third, I show that it is not necessarily evidence of a broken securities fraud regime that there is a substantial incidence of litigation or that litigation follows largely or even solely on price declines; indeed, securities litigation may be endemic where there is substantial or even complete deterrence. Finally, one should be concerned generally with the current reform proposals, since the criticisms in the legal literature on which those proposals are based are themselves ill-founded.

While all this is not to say that 10b-5 is not without its problems – indeed, it is hard to justify economically the need for a mandatory disclosure regime at all! – or that other liability mechanisms might be just as suitable or even better,<sup>5</sup> this paper presents at least a first step toward a proper economic evaluation of securities antifraud mechanisms. Perhaps as a matter of political economy, we are stuck with some system of mandatory disclosure and non-disclaimable securities fraud law; one should bear in mind that the status quo is not as bad as things might get, particularly in light of current reform proposals that amount to coercive federal corporate governance mandates enforced by threat of a lifetime in prison.

Section 1.1 of this paper provides a brief refresher on the functioning of the fraud on the market rule; Section 1.2 briefly surveys the major criticisms of the rule and notes how they appear to be winning the day in current legislative

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<sup>5</sup>One issue with vicarious liability is why should liability be borne by non-selling shareholders, as opposed to selling shareholders. While I do not consider the issue here, one suspects that we fine the firm rather than ex-shareholders because it is easier to fine one firm than potentially very numerous ex-shareholders, and because requiring ex-shareholders to remain possibly liable for years negatively impacts liquidity.

reform proposals. Section 2 specifies a rational expectations signaling model where managers signal private information to the market. Section 3 states some results concerning incentives to commit fraud and the effectiveness of vicarious liability. Section 4 then considers the functioning of 10b-5 liability based on different specifications of what the court can observe. Section 5 briefly concludes and outlines directions for future research.

## 1.1 A mini-review of 10b-5 fraud on the market

Rule 10b-5 and Section 10b of the Securities Exchange Act of 1934 make actionable material misstatements or omissions in the sale or purchase of securities, with a private right of action granted to investors by the Supreme Court in 1971 in *Superintendent of Ins. v. Bankers Life & Cas. Co.* Subsequent developments of legal doctrine allow multiple plaintiff claims to be aggregated into class actions, and, as implemented in the Supreme Court case of *Basic v. Levinson* in 1988, the efficient capital markets hypothesis creates a market test for the non-scienter elements of fraud (causation, reliance, materiality, and damages).<sup>6</sup> This market test is whether a change in stock price occurred at the time that information reached the market that corrected the misstatement or omission.<sup>7</sup> That is, making out a 10b-5 fraud on the market class action is largely a matter of conducting an event study on stock price movement around the time that the market learned of the fraud. Damages for each plaintiff are then the price drop of the corrective disclosure multiplied by the plaintiff's net change in position from the moment just before the fraud was committed to the moment just after the corrective disclosure occurred (this period is known as the "effective period" of the fraud).

An example will help to clarify to the operation of the rule. Suppose that at time 0, the firm's shares are trading at \$7. At time 1, the firm makes a disclosure to the market, and the firm's stock price rises to \$10. At time 2, it is revealed to the market that the firm's disclosure at time 1 was false, and the firm's stock price drops to \$6. If an investor's holding of stock at just before time 1 was 50 shares, and her holding of stock at just after time 2 is 75 shares, the investor would be entitled to recover damages of \$4 on each of 25 shares, for a total recovery of \$100. One can imagine more complicated scenarios where multiple frauds or corrective disclosures occur, but the basic story remains the same.

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<sup>6</sup>Scienter requires that the firm or its agents made the statement with the requisite intent to defraud (i.e., that they knew that the statement was untrue at the time of its making), although often-times in the corporate context this is more akin to a negligence standard since some agent of the firm generally knows of the misstatement, though not necessarily whether the misstatement is material.

<sup>7</sup>Prior to the Supreme Court's *Dura Pharmaceuticals* decision of 2005, a plaintiff could make out a fraud on the market claim with merely fraudulent price inflation, without having to show a stock price drop at the time of corrective disclosure. *Dura* appears to have made ex post declines a necessary element of a fraud on the market claim. See Spindler (2007b).

## 1.2 Prior literature: criticisms of fraud on the market

The literature on 10b-5 fraud on the market has not been kind. More or less every aspect of the fraud on the market mechanism has been impugned in some way: the compensatory function; the deterrent function; the actual calculation of damages; the adjudicative accuracy or "merits" of the lawsuits that are brought; the high transaction costs entailed; whether the targeted activity of secondary market fraud is actually harmful – all this has been widely questioned over the past decade or so in a vibrant legal literature written by some of the best and most prominent securities scholars in the nation.<sup>8</sup> In this subsection, I describe these arguments in brief.

Several scholars have taken up the increasingly popular position that the fraud on the market rule is not a proper deterrent, since it punishes innocent shareholders instead of the culpable executives who commit the acts of fraud. Critics of vicarious liability (Arlen and Carney 1992; Coffee 2006) have made the point that to the extent that managers benefit from fraud while shareholders do not, punishing the firm collectively is not helpful. An important line of argument advanced initially by Arlen points out that vicarious liability may in fact deter the firm from attempting to root out fraudsters for fear of civil liability (Arlen 1994; Arlen and Kraakman, 1997). While these commentators generally support private market solutions for combating fraud and other malfeasance (i.e., letting firms work things out themselves by scaling back fraud on the market liability), others have extended this argument to conclude that fraud is a result solely of managerial agency, and to call for increased public enforcement against executives (Alexander, 1996; Langevoort, 2007; Grundfest 2007).

The most fundamental criticism of the compensatory function of the fraud on the market mechanism is the argument that diversified investors do not benefit from securities liability on the premise that losses from fraud are diversifiable risk (Alexander, 1996 at 1502; Booth, 2005 at 1; Coffee, 2005, 2006; Fox 2005 at 529). The reasoning is that since a trader is just as likely to be on the winning side of a fraudulent transaction as the losing side, gains and losses ought to even out with a large number of trades. If that reasoning holds, then 10b-5 liability simply shifts money from one pocket of the investor to another, minus transaction costs.<sup>9</sup> This argument has led some to propose capping damages (Langevoort, 1996 at 642), having fraud fines collected by the SEC instead of private plaintiffs (e.g., Alexander, 1996), or moving instead to other forms of punitive public sanctions (e.g., Langevoort, 2007 at 633).

Another issue regarding compensation is that of the transactions costs involved in securities class actions (Alexander 1996; Coffee 2005 at 14-15; Coffee 2007; Grundfest 2007). Lawyers' fees, including plaintiffs' lawyers' cut of any award or settlement, are a significant portion of any transfer between the firm

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<sup>8</sup>Many of these criticisms actually find their earliest expression in Easterbrook and Fischel (1985), who nevertheless are unwilling to dismiss private securities litigation as fundamentally flawed. Later scholars have been much more critical of 10b-5.

<sup>9</sup>This view has filtered out into the general financial community as well: The Economist (May 27, 2006 at 72) magazine referred to securities class actions as "economic lunacy" because they "compensate shareholders with their own money."

and plaintiffs, and other costs such as distraction of management may be significantly higher. Private class actions are thought by some to exacerbate these costs, and that everyone (except perhaps for plaintiffs' lawyers) could be made better off by switching to a regime of public enforcement. Coffee (2007 at 16-19) suggests that total litigation costs could actually exceed plaintiff litigation recoveries.

There is then the question of whether, even if 10b-5 class actions would serve compensatory or deterrent functions given proper implementation, the mechanism implementing the recovery rule is somehow broken. A rather well-developed line of literature questions the merits of securities litigation (Alexander 1991; Bohn and Choi 1996; Perino 2003; Choi 2004), generally based upon empirical studies that have tried unsuccessfully to correlate incidence of securities settlements with some objective criteria of fraudulent behavior. Rather, litigation appears to follow almost inevitably on the heels of large share price declines, which has led some to decry 10b-5 as a scheme of "insurance" for investors who don't need it (Coffee, 2005 at 5).

A somewhat smaller line of literature questions whether the damages remedies afforded under 10b-5 class actions are correct. First, taking the pocket-shifting argument as a starting point, some scholars have argued that the 10b-5 measure of damages does not correspond to the social harm caused by secondary market fraud (Easterbrook and Fischel 1985, Mahoney 1996, Langevoort, 1996). That is, if a diversified trader simply diversifies away secondary market fraud risk, there is not necessarily an efficiency loss from that fraud. Alternatively, if trading losses are reimbursed under 10b-5, there is little incentive to invest in information gathering.

The second remedies criticism is that the 10b-5 measure of damages overcompensates plaintiffs (or at least overpunishes defendants) due to feedback effects, since prospective liability is itself bad news which lowers share price and thereby further increases the amount of prospective liability (this thesis is most strongly stated by Alexander 1994 and Booth 2007; with earlier but more agnostic statements by Easterbrook and Fischel 1985 at 638-9; Arlen and Carney 1992). If that is the case, then 10b-5 might be overdeterrent by construction, and hence chill useful disclosure of firm information. Alexander (1994) goes even further, claiming that 10b-5 damages are systemically overstated because share price declines incorporate not just the corrected information regarding the firm's cash flows, but also a "litigation put" (a positive value associated with the plaintiffs' right to recover their investment in some cases).

Taking some combination of these criticisms together, one can formulate any number of proposals for reform that would, on those terms, appear superior to private securities litigation. Alexander (1996), for instance, argues for a schedule of SEC administrative fines instead of private class actions. Langevoort (1996), finding 10b-5 overdeterrent and encouraging meritless suits, proposes a cap on damages against firms. Coffee (2005) and Mahoney (1996) favor strengthening pleading requirements to cut back on the incidence of suit. Grundfest (2007) prefers federal sanctions on individual executives, including jail terms, and Langevoort (2007) proposes mechanisms to leave malfeasant ex-

ecutives penniless. This is but a smattering of the various proposals that have surfaced in recent scholarship.

