Price Drop Damages

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ABSTRACT

Assessing damages is often hard. When a reference asset—like stock—that is affected by misconduct trades in a liquid market, there is an appealing shortcut: *price drop damages*. The logic is simple: a court can leverage the fact that the price of this asset will reflect the consensus view among market participants of harm caused by the misconduct. But because market prices also reflect the expected value of any legal remedy, price drop damages are biased. We develop a simple model that allows us to characterize the magnitude and direction of this bias. We show that price drop damages understate harm when the expected net award flowing to purchasers of the reference asset positive, as in a corporate derivative case. In contrast, when the net recovery is negative, as in a securities fraud case, they overstate harm. Our analysis thus identifies, and offers a means to weigh contextually, an overlooked downside to leveraging the wisdom of crowds.

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Introduction

Assessing damages is often hard. For example, consider a controlled corporation that announces a maneuver that will reduce the set of legal rights available to minority stockholders. If a court of competent jurisdiction holds that the controller's actions were unlawful, what is the appropriate remedy?

Vice Chancellor Laster confronted a version of this question in a recent case.[1] One option was for the court to directly assess the dollar value of the change in the stockholders' legal rights. Doing so would have required testimony from dueling experts bearing competing models, each piled high with assumptions about all the ways that one or the other state's law would affect the value of the minority stockholders' shares. As VC Laster aptly put it, all this "would be hard."[2]

Happily, there was a ready alternative: damages would equal the amount by which the price of the company's stock dropped when investors learned of the transaction (controlling for changes in the prices of comparable stocks during the same period). After all, the affected shares traded in a liquid market. Insiders who knew the announcement was coming were barred from trading ahead of it, limiting the extent of leakage. And the details of the reorganization were such that there were no material procedural or legal bars that would have prevented it from going forward.[3] Under these circumstances, the court had a "sufficiently reliable basis to craft a monetary award for any harm" that the maneuver might cause.[4]

In relying on market-based measures, VC Laster was on firm legal and conceptual ground. The standard paradigm in academic finance, the efficient market hypothesis, holds that the price of an asset that trades in a liquid market reflects available information about its value.[5] This implies that prices respond quickly and in an unbiased fashion to new information. In the 1980s, economically sophisticated lawyers and legal academics began to see an implication for law. If putatively actionable conduct was more or less unanticipated and affects a reference asset that trades in an efficient market, econometricians can use changes in the price of that reference asset to back out investor con-

[1] *Palkon v. Maffei*, 311 A.3d 255, 262 (Del. Ch. 2024) ("*TripAdvisor*") (denying plaintiff minority shareholders' bid to enjoin TripAdvisor's redomestication to Nevada), cert. denied, No. 2023-0449-JTL, 2024 WL 1211688 (Del. Ch. Mar. 21, 2024), and rev'd, No. 125, 2024, 2025 WL 384054 (Del. Feb. 4, 2025).

[2] *Id.* at 285.

[3] *Id.* at 286.

[4] *Id.*

[5] While behavioral finance has nibbled around the edges, the efficient market hypothesis has remained the dominant paradigm in finance economics since it rose to prominence in the 1960s. For an early review of the theory and evidence supporting the paradigm, see generally, Eugene F. Fama, *Efficient Capital Markets: A Review of Theory and Empirical Work*, 25 J. Fin. 383 (1970).

sensus about the magnitude of the harm from the conduct.[6]

Over the decades that followed, what was once an academic dream has increasingly become a reality in litigation. What we call *price drop damages* first took hold, and has taken hold most