In any event, the critics seem to have been rather effective. The past two decades have seen a cutting-back of 10b-5, with reforms such as the Private Securities Litigation Reform Act of 1995 and the Securities Litigation Uniform Standards Act of 1998 (which together tighten class and pleading requirements and in some cases limit damages) and Supreme Court decisions such as *Dura Pharmaceuticals* and *Tellabs* that have eroded the private right of action against the firm by increasing evidentiary burdens. At the same time, there has been a growing trend toward public enforcement, as well as non-indemnifiable liability risk for individual agents of the corporation. Among other things, Sarbanes Oxley provides for SEC collection of penalties, mandates particular governance structures such as board composition and relationships with auditors, imposes enhanced reporting and certification responsibilities for managers, beefs up extant regulators and creates new ones (such as the Public Company Accounting Oversight Board), and imposes up to 25 year jail terms on managers for even minor reporting or fiduciary violations that need not have a material effect upon the firm's operations or share price. And many influential commentators are pushing for yet more along these lines; for example, in this spirit, a recent open letter from six prominent securities law professors to the SEC voiced several of these criticisms and urged further private securities litigation reforms (Langevoort et al. 2007). And the Paulson Committee Report (2006) also prominently recommends cutting back on private securities litigation for the sake of US capital markets' competitiveness, and repeats the pocket-shifting, deterrence, and transaction costs arguments.

## 2 The model: a simple signaling game without agency costs

In this Section, I formulate a model of vicarious liability for securities fraud (and, in particular, the fraud on the market rule) in a simple game where managers act altruistically with regard to the current shareholders of the firm. This set-up is meant to show explicitly how incentives for fraud exist, and how vicarious liability may help preserve truthful signaling, in a context where the manager maximizes shareholder welfare.

The way the model works is the following. In period 1, the firm owns a risky project, about which the manager receives a private but noisy signal. The manager can then reveal this signal to the market, or he can lie about it (for instance, disclosing a high value when the true signal was low). The manager discloses so as to maximize aggregate shareholder payoffs. Shareholders then make a decision to either hold their shares or sell them at the prevailing market price. All shares sold are bought by new investors in a competitive and rational capital market. In period 2, after the sale occurs, the firm realizes cash flows, and liability is assessed depending upon the level of cash flows as well as

other factors (I consider various specifications of how and when liability might be assessed in Section 4). Liability, if any, is assessed against the firm, and transferred to the purchasers. Based upon the expected liability, the economy finds an equilibrium where the manager's disclosure is credible (a separating equilibrium) or non-credible (a pooling equilibrium).

## 2.1 The economy

The economy in this model consists of a firm that owns a project, a manager,  $N$  shareholders who each own one of the firm's shares, a continuum of potential purchasers, and a liability mechanism that transfers wealth between the firm and purchasers.

### 2.1.1 The firm

At the start of period 1, the firm has  $N$  shares outstanding, which are owned by  $N$  shareholders. The firm owns a non-risky asset that is worth a constant  $\omega$  per share (normalized to zero)<sup>10</sup> and a risky project that produces cash flows of  $v$  in period 2. Cash flows  $v$  are distributed uniformly on the interval  $[0, \eta]$ , where  $\eta$  is either  $H$  (high) or  $L$  (low),  $H > L$ . The probabilities of  $\eta = H$  and  $\eta = L$  are common knowledge, and are denoted as  $\Pr(H)$  and  $\Pr(L)$ , where  $\Pr(L) = 1 - \Pr(H)$ . Penalties assessed against the firm are paid pro-rata by persons who own shares at the time the penalty is assessed in period 2 (i.e., shareholders who have sold in period 1 do not participate in funding the liability, but purchasers who bought in period 1 do). Liability per share assessed against the firm is denoted as  $l$ ; total liability is  $Nl$ .

### 2.1.2 Shareholders

Shareholders are risk-neutral investors; hence, utilities are written simply as payoffs. Each of the shareholders owns 1 share of the firm. In period 1, each shareholder can choose to either sell or hold her share. (The analysis is unchanged if shareholders are allowed to purchase additional shares, as I show in Appendix A). Shareholders who do not sell (henceforth, "non-selling shareholders") receive an expected payoff of  $U_N = E[v - \theta l]$ , where  $v$  is the cash flow per share,  $l$  is the measure of damages per share assessed under the fraud liability rule, and  $\theta$  is a function that determines whether fraud liability measure is imposed.<sup>11</sup> Selling shareholders ("selling shareholders") receive the payoff of  $U_{S_i} = p - c_i$ , where  $p$  is the trading price of the firm's shares after the manager's disclosure and  $c_i$  is the particular shareholder's cost of liquidating

<sup>10</sup>The risk-free asset  $\omega$  ensures that the firm will be solvent for a given level of share turnover. For simplicity of exposition, I normalize  $\omega$  to zero and allow the non-selling shareholder's payoff to be less than zero – bearing in mind that there is a maximum level of share turnover that can be supported.

One interpretation of  $\omega$  is that it is an element of returns that is not subject to the 10b-5 penalty and about which an informational asymmetry does not exist.

<sup>11</sup>For instance,  $\theta = 1$  means the court finds the firm liable,  $\theta = 0$  means it does not.

the share. The cost  $c_i$  may represent foregone returns, tax, transactions fees, or other costs of selling or of not holding the share;  $c_i$  may also be negative (for instance, if the shareholder has an immediate need for cash). What these costs do is to create a degree of heterogeneity among shareholders, which allows for trading among investors and the distinction between, say, long and short term investors.

I assume that the distribution of  $c_i$  is common knowledge; shareholders realize their particular values  $c_i$  after the manager's disclosure but before making the decision of whether to sell. A shareholder will therefore choose to sell her share if  $p - c_i > E[v - \theta l]$ . The fraction of shareholders who choose to sell their shares in period 1 is denoted as  $\pi$ .

### 2.1.3 The manager

In period 1, the manager receives a private signal  $\eta$ , which may be either  $H$  or  $L$ ; since  $v$  is distributed uniformly on  $[0, \eta]$ , the manager's signal has predictive power. The manager then makes a disclosure  $\eta'$ , which may be either truthful ( $\eta' = \eta$ ) or not ( $\eta' \neq \eta$ ).<sup>12</sup> In making his disclosure decision, the manager acts altruistically to maximize the sum of shareholders' ex post payoffs, which, incidentally, means ignoring the interests of future purchasers.<sup>13</sup> He thus takes into account the proportion  $\pi$  of shareholders who sell and who receive  $p - E[c_i]$ , and the proportion  $1 - \pi$  who do not sell and who receive  $E[v - \theta l]$ . The manager's objective function is thus

$$\max_{\eta'} E[\pi(p - c_i) + (1 - \pi)(v - \theta l) | \eta]$$

where  $p$ ,  $l$ , and  $\theta$  are each functions of the manager's signal.

### 2.1.4 Purchasers

Purchasers are risk-neutral agents who can purchase 1 share of the firm's stock in period 1. In period 2, if the liability mechanism operates, each purchaser receives a transfer  $t$ , which represents her share of the fraud remedy. However, since each purchaser now owns a share of the firm, the purchaser also participates in funding the liability award; that is, each purchaser has her payoff reduced by  $l$  in the event of liability.<sup>14</sup>

Purchasers draw inferences from the manager's signal under the particular liability regime, and break even in expectation given the manager's disclosure

<sup>12</sup>Henceforth for convenience I will denote high and low signals by  $H'$  and  $L'$  respectively.

<sup>13</sup>This assumption is equivalent to letting shareholders write a complete but unobservable contract with the manager. In either case, shareholders (or the manager) are unable to commit to not behaving opportunistically. Whether this is realistic is dubious given the resourcefulness of the market, but it is the assumption under which proponents of mandatory disclosure proceed.

On the issue of conflicts between present and future stakeholders, Greenwald and Stigler (1991) and Schwarcz (2005) provide earlier treatments.

<sup>14</sup>This is what is commonly referred to as the circularity of 10b-5 damages or "pocket-shifting," since purchasers both receive transfers and fund payment of 10b-5 liability.

(that is, the market efficiently prices the share given the available information). I will call this break-even condition the purchaser's individual rationality constraint ( $IR_P$ ) which is expressed formally as:

$$\alpha E[v + \theta(t - l) \mid H] + (1 - \alpha)E[v + \theta(t - l) \mid L] - p = 0 \quad (1)$$

The variable  $t$  is the transfer to the purchaser;  $l$  is the liability per share; and  $\theta$  is the "adjudication function" (described immediately below) which equals 1 if the firm is found liable, and zero if not. The term  $\alpha$  is the purchaser's subjective probability of the firm's being of type  $H$  given the manager's signal. For instance, in the case where the manager's signal perfectly identifies the type of firm (i.e., separating equilibrium),  $\alpha \in \{0, 1\}$ . In the case where the manager's signal is non-credible (i.e., pooling equilibrium), the purchaser derives no new information from the signal and  $\alpha = \Pr(H)$ .

### 2.1.5 The liability mechanism

In period 2, the firm realizes cash flows  $v$  per share from the risky project. Under the fraud on the market cause of action, purchasers can make out a claim for damages only where the price has fallen below the price at which they purchased. Damages under Rule 10b-5 are equal to the price the purchaser paid minus the price post-revelation of the fraud:  $p - p'$ , where  $p$  is the purchase price, and  $p'$  denotes the post-revelation share price. For a plaintiff purchaser, a fraud claim is only colorable where there has been a price decline, i.e.,  $p - p' > 0$ .<sup>15</sup> Even given a price decline, liability only operates where a court adjudges that fraud occurred. To capture the role of courts, I let  $\theta$  be an "adjudication function" that equals 1 when the court imposes liability, and 0 when it does not. I capture the necessity of price declines for liability by letting  $\theta = 0$  whenever  $p - p' \leq 0$ .<sup>16</sup> For example, under a strict liability regime where the firm is liable for any price decline,  $\theta = 1$  if  $p - p' > 0$ , and 0 otherwise.

We can express the post-revelation trading price  $p'$ , liability  $l$ , and transfer  $t$ , in terms of the other variables of the model. First, note that the operation of damages under 10b-5 is to award to defrauded purchasers a transfer  $t$  from the firm equal to the difference between the purchase price and the share price after the fraud is revealed,  $p - p'$ . Second, it must be the case that the transfer and the liability totals must balance (i.e., what the firm pays, the purchasers receive). Finally, the price of the share once the fraud is revealed,  $p'$ , adjusts

<sup>15</sup>This is the definition of "economic loss" that the Supreme Court enunciated in *Dura Pharmaceuticals*.

<sup>16</sup>Note that 10b-5 does allow damages from fraudulent price deflation, as where the managers disclose falsely low value to be able to purchase stock for themselves on the cheap. I do not consider those cases here, in part because they do not occur as often as price inflation, and because, when they do, it is under a different model of shareholder interaction than the instant one. For instance, Arlen and Carney (1992) report that only 8.7% of securities fraud on the market cases involve allegations of fraudulent price deflation, and that a significant portion of that 8.7% comprise management or controlling shareholder buyouts. While those are still important cases to consider, they are beyond the scope of this paper.

in an efficient market to take into account the realized cash flow net of the expected liability. We then have the following:

$$\text{Damages: } t = p - p' \tag{2}$$

$$\text{Balanced budget: } l = \pi t \tag{3}$$

$$\text{Post-liability price: } p' = v - l \tag{4}$$

This allows us to formulate the following proposition regarding the compensatory nature of damages under the fraud on the market regime:

**Proposition 1 *Perfect Compensation:*** *When the specific remedy of 10b-5 liability is assessed (i.e.,  $t = p - p'$ ;  $l = \pi t$ ), purchasers are made just as well off, and no better, than they were at the time of the purchase. This occurs even though "feedback effects" make the price decline upon the revelation of fraud ( $p - p'$ ) exceed the difference between purchase price and resulting cash-flows ( $p - v$ ).*

To show this, one starts by combining the identities of (2) and rearranging:

$$\begin{aligned} l &= \frac{\pi}{1 - \pi}(p - v) \\ t &= \frac{1}{1 - \pi}(p - v) \end{aligned} \tag{5}$$

Hence, the liability per share exceeds the shortfall of cash flows versus purchase price by a factor of  $\pi/(1 - \pi)$ .<sup>17</sup> Transfers per purchaser are higher than liability per share since the number of purchasers can never exceed the number of shares, such that  $t - l$ , the purchaser's net recovery from 10b-5, must always be positive.

Solving for the post-revelation share price,  $p' = \frac{1}{1 - \pi}(v - \pi p)$ . Note that the post-revelation share price is declining in  $p$ , and is decreasing in  $\pi$ . From this, we can see that the decline in share price will exceed by a factor of  $(1 - \pi)^{-1}$  the difference between the disclosed price  $p$  and the project's realized cash flows  $v$  - i.e., that there is indeed a "feedback effect" as noted by Booth (2007) and others:  $p - p' = (1 - \pi)^{-1}(p - v)$

However, one can show that this feedback effect results in perfect compensation to the purchasers. In the event of 10b-5 liability, the purchaser receives a share of the firm's cash flows, funds the liability, receives the transfer, and pays the purchase price:  $U_P = v - l + t - p$ . Substituting in, then, for  $l$  and  $t$ , one finds that in the event of 10b-5 liability, the purchaser receives  $U_P = 0$ . That is, the purchaser enjoys full ex post compensation.

It is worth a slight digression to illustrate what happens to ex post payoffs where the firm incurs costs from litigation.

<sup>17</sup>I previously noted this result in Spindler (2007b), comparing *ex ante* and *ex post* fraud remedies.

**Proposition 2** *Foreseeable costs of litigation that are borne by the firm do not affect the purchaser's full recovery.*

To see this, suppose that litigation costs the firm  $\varepsilon$ , and that these costs are foreseeable once the firm's fraud is revealed (i.e., it is known whether the firm will ultimately be held liable or not by the court). The market takes these costs into account in valuing the share, and the post liability share price is  $p' = v - l - \varepsilon$ . As before, the transfer is calculated by the court as  $t = p - p'$ , and liability  $l = \pi t$ . Putting these together we get  $l = \frac{\pi}{1-\pi}(p - v + \varepsilon)$ . The purchaser's net payoff with litigation costs is  $U_P = v - l - \varepsilon + t - p$ . Substituting in for  $l$  and  $t$ , we see that  $U_P = 0$ . That is, when the 10b-5 remedy is assessed, the remedy makes the defrauded purchaser whole ex post, inclusive of litigation costs borne by the firm.

Plaintiffs' attorneys' fees as a function of the transfer  $t$  do, however, affect purchaser compensation. Suppose that  $\varepsilon(t) = \varepsilon \cdot t$ , where  $\varepsilon$  is some fraction between 0 and 1. That would mean that a plaintiffs' attorney takes the fraction  $\varepsilon$  out of each transfer dollar each purchaser receives. In such a case, the purchaser's net payoff is  $U_P = v - l + (1 - \varepsilon)t - p = -\varepsilon \frac{p-v}{1-\pi}$ . One could, of course, fix this, if desired, by making firms responsible for plaintiffs' attorneys' fees. As shown below in Section 4.1.1, where compensation is incomplete, deterrence is affected.

### 2.1.6 Beliefs and the shareholder decision to sell

Shareholders choose to sell when the payoff from selling exceeds the expected payoff from holding the share. This depends, among other things, on the level of liquidation penalty the shareholder would incur from selling the share. Specifically, shareholder  $i$  will sell if  $U_{S_i} = p - c_i > U_N = E[v - \theta l]$ . Thus, there exists some cut-off threshold  $c^*$  above which shareholders choose to hold, and below which shareholders choose to sell. Rearranging,  $c^* = p - E[v - \theta l]$ .

The cut-off  $c^*$  must always be greater than zero since the price  $p$  will take into account the right of recovery for purchasers of the share, such that  $p$  will exceed the expected value of the share's future cash flows,  $E[v]$ . Substituting in for  $l$ , the cutoff is:

$$c^* = p \left( \frac{1 - \pi + \pi E[\theta]}{1 - \pi} \right) - E \left[ v \left( \frac{1 - \pi + \pi \theta}{1 - \pi} \right) \right]$$

Note that the cutoff  $c^*$  is increasing in  $\pi$ . This means that as the proportion of shareholders who sell increases, the cutoff below which one chooses to sell also increases. A shareholder's beliefs about what other shareholders believe in terms of selling behavior matters: if everyone else is going to sell, then the shareholder should sell, too, since being the last one holding the bag carries a very large penalty.<sup>18</sup> If  $\pi = 1$ , then  $l = t$ , and separating equilibrium is un-

<sup>18</sup>This is a rational panic scenario, where the belief that other agents are panicking makes it rational to panic oneself (for instance, in a bank run, given that other depositors are withdrawing their deposits, running on the bank is the rational thing to do).

sustainable (purchasers are merely suing themselves, so there is no longer any meaningful anti-fraud deterrent). For a separating equilibrium to result, there must not only be an adequate distribution of liquidation costs, but shareholders must have appropriate beliefs about the behavior of their fellow shareholders given that distribution. More specifically, for any level of  $\pi$ , there is a distribution of finite liquidation costs  $c_i$  that will support equilibrium if shareholders believe that  $\pi$  is the actual level of shareholder selling.<sup>19</sup>

On a different point, the distribution of  $c_i$  may affect the manager's decision-making: a higher price raises  $c^*$ , which means that shareholders are going to incur more liquidation costs than they otherwise would (i.e., a higher price leads to more wasteful churning). This constitutes an additional incentive to the altruistic manager to disclose low. While this effect may not be large, it significantly complicates the math. I will therefore make a simplifying assumption on the distribution of  $c_i$ , namely, that if  $c_i < c^*$ , then  $c_i \leq 0$ .

## 2.2 Summary timeline

Summing up the above, the game proceeds in the following steps:

1. The manager (who acts as the shareholders' altruistic alter ego) receives a private but noisy signal of the firm's value,  $\eta \in \{H, L\}$ , where the cash flow per share of the firm's risky project  $v$  is uniformly distributed on the interval  $[0, \eta]$ .
2. The manager issues a report regarding firm value,  $\eta'$ , which may be true ( $\eta' = \eta$ ) or not ( $\eta' \neq \eta$ ).
3. Shareholders learn  $c_i$  (their personal liquidation cost), after which shareholders may choose to sell their shares.
4. Price  $p$  is determined in a competitive capital market where purchasers break even in expectation. Purchasers purchase all shares offered by selling shareholders.
5. Cash flow  $v$  is publicly realized.

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<sup>19</sup>Suppose, for example, that  $\eta = 1$  and  $\theta = 1$ . For measure .1 of shareholders, let  $c_i = 0$ , while for measure .9,  $c_i = .6$ . If beliefs are that  $\pi = .1$ , then  $c^* \approx 0.56$ , and, indeed, under these beliefs exactly .1 of shareholders would choose to sell. However, given that same distribution of  $c_i$ , shareholders could instead believe that  $\pi = 1$ , in which case  $c^* = \infty$ , and all shareholders choose to sell. Thus, both  $\pi = .1$  and  $\pi = 1$  are possible in a rational expectations equilibrium, depending upon the beliefs of shareholders.

I do not show the analysis here, but the cutoff  $c^*$  is unchanged letting  $\omega > 0$ ; i.e.,  $c^*$  is not a function of  $\omega$ . This means that, as a percentage of expected firm value, the requisite liquidation costs are a decreasing function of  $\omega$ . While requisite liquidation costs may seem improbably high in relation to just  $E[v]$  (in this example,  $c^* > E[v]$ ), they are much more realistic in comparison to  $E[\omega + v]$ . One interesting possibility is that if  $c_i$  is an increasing function of  $\omega$ , then shareholders can always commit to not completely selling out by contributing more capital to the firm.

6. The fraud is publicly revealed, in the sense that  $\theta$  is publicly realized, and the post-revelation stock price  $p'$  is publicly realized.
7. Liability  $l$  and transfers  $t$ , if any, are assessed and made.

### 2.3 Equilibrium

Stating this game formally, the manager chooses a report  $\eta'$  to maximize shareholder payoffs:

$$\max_{\eta'} E[\pi p + (1 - \pi)(v - \theta l) \mid \eta] \quad (6)$$

subject to the purchasers' break-even (individual rationality) constraint

$$IR_P : \alpha E[v + \theta(t - l) \mid H] + (1 - \alpha)E[v + \theta(t - l) \mid L] - p \geq 0$$

where  $\alpha$  is the purchaser's updated Bayesian probability that the manager's private signal was  $H$ . If, in equilibrium, high and low value firms disclose identically (a "pooling equilibrium"), the signal contains no information. In that case, purchasers learn nothing new from the disclosure, and so  $\alpha = \Pr(H)$ . On the other hand, if, in equilibrium, high firms disclose  $H$  and low firms disclose  $L$  (a "separating equilibrium"), purchasers are fully informed of firms' underlying quality. With separation,  $\alpha = 1$  if  $\eta' = H$ , and  $\alpha = 0$  if  $\eta' = L$ .

In order for a separating equilibrium to occur, it must be the case that the manager prefers to signal so as to reveal truthfully his information. This must be true both where the manager receives a high signal  $H$  (the high value firm) and where the manager receives the low signal  $L$  (the low value firm). Formally, these constraints are:

$$IC_L : E[\pi p_L + (1 - \pi)(v - \theta l) \mid L \cap L'] \geq E[\pi p_H + (1 - \pi)(v - \theta l) \mid L \cap H']$$

$$IC_H : E[\pi p_H + (1 - \pi)(v - \theta l) \mid H \cap H'] \geq E[\pi p_L + (1 - \pi)(v - \theta l) \mid H \cap L']$$

The first constraint,  $IC_L$ , is the incentive compatibility constraint for a low-value firm, which requires that a low value firm will not prefer to mimic a high-value firm (which receives the high-value firm price,  $p_H$ ). That is, expected payoffs are higher given low quality ( $L$ ) and a low signal ( $L'$ ) than given low quality and a high signal ( $H'$ ). The second constraint,  $IC_H$ , is the incentive compatibility constraint for a high value firm, which requires that a high-value firm will not prefer to mimic a low-value firm. These constraints will be satisfied or not depending upon, in particular, the adjudication function  $\theta$ , as described in Section 4.

### 3 Deviant corporate governance and vicarious liability

Here, I will state some general results concerning the effectiveness of vicarious liability as a deterrent. The first is that incentives for securities fraud exist even where the manager perfectly represents the interests of shareholders, maximizing aggregated shareholder payoffs:

**Proposition 3 *Deviant Corporate Governance:*** *Absent liability, fraud is Pareto-optimal among the set of shareholders.*

To see this, recall from Section 2.1.2 that the ex ante expected utility of the selling shareholder is  $U_{S_i} = p - c_i$ , and that of the non-selling shareholder is  $U_N = E[v - \theta l]$ . If there is no liability,  $\theta l = 0$ , and  $U_N = E[v]$ . From this, one can see that selling shareholders do better, and non-selling shareholders do no worse, where the price of the share  $p$  is higher. Thus, shareholders would choose to set  $p$  as high as possible, all else being equal. What this is saying is that shareholders are no different than the seller in any sort of commercial transaction, who prefers a higher price to a lower one. Given a manager who maximizes aggregate shareholder payoffs, firms will tend to commit fraud.

Note that this result is in accord with Arlen and Carney's (1992) empirical finding that the vast majority of frauds involve price inflation; the cause of this fraud is not, however, agency costs, as Arlen and Carney suggest.

**Corollary 4** *Absent liability, a pooling equilibrium is the only possible equilibrium.*

What happens when there exists no liability? Shareholders prefer to disclose fraudulently, and both low and high firms will disclose high. However, purchasers know that they can no longer attach any credibility to shareholder disclosures, and a pooling equilibrium results where the price that purchasers will pay is the prior-weighted expected value of the firm:  $p = \Pr[H] \cdot \frac{1}{2}H + \Pr[L] \cdot \frac{1}{2}L$ .<sup>20</sup> While the instant model has nothing to say about efficiency per se, pooling is likely to be inefficient as it can result in adverse selection, suboptimal investment in projects, and supraoptimal investments in information.

The next proposition states that some level of vicarious liability can always serve to properly deter fraud:

**Proposition 5 *Effectiveness of Vicarious Liability:*** *If at least one shareholder does not sell ( $\pi < 1$ ), then there exists some level of vicarious liability such that separation is an equilibrium outcome.*

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<sup>20</sup>One must also consider what happens when purchasers observe disclosure that is off the equilibrium path, namely, if a firm discloses  $\eta' = L$ . If purchaser beliefs are that disclosure of low either indicates low quality or conveys no information, then the pooling equilibrium is stable.

This is apparent from an examination of the incentive compatibility constraints  $IC_L$  and  $IC_H$ . Rearranging and combining these constraints, in a separating equilibrium it must be the case that

$$E[\theta l|L \cap H'] - E[\theta l|L \cap L'] \geq \frac{\pi}{1-\pi}(p_H - p_L) \geq E[\theta l|H \cap H'] - E[\theta l|H \cap L']$$

For this to hold, it must be that  $p_H - p_L \in (-\infty, \infty)$ , which means that there must be some bounds on  $p_H$  and  $p_L$ . Substituting in from the  $IR_P$  constraint that  $p_\eta = E[v + \frac{1-\pi}{\pi}\theta l|\eta \cap \eta']$ , this condition may be rewritten as:

$$E[\theta l|L \cap H'] - E[\theta l|H \cap H'] \geq \frac{\pi}{1-\pi}(E[v|H] - E[v|L]) \geq E[\theta l|L \cap L'] - E[\theta l|H \cap L']$$

This condition is easily met, in theory if not in practice, since the regulator can fix the fraud penalty at a high level and the non-fraud penalty at a low level (for instance, let  $E[\theta l|L \cap H'] = E[\theta l|H \cap L'] = \infty$ , and  $E[\theta l|L \cap L'] = E[\theta l|H \cap H'] = 0$ ). Thus, vicarious liability is a theoretically sound means of deterring securities fraud.<sup>21</sup>

Of course, this does not tell us about whether a vicarious liability scheme, such as 10b-5, is implementable given what the court can observe. The example of setting fraud penalties to infinity works if fraud is perfectly detectable, but probably not otherwise. Whether the specific 10b-5 remedy is implementable in a fashion that deters fraud is the focus of the next Section.

## 4 Efficacy of the 10b-5 remedy under limited verifiability

As shown in Proposition 5, vicarious liability has the potential to create a separating equilibrium. Whether it can do so depends upon the particular liability rule used. Ultimately, any process for finding liability will be limited by what the court can observe. So, for instance, if the court observes everything, including the manager's private knowledge, perfect enforcement is possible. But in the more plausible case that the court cannot observe everything, the court must work with what it has. I consider three particular classes of adjudication functions defined by what the court might or might not be able to observe.

First, I consider adjudication functions where the court can observe only the transaction price  $p$ , the resulting share price  $p'$ , and the proportion of shares sold  $\pi$ . These are the most eminently feasible set of adjudication functions, since they require nothing more from the court than subtracting  $p'$  from  $p$  and assessing that, multiplied by the number of plaintiffs' shares, against the firm. I

<sup>21</sup>In the case of limited liability, in order for the firm to be solvent, there is an additional condition for vicarious liability to work: there must be an adequate value of the risk-free asset  $\omega$  to pay out on claims made against the firm. Presumably a firm could bond itself, if it chooses, by having its shareholders put in more money to purchase more  $\omega$ .

show that under strict liability (where firms are always liable for declines), separation occurs, but that under partial strict liability (where fraud is discovered or liability assessed only part of the time), it never occurs. Similarly, separation will fail where damages are arbitrarily capped. I show, however, that separation may occur under partial strict liability where firms incur litigation costs. I also show that where 10b-5 is replaced with a non-compensatory system of fines, to reach a separating equilibrium requires that the court have access to much more information than under 10b-5.

Second, I consider the possibility that the court can also observe the firm's signal  $\eta'$  and the prior probabilities  $\Pr[H]$ , and also draw inferences about the reporting strategies that firms follow (Bayesian updating).<sup>22</sup> Since strict liability ensures separation, it is unsurprising that separation can occur where the court has received additional information. I show, however, that making adjudications based upon a "preponderance of the evidence" (i.e., a more than 50% likelihood of fraud) results in only partial separation, where low firms employ a mixed strategy of sometimes lying and sometimes not.

Third, I consider the possibility that the court can observe everything. Not surprisingly, this leads to perfect enforcement and perfect separation. In such a case, other liability regimes, such as infinite penalties for fraud, would work just as well.

## 4.1 Minimal verifiability: prices

### 4.1.1 Strict liability: $\theta = 1$

One criticism of fraud on the market litigation has been that it amounts to a scheme of insurance, where firms are made liable for insuring the price of their shares; this is generally thought to be bad (Coffee, 2005).<sup>23</sup> While such a scheme of strict liability is counter, perhaps, to the scienter requirements of the law, it is easy to show that, whatever its other demerits, it still yields a separating equilibrium.

**Proposition 6 *Effectiveness of Strict Liability:*** *Even if courts can only observe prices,  $p$  and  $p'$ , separation is still attainable by letting  $\theta = 1$  for  $p' < p$ ,  $\theta = 0$  otherwise.*

To model the effect of a price insurance scheme, let  $\theta = 1$  if  $p' < p$ , and  $\theta = 0$  otherwise: i.e., the firm is liable to purchasers whenever the share price declines. From (2) and (5),  $p' < p \Leftrightarrow v < p$ . If separation were to occur, the prices are calculated from the following form of the purchaser's break-even constraint:

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<sup>22</sup>Whether the court can observe the firm's signal in a meaningful sense is questionable; translating a firm's disclosure into a price or a ranking requires the court to undertake analysis of the firm's fundamentals, a task for which the court is not generally qualified.

<sup>23</sup>In Spindler 2007a, I note that strict liability in the IPO context destroys value as it prohibits the transfer of risk from risk-averse entrepreneur to risk-neutral investor. The IPO context is different than secondary trading, since the latter involves investors on both ends of the transaction, both of whom are diversified and effectively risk-neutral.

$$\begin{aligned}
IR_P & : \int_0^\eta v \frac{f(v)}{F(\eta)} dv + \int_0^{\min\{p_\eta, \eta\}} \theta(p_\eta, \eta, v) \cdot (p_\eta - v) \frac{f(v)}{F(\eta)} dv - p_\eta = 0 \\
& \Leftrightarrow p_\eta = \eta
\end{aligned}$$

That is, purchasers are willing to pay the maximum of the firm's potential cash flows,  $\eta$ , since under a fully compensatory regime, they would always get back whatever they pay.<sup>24</sup>

One must then check to make sure that these prices satisfy the manager's incentive compatibility constraints. Starting with the low type's incentive compatibility constraint,  $IC_L$ ,

$$\begin{aligned}
IC_L & : \pi p_L - \pi \int_0^{\min\{p_L, L\}} (p_L - v) \frac{f(v)}{F(L)} dv \geq \pi p_H - \pi \int_0^{\min\{p_H, L\}} (p_H - v) \frac{f(v)}{F(L)} dv \\
& \Leftrightarrow L - \frac{L}{2} \geq H - \left( HL - \frac{L^2}{2} \right) \frac{1}{L} \Leftrightarrow \frac{L}{2} \geq \frac{L}{2}
\end{aligned}$$

which means that the low-type firm will always weakly prefer to report its true type.

Turning to the high-type's incentive compatibility constraint,  $IC_H$ ,

$$\begin{aligned}
IC_H & : \pi p_H - \pi \int_0^{\min\{p_H, H\}} (p_H - v) \frac{f(v)}{F(H)} dv \geq \pi p_L - \pi \int_0^{\min\{p_L, H\}} (p_L - v) \frac{f(v)}{F(H)} dv \\
& \Leftrightarrow H - \frac{H}{2} \geq L - \left( L^2 - \frac{L^2}{2} \right) \frac{1}{H} \Leftrightarrow (H - L)^2 \geq 0
\end{aligned}$$

which is always true, meaning that the high-type firm will always prefer to report its true type.

Thus, a scheme of price insurance results in full separation. It is, in other words, an adequate deterrent to fraud. It is also fully compensatory: purchasers of shares, who would otherwise lose out due to the inflated purchase price of the shares, are completely compensated by the liability and transfer scheme. On the other side of the coin, shareholders gain ex ante exactly zero from fraud: their expected gain from selling at a fraudulent price ( $E[\pi(p - v)]$ ) is exactly offset by the expected loss from fraud in the event that they do not sell ( $E[(1 - \pi)(\theta \frac{\pi}{1 - \pi}(p - v))]$ ). Thus, the claim that 10b-5 liability merely shifts dollars from one pocket of the shareholder to the other (Booth 2005, Economist 2006) is simply not correct; there is a divergence of interest between current shareholders and purchasers which makes some fraud deterrent necessary to allow separation to occur. For instance, if  $\theta = 0$ , then both types of firms would report  $H$  since

<sup>24</sup>In fact, purchasers would be willing to pay up to  $\infty$ . However, if there is an infinitesimal expected cost to paying a higher price (e.g., a plaintiffs' lawyers' fee of 1 penny), the limit of what purchasers will pay goes to  $\eta$  as that cost goes to 0.

there is no penalty for lying. A scheme of full price insurance perfectly remedies that divergence of interest.

It is worth noting that this is a readily implementable scheme of liability: a court simply assigns liability based on share price movements. Transaction costs would be very low, since if the burden of proof is simply to point to a share price drop, it seems reasonable to suppose that legal fees and court costs would be minimal. However, it is true that under strict liability, litigation is constantly occurring: here, even with separation, the probability that the realized cash flows are less than the transaction price  $p_H = H$  or  $p_L = L$  is 1, since the firm prices its shares at the upper limit of its potential cash flows. This implies, perhaps, that a significant volume of litigation is not necessarily indicative of a failed disclosure regime, which cuts against the merits literature's view that settlement absent indicia of fraud is evidence of 10b-5's broken-ness (Alexander 1991; Bohn and Choi 1996; Perino 2003; Choi 2004).

**What happens under a non-compensatory regime?** It is worth asking at this point, what would happen if instead of using liability assessed against the firm to compensate purchasers, the government simply kept the money or threw it away? In such a case, separation does not occur, because prices are depressed to the point where the low firm does better disclosing high, as this allows the firm's shareholders the ability to capture more of the potential upside of their firm. Thus, deterrent and compensatory effects are interrelated: removing the compensatory nature of the 10b-5 mechanism (i.e., letting  $t = 0$ ,  $l = p - p'$ ) under-deters fraud and results in pooling.

Suppose that liability is assessed in the same way, by subtracting ex post price from ex ante price and multiplying by the number of shares transacted:  $t = p - p'$ ,  $l = \pi t$ , except that purchasers' ex post payoff is now  $P_P = v - l - p_\eta$ . That is, they do not receive the liability transfer  $t$ ; instead, the government keeps it. In this counterfactual case, incidentally, the critics' claim would be correct that purchasers suffer from liability assessed against the firm.

Using the  $IR_P$  constraint to figure prices and substituting in with  $l = \frac{\pi}{1-\pi}(p - v)$  from the above, we have

$$\begin{aligned} & \eta^{-1} \int_0^\eta v dv - \eta^{-1} \int_0^p \theta \frac{\pi}{1-\pi} (p_\eta - v) dv - p_\eta = 0 \\ \Rightarrow & p_\eta = \eta \cdot \frac{\sqrt{1-\pi} - (1-\pi)}{\pi} \end{aligned}$$

Note that the price is decreasing in  $\pi$ , with a minimum of  $p_\eta = 0$  when  $\pi = 1$  and  $\lim_{\pi \rightarrow 0} p_\eta = \frac{1}{2}\eta$ . Price will always be depressed below the expected value of the firm's cash flows.

In order to have a separating equilibrium, the incentive compatibility constraints of both the high and low firms must be satisfied. Starting with the low firm:

$$IC_L : \pi p_L - \pi L^{-1} \int_0^{p_L} (p_L - v) dv \geq \pi p_H - \pi L^{-1} \int_0^{\min\{p_H, L\}} (p_H - v) dv$$

By working through this inequality, we can see that the low firm never chooses to report truthfully. In the case where  $p_H > L$ , rearrangement and substitution of the inequality yields that the firm reports truthfully only if  $p_L - \frac{1}{2}L - \frac{1}{2}p_L^2 L^{-1} \geq 0$ , which can never be true since  $\lim_{\pi \rightarrow 0} p_\eta = \frac{1}{2}\eta$ .

In the case where  $p_H < L$ , rearrangement yields that the low firm will disclose truthfully only where  $p_H + p_L \geq 2L$ , which can also never be true since  $p_H > p_L$  and by assumption  $p_H < L$ . Thus, there is never separation where the government does not use the liability  $l$  to compensate purchasers.

What this example shows, then, is that the compensatory function of 10b-5 is inextricably intertwined with the deterrent function. By taking the transfer  $t$  away from the purchaser, deterrence (in the form of a separating equilibrium) has been fouled up: the depressed ex ante purchase price means that the low firm has more to gain, and less to lose, from falsely reporting than it did where the compensatory nature of 10b-5 affected share prices ex ante.

#### 4.1.2 Partial strict liability and damages caps

What happens when the enforcement mechanism operates as strict liability, but only sometimes? In other words, suppose that there is only some constant probability of being found liable given a price decline, which is less than one. We would expect the price to be lower, since purchasers will fail to be compensated as completely for their losses, and ex ante will be willing to pay less. Thus, arbitrarily limiting remedies under 10b-5 leads to under-deterrence and pooling.

The purchaser's  $IR_P$  constraint again gives a quadratic term which we can solve to obtain  $p_\eta$  for the separating case.

$$IR_P : \int_0^\eta v \frac{f(v)}{F(\eta)} dv + \int_0^{p_\eta} \theta (p_\eta - v) \frac{f(v)}{F(\eta)} dv - p_\eta = 0 \quad (7)$$

$$\Rightarrow p_\eta = \eta \cdot k, \text{ where } k \equiv \frac{(1 - \sqrt{1 - \theta})}{\theta} \in \left(\frac{1}{2}, 1\right) \text{ for } \theta \in (0, 1)$$

The term  $k$  is always less than 1, which implies that  $p_\eta$  is always less than  $\eta$ .

We then check to see if this  $p_\eta$  satisfies the  $IC_L$  constraint.

$$IC_L : p_L - \int_0^{\min\{p_L, L\}} \theta (p_L - v) \frac{f(v)}{F(L)} dv \geq p_H - \int_0^{\min\{p_H, L\}} \theta (p_H - v) \frac{f(v)}{F(L)} dv$$

There are two possible variants of this constraint that must be considered. First, if  $p_H > L$ , the condition is

$$\frac{\theta}{L} \left[ \int_0^L (p_H - v) dv - \int_0^{p_L} (p_L - v) dv \right] \geq p_H - p_L$$

$$\Leftrightarrow \frac{\frac{(1 - \sqrt{1 - \theta})}{\theta} - \frac{1}{2}\theta - \frac{1}{2}\theta * \left(\frac{(1 - \sqrt{1 - \theta})}{\theta}\right)^2}{\frac{(1 - \sqrt{1 - \theta})}{\theta} * (1 - \theta)} = \frac{1}{2}k^{-1} \geq H/L$$

Since  $H/L > 1$ , this can never be true for the range of  $\theta \in (0, 1)$ , since  $k^{-1}$  must always be less than 2.

We can then check whether  $IC_L$  is satisfied where  $p_H \leq L$ . If  $p_H < L$ , the condition is

$$p_L - \frac{\theta}{L} \int_0^{p_L} (p_L - v)dv \geq p_H - \frac{\theta}{L} \int_0^{p_H} (p_H - v)dv$$

$$\Leftrightarrow \frac{1}{2}L^{-1}\theta(p_H + p_L) \geq 1$$

Since  $p_H, p_L < L$ , the above is true only if  $\theta \geq 1$ , which is a contradiction. Thus, if  $\theta$  is a fixed constant that is less than 1, there is no separating equilibrium since the low value firm always gains from reporting  $H$ .

This result is essentially the same as for a price cap on class action damages, a reform that has been proposed by some including Langevoort (1996). Supposing that courts limit damages in some cases to a maximum amount, such that the purchaser enjoys full recovery for some level of cash flows  $v > \bar{v}$  such that  $l = l(v)$ , but that damages are capped such that the liability assessment  $l = l(\bar{v})$  for any  $v < \bar{v}$ . It is unsurprising that since strict liability perfectly internalizes fraud, any arbitrary departure therefrom will have distortive effects upon firm behavior.

**Indeterminate liability** One complication is whether the ex post share price  $p'$  is set before or after the adjudication function  $\theta$  is determined. That is, if  $p'$  is determined when  $\theta$  has been realized (liability will either be assessed or it won't), then the adjustment of the ex post price and the liability mechanism operate so as to make the purchaser whole. However, if  $p'$  is determined when there is only some expectation regarding  $\theta$ , then  $p' = v - E[\theta l]$ , and it follows that the purchaser's recovery will be lower than in the former case.

More specifically, if  $p'$  is determined with only the expectation of  $\theta$  known, then (assuming that  $\theta$  is not a function of  $v, \pi, p$ ), the post revelation trading price is  $p' = v - E[\theta l]$ . Consequently, liability is  $l = \frac{\pi}{1 - \pi E[\theta]}(p - v)$ ,  $t = l/\pi$ .

The purchaser's ex post payoffs are then  $P_P = v - \frac{1 - \pi}{1 - \pi E[\theta]}(p - v) - p$ . We can write the  $IR_P$  constraint under separation as:

$$E[P_P] = \eta^{-1} \int_0^{\eta} vdv + \eta^{-1} \int_0^{p_\eta} \tilde{\theta}(p - v)dv = p_\eta$$

where  $\tilde{\theta} \equiv \theta \frac{1 - \pi}{1 - \pi E[\theta]}$ . This yields a price of  $p_\eta = \tilde{k} \cdot \eta$ , where  $\tilde{k} \equiv \tilde{\theta}^{-1}(1 - \sqrt{1 - \tilde{\theta}})$ .

This does not really change the results from the partial strict liability case described above, since  $\theta$  simply translates into a somewhat smaller  $\tilde{\theta}$ , and a pooling equilibrium will result for any  $\theta < 1$ . It does, however, mean that purchasers are not made quite whole, even when liability is assessed.

### 4.1.3 Partial strict liability with a litigation penalty or manager fines

In reality, litigation is not costless. Firms are required to pay attorneys to defend them, managerial time and effort is diverted, and plaintiffs' attorneys

may take a sizeable chunk of any award or settlement that is assigned. Because of the large litigation costs that we observe in real life, some observers have questioned the compensatory function of the fraud on the market mechanism, as well as the ability of such a system to provide useful deterrence against fraud (e.g., Coffee 2007). Indeed, it is apparent that where litigation costs are sufficiently large, firms will do anything to avoid litigation, including disclosing a fraudulently low report (i.e.,  $\eta'(H) = L$ ). But is a moderate level of litigation penalty always such a bad thing? As shown above in Section 2.1.5, foreseeable litigation costs borne by the firm *do not* affect the compensatory nature of the fraud on the market remedy. I show in this subsection that litigation penalties may support separation where it would not have otherwise existed. Additionally, in the complete contracting framework here, penalties imposed upon the manager are equivalent to penalties imposed upon the firm because the firm would always indemnify the manager.<sup>25</sup>

Suppose that  $\theta < 1$  (a partial strict liability scheme which, as shown above, would not ordinarily result in separation), and that a per-share litigation penalty of  $\varepsilon > 0$  is incurred by the firm when it is successfully sued. Since there is full recovery inclusive of the litigation costs borne by the firm, this means that the purchaser's break-even constraint  $IR_P$  is unchanged from the prior case, so that  $p_\eta = \eta \cdot k$ , where  $k$  is defined as above:  $k \equiv \frac{(1-\sqrt{1-\theta})}{\theta}$ . Since  $\theta < 1 \Rightarrow p_\eta < \eta$  (as shown in eq.(7)), the low firm's incentive compatibility constraint is:

$$IC_L : p_L - \int_0^{p_L} \theta(p_L - v + \varepsilon) \frac{f(v)}{F(L)} dv \geq p_H - \int_0^{\min\{p_H, L\}} \theta(p_H - v + \varepsilon) \frac{f(v)}{F(L)} dv$$

If  $p_H < L$ , this becomes:

$$\begin{aligned} & L^{-1}\theta \left[ (p_H)(p_H + \varepsilon) - \frac{1}{2}p_H^2 - \frac{1}{2}p_L^2 - \varepsilon p_L \right] \geq p_H - p_L \quad (8) \\ \Leftrightarrow & \underbrace{\varepsilon \cdot L^{-1}\theta(p_H - p_L)}_{E[\Delta \text{ litigation penalty}]} \geq \underbrace{p_H - p_L}_{\Delta \text{ revenue}} - \underbrace{L^{-1}\theta \frac{1}{2}(p_H^2 - p_L^2)}_{E[\Delta \text{ liability}]} \\ \Leftrightarrow & \varepsilon \geq \frac{L}{\theta} - \frac{1}{2}(p_H + p_L) \end{aligned}$$

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<sup>25</sup>Here there actually is a distinction between an altruistic manager and a self-interested manager with whom the shareholders write an unobservable but complete contract. In the former, fines on the manager simply have no effect. In the latter, fines on the manager are litigation penalties that are borne by the firm.

If  $p_H > L$ , the  $IC_L$  constraint is

$$\begin{aligned}
p_L - L^{-1}\theta \int_0^{p_L} (p_L - v - \varepsilon)dv &\geq p_H - L^{-1}\theta \int_0^L (p_H - v - \varepsilon)dv \\
\underbrace{\varepsilon \cdot L^{-1}\theta(L - p_L)}_{E[\Delta \text{ litigation penalty}]} &\geq \underbrace{p_H - p_L}_{\Delta \text{ revenue}} - \underbrace{L^{-1}\theta[Lp_H - \frac{1}{2}L^2 - \frac{1}{2}p_L^2]}_{E[\Delta \text{ liability}]} \\
\varepsilon &\geq \frac{L}{\theta(L - p_L)} \left( p_H - p_L - \frac{1}{L}\theta \left( Lp_H - \frac{1}{2}L^2 - \frac{1}{2}p_L^2 \right) \right)
\end{aligned}$$

Since  $p_\eta = \eta \cdot k$ , these two conditions become

$$\begin{aligned}
(1) \quad p_H < L &\Rightarrow \varepsilon \geq \left[ L - \underbrace{(1 - \sqrt{1 - \theta})}_{\in(0,1)} \left( \frac{H + L}{2} \right) \right] \theta^{-1} \\
(2) \quad p_H > L &\Rightarrow \varepsilon \geq \frac{(H - L) \cdot k - \theta \left( Hk - \frac{1}{2}L - \frac{1}{2}Lk^2 \right)}{\theta(1 - k)}
\end{aligned}$$

As there is a penalty being levied on disclosing a higher value, we need also to check the incentive compatibility constraint of the high-type firm, since for a large enough  $\varepsilon$ , firms would prefer to disclose a lower value in order to avoid costly litigation. Turning to the high-type firm's incentive compatibility constraint,  $IC_H$ , knowing that under partial price insurance  $p_H < H$  and  $p_L < H$ :

$$\begin{aligned}
p_H - \frac{\theta}{H} \int_0^{p_H} (p_H - v + \varepsilon)dv &\geq p_L - \frac{\theta}{H} \int_0^{p_L} (p_L - v + \varepsilon)dv \\
\Leftrightarrow \varepsilon &\leq \frac{H}{\theta} - \frac{1}{2}k(H + L)
\end{aligned}$$

So, for  $p_H < L$ , we have that separation occurs where

$$\varepsilon \in \left[ \frac{L}{\theta} - \frac{1}{2}k(H + L), \frac{H}{\theta} - \frac{1}{2}k(H + L) \right] \quad (10)$$

and it is apparent (by adding  $\frac{1}{2}k(H + L)$  to both bounds) that a level of litigation penalty exists such that separation will occur. For  $p_H > L$ , we have separation where

$$\varepsilon \in \left[ \frac{(H - L) \cdot k - \theta \left( Hk - \frac{1}{2}L - \frac{1}{2}Lk^2 \right)}{\theta(1 - k)}, \frac{H}{\theta} - \frac{1}{2}k(H + L) \right] \quad (11)$$

This second interval exists for all  $\theta \in (0, 1)$ .<sup>26</sup>

<sup>26</sup>We can see this by operating upon the inequality:

This subsection demonstrates several things. First, the 10b-5 fraud on the market remedy is perfectly compensatory even taking into account litigation costs borne by the firm; this does, however, except plaintiffs' attorneys' fees, which do affect plaintiff recoveries.

Second, even for a scheme of partial strict liability (i.e.,  $\theta \in (0, 1)$ ), there exists a range of litigation penalties that ensures separation; outside of this range ensures pooling. This means that litigation penalties borne by the firm can actually be either helpful or hurtful in the securities class action context, since they can provide an extra deterrent to both fraudulently high and truthfully high reporting.

Third, note that, given the complete contracting framework in which this model takes place, a penalty levied on the manager would have the same effect as a litigation penalty levied upon the firm as a whole. That is, the firm simply indemnifies the manager for any fines incurred, as the firm and manager negotiate back to their joint optimum. Thus, the effect of instituting or increasing agent liability is simply to cause indemnification thereof, which has an identical effect to other sorts of litigation costs: it can encourage separation in some cases where the increased fine pushes the litigation costs into the range of  $\varepsilon$  specified above, but it can also lead to pooling when those fines push  $\varepsilon$  outside of those bounds.

**Manager penalties only, no compensation** Since a criticism of the 10b-5 remedy has been that managers are responsible for fraud and that therefore penalties should be levied upon managers rather than firms, one might ask what would happen if we abandoned the 10b-5 remedy in favor of a schedule of managerial penalties only. With complete contracting, the manager will be indemnified for any fines  $J \cdot N$  that he is required to pay, such that there is a cost to each share of  $J$ . Where there is no 10b-5 rule, litigation costs will in fact affect purchaser recoveries, such that purchasers really are worse off where the manager is fined. Assuming  $\theta = 1$ , the  $IR_P$  constraint is:

$$\begin{aligned} \eta^{-1} \int_0^\eta v dv - \eta^{-1} \int_0^{p_\eta} J dv - p_\eta &= 0 \\ \Rightarrow p_\eta &= \frac{1}{2} \eta \cdot \frac{\eta}{J + \eta} \end{aligned} \quad (12)$$

Note that prices are depressed below the value of the cash flows in this case, since the purchasers have a net negative expected payoff from the fine  $J$ .

$$\begin{aligned} \frac{(H - L) \cdot k - \theta (Hk - \frac{1}{2}L - \frac{1}{2}Lk^2)}{\theta \cdot (1 - k)} &\leq \frac{H}{\theta} - \frac{1}{2}k \cdot (H + L) \\ \Leftrightarrow H \left[ \underbrace{2k - 1 - k\theta - \frac{1}{2}k^2\theta}_{-} \right] + L \left[ \underbrace{\frac{1}{2}\theta + \frac{1}{2}k\theta - k}_{-} \right] &\leq 0 \end{aligned}$$

which is always true for  $\theta \in (0, 1)$ .

Because of the complexity of the  $p_\eta$  formulation, it will be more instructive to temporarily normalize  $L$  to zero. The low firm's incentive compatibility constraint  $IC_L$  is

$$0 \geq \pi p_H - (1 - \pi)J$$

Plugging in for  $p_H$  from eq(12), we get that  $IC_L^H$  is satisfied only if

$$J \geq \frac{1}{2}H \left( \sqrt{\frac{1+\pi}{1-\pi}} - 1 \right) \quad (13)$$

The high firm's incentive compatibility constraint  $IC_H^L$  is

$$\begin{aligned} \pi p_H + (1 - \pi)H^{-1} \left[ \int_0^H v dv - \int_0^{p_H} J dv \right] &\geq (1 - \pi)H^{-1} \int_0^H v dv \quad (14) \\ \Leftrightarrow J &\leq \frac{\pi}{1 - \pi} H \end{aligned}$$

From eqs(13) and (14), separation will occur only if  $J \in \left[ \frac{1}{2}H \left( \sqrt{\frac{1+\pi}{1-\pi}} - 1 \right), \frac{\pi}{1-\pi}H \right]$ .

There are a few notable things about this outcome. First, purchasers are made worse off ex post by the imposition of the manager fines  $J$ . Second, prices  $p_\eta$  are depressed below the expected value of the firm's cash flows in order to satisfy the purchasers' ex ante break-even constraint. Third, even if the fine  $J$  is allowed to be variable, courts (or whoever is administering the fine) must have at their disposal quite a lot of information in order to ensure a separating equilibrium: the court must know  $L$ ,  $H$ , and  $\pi$ . (Note that, in comparison, the bounds of the separation-supporting  $\varepsilon$  in (11) does not have  $\pi$  as an argument.)<sup>27</sup> Post-revelation declines in price will not be informative: the decline in share price is  $p - p' = \frac{1}{2}\eta \cdot \frac{\eta}{J+\eta} - v + J$ , which leaves the court with two unknowns and one equation, so conditioning the fine  $J$  on the degree of price drop will not work. Either too high or too low a fine causes the breakdown of the separating equilibrium, and it seems doubtful that a court or administrator with limited information could keep fines within the necessary bounds.

## 4.2 Moderate verifiability: prices, priors, and strategies

### 4.2.1 Likelihood ratio cutoff strategy

The adjudication functions so far (other than perfect enforcement) have assumed that courts or administrators know very little: only prices. One might suppose, however, that courts have (or can get) a little more information: if courts can formulate a prior of firm quality and can observe the firm's signal and cash flows,

<sup>27</sup>While this model does not incorporate incomplete contracting, under such a framework, the government would be required to know even more information to impose its penalty correctly.

then it is possible to draw some inference about whether it is more likely than not that fraud was committed. The court would set a cut-off level  $v^*$  of cash flows such that any cash flow below  $v^*$  results in a determination of liability if the firm reported  $H$ , while any result at or above  $v^*$  does not. To determine whether the firm is liable, the court asks whether it is more likely than not that the report of  $H$  was false, i.e.,

$$\Pr[L|v \cap H'] > 1/2 \quad (15)$$

Applying Bayes' Rule,

$$\Pr[L|H' \cap v] = \Pr[H' \cap v|L] \Pr[L] / \Pr[H' \cap v]$$

The court takes into account the low firm's likelihood of lying: the low-type firm reports  $H'$  fraction  $\sigma$  of the time, and  $L'$  fraction  $(1 - \sigma)$  of the time (i.e.,  $\Pr[H'|L] = \sigma$ ). To compute this value, first note that the numerator term  $\Pr[H' \cap v|L]$  is equal to the probability that a low firm reports high times the probability that a low firm that reports high generates a cash flow of  $v$ :

$$\begin{aligned} \Pr[H' \cap v|L] &= \Pr[H'|L] \cdot \Pr[v|H' \cap L] \\ &= \Pr[H'|L] \cdot \Pr[v|L] \\ &= \sigma \cdot L^{-1} \end{aligned}$$

The second equality results from the fact that the reporting strategy of the firm does not affect cash flows  $v$ .<sup>28</sup>

The denominator term  $\Pr[H' \cap v]$  is equal to the probability of a high report times the probability of cash flow  $v$ :  $\Pr[H'] \cdot \Pr[v]$ . One can calculate  $\Pr[H']$  since we know that low firms lie with probability  $\sigma$  and high firms always tell the truth:

$$\begin{aligned} \Pr[H'] &= \Pr[H'|L] \cdot \Pr[L] + \Pr[H'|H] \cdot \Pr[H] \\ &= \sigma \cdot \Pr[L] + 1 \cdot \Pr[H] \end{aligned}$$

The likelihood of cash flows  $v$  is

$$\begin{aligned} \Pr[v] &= \Pr[v|L] \Pr[L] + \Pr[v|H] \Pr[H] \\ &= L^{-1} \Pr[L] + H^{-1} \Pr[H] \end{aligned}$$

Putting this all together, the probability that the high reporting firm is actually a low-type firm given cash flow  $v$  is then

$$\begin{aligned} \Pr[L|v \cap H'] &= \frac{\underbrace{\sigma \cdot L^{-1}}_{\Pr[H' \cap v|L]} \cdot \Pr[L]}{\underbrace{(\sigma \cdot \Pr[L] + \Pr[H])}_{\Pr[H']} \cdot \underbrace{(L^{-1} \Pr[L] + H^{-1} \Pr[H])}_{\Pr[v]}} \text{ for } v \leq L \\ \dots \text{or} &= 0 \text{ for } v > L \end{aligned}$$

<sup>28</sup>To be fully rigorous, the probability of any given  $v$  is zero, but since we have  $\Pr[v|L]$  in the numerator and  $\Pr[v]$  in the denominator we use the ratio of the probability density functions.

Note that  $v$  is not an argument of the probability function, except for whether  $v$  is greater or less than  $L$ ; if  $v > L$ , the firm must have been a high type firm and the probability of fraud is zero. This means that the cutoff  $v^*$  at which the court determines liability must be either  $L$  or zero. Suppose first that the cutoff is zero: in such a case, the low firm always lies since there is never any liability for doing so;  $\sigma = 1$  and

$$\begin{aligned}\Pr[L|v \cap H'] &= \frac{L^{-1} \cdot \Pr[L]}{(\Pr[L] + \Pr[H]) \cdot (L^{-1} \Pr[L] + H^{-1} \Pr[H])} \leq \frac{1}{2} \\ \Leftrightarrow \Pr[H] &\geq \frac{H}{H+L}\end{aligned}$$

That is, if the probability of a the firm being of high type is sufficiently large, then it is always more likely than not that the firm reporting high is, in fact, of high type. In that case,  $v^* = 0$  and  $\sigma = 1$  in a pooling equilibrium.

Suppose, however, that  $\Pr[H] < \frac{H}{H+L}$ . If the court used  $v^* = 0$  as its cutoff, low firms would always lie, and the probability of fraud given a high report and  $v < L$  would be greater than  $1/2$ . Thus,  $v^* = 0$  is not an equilibrium and the court's cutoff strategy would have to be  $v^* = L$ , which amounts to a regime of strict liability for low-type firms and which (as we have seen above) makes low-type firms indifferent to lying. In such a case, low firms can play a mixed strategy, meaning that  $\sigma$ , the probability of lying, takes on any value  $\sigma$  such that  $\Pr[L|v \cap H'] > 1/2$ .

$$\begin{aligned}\Pr[L|v \cap H'] &= \frac{\sigma \cdot L^{-1} \cdot \Pr[L]}{(\sigma \cdot \Pr[L] + \Pr[H]) \cdot (L^{-1} \Pr[L] + H^{-1} \Pr[H])} > 1/2 \\ \Leftrightarrow \sigma &> \frac{\{H(1 - \Pr[H]) + L \Pr[H]\} \cdot \Pr[H]}{(-La + Ha + H) \cdot (1 - \Pr[H])}\end{aligned}$$

We have a mixed strategy equilibrium, then, where  $\sigma \in \left( \frac{\{H(1 - \Pr[H]) + L \Pr[H]\} \cdot \Pr[H]}{(-La + Ha + H) \cdot (1 - \Pr[H])}, 1 \right)$  and  $v^* = L$ .

What does this result tell us? First of all, the 10b-5 remedy works to sustain a mixed separating equilibrium in a setting where courts are Bayesian updaters. Second, even where a court has available to it more information, cash flows and price declines are still important evidence in determining whether or not fraud has been committed.<sup>29</sup> This means that correlation between price declines and lawsuits is to be expected under a well-functioning anti-fraud rule; it is not necessarily evidence of "meritless" litigation. Third, where a court employs a preponderance of the evidence standard, there will still be some incidence of fraud and litigation, perhaps significantly so depending upon the parameter values of the model. This happens because the court, which is a Bayesian

<sup>29</sup>This would be true even in a more complicated model where the court gets a noisy signal of the firm's type which it uses to update its prior expectation: the realized cash flow  $v$  still contains important information.

updater, will never assess liability where firms play strict separating strategies, which leads low firms to lie. One could always reduce the degree of fraud by decreasing the evidentiary burden required to establish guilt, if one wished. In any event, a fairly high incidence of litigation is not necessarily a symptom of a broken anti-fraud regime.

### 4.3 Full verifiability: perfect enforcement

Suppose that courts are able to verify the manager's private signal  $\eta$  and that the rule is to impose liability whenever a low type firm claims to be of high type. If that is the case, then  $IR_P$  yields separated prices of  $p_H = H/2$  and  $p_L = L/2$ , since, if everyone tells the truth, there is never any successful litigation; thus, a purchaser's payoff is just the expected cashflows of the firm,  $E[v] = \eta/2$ .

Since the high-type firm never faces any penalty if it reports high, but enjoys a higher price for doing so, the high-type firm never lies.

If the low type firm discloses truthfully, it is never liable. Any time that the low type firm reports falsely, it faces  $\theta = 1$  in the event that cash flows fall short of  $p_H$ .

$$IC_L : \pi p_L + (1 - \pi) L^{-1} \int_0^L v dv \geq \pi p_H + (1 - \pi) \left[ \int_0^L v L^{-1} dv - \int_0^{\min\{p_H, L\}} \frac{\pi}{1 - \pi} (p_H - v) L^{-1} dv \right]$$

If  $p_H < L$ , then the  $IC_L^H$  constraint is always strictly satisfied. If  $p_H > L$ , then the  $IC_L^H$  constraint is weakly satisfied. Thus, under a regime of perfect enforcement, 10b-5 functions to perfectly deter fraud.

## 5 Conclusions and future research

The model I present in this paper questions much of the common wisdom regarding the causes of corporate fraud, the role of vicarious liability, and the efficacy of 10b-5 class actions. I show that fraud may arise from shareholder incentives, since shareholders are, in aggregate, sellers of the firm's shares and thus may prefer corporate governance that tends to inflate the firm's price. For this brand of fraud, I show that vicarious liability is a proper form of deterrence mechanism. In particular, I show that 10b-5 functions well in terms of both deterrence and compensation, and requires very little in terms of verifiability (i.e., what the court can observe) in order to operate. In contrast, the proposed substitutes – damages caps, SEC-administered fines, disallowing investor recovery, and manager penalties – may perform worse and often require that the court/regulator has much more information at its disposal. This model is therefore a direct challenge to the extant criticisms of 10b-5 and to the commonly heard proposals for its replacement.

There are several directions along which one may expand this analysis. It remains to be shown how 10b-5 functions when managerial moral hazard and limited contracting are included; for instance, where the manager's compensation contract consists of an equity stake. Additionally, the model could easily

accommodate unobservable managerial effort, and this would be one way, perhaps, to highlight efficiency losses from overbearing liability placed upon the manager.

But, in any event, the implications of the simple model presented here are clear and noteworthy. 10b-5 does not appear to be as bad, at least at first blush, as everyone says it is. Several alternatives to 10b-5 appear to be markedly worse. More analysis is required, but the framework of this model provides a useful starting point.

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## A Allowing shareholders to be buyers as well as sellers

Suppose that shareholders can hold more than one share, and that they may choose to buy an additional share. We can write the proportions (probabilities) of selling, holding, and buying as  $\pi_s$ ,  $\pi_h$ , and  $\pi_b$ , respectively. Shareholders who purchase an additional share receive the transfer from that additional share when fraud liability is assessed, and pay the liability on both the old and new shares.

**Proposition 7 *Shareholders Are Always Net Sellers:*** *Even if shareholders can purchase an additional share of stock, assuming that total liability and transfers must balance, the manager's problem of maximizing aggregate shareholder payoffs can be expressed as a problem where shareholders only sell or hold shares.*

Assuming that the manager maximizes aggregate shareholder payoffs, and suppressing  $c_i$ , the manager's objective function is

$$\max_{\eta'} \pi_s p_{\eta'} + \pi_h E[v - \theta l | \eta] + \pi_b E[v - \theta l | \eta] + \pi_b E[v - \theta l + \theta t - p_{\eta'} | \eta]$$

That is, a shareholder who buys an additional share has the payoffs of both a nonselling shareholder and a purchaser.

If transfers balance liabilities (i.e.,  $l = \pi_s t$ ), the expression becomes:

$$\max_{\eta'} \pi_s p_{\eta'} + \pi_h E[v - \theta l | \eta] + \pi_b E[v - \theta l | \eta] + \pi_b E[v + \frac{1 - \pi_s}{\pi_s} \theta l - p_{\eta'} | \eta]$$

Note that  $v$  is not a function of  $\eta'$ , and therefore does not affect the manager's maximization problem. Rewriting without  $v$ , the expression is:

$$\max_{\eta'} \pi_s p_{\eta'} + \pi_h E[-\theta l | \eta] + \pi_b E[-\theta l | \eta] + \pi_b E[\frac{1 - \pi_s}{\pi_s} \theta l - p_{\eta'} | \eta]$$

Reallocating terms, this becomes:

$$\max_{\eta'} (\pi_s - \pi_b) p_{\eta'} + \left( \pi_h + \pi_b - (1 - \pi_s) \frac{\pi_b}{\pi_s} \right) E[-\theta l | \eta]$$

Utilizing the fact that  $\pi_h + \pi_b = 1 - \pi_s$ , we have:

$$\max_{\eta'} \underbrace{(\pi_s - \pi_b)}_{+} p_{\eta'} + \underbrace{(\pi_h + \pi_b)}_{+} \left( 1 - \frac{\pi_b}{\pi_s} \right) E[-\theta l | \eta]$$

Note that the coefficients of both terms are positive. This follows since it must be that  $\pi_s \geq \pi_b$  in order for markets to clear: the number of sellers has

to equal the number of buyers, and purchasing shareholders are only a subset of all purchasers. Thus, this is a weighted average of payoffs. Letting  $\tilde{\pi} \equiv \frac{\pi_s - \pi_b}{(\pi_s - \pi_b) + (\pi_h + \pi_b)(1 - \frac{\pi_b}{\pi_s})}$ , and putting back in the  $v$  terms, this may be rewritten as

$$\max_{\eta'} \tilde{\pi} p_{\eta'} + (1 - \tilde{\pi}) E[v - \theta l | \eta]$$

which is equivalent to a manager's maximization problem where shareholders may only sell or hold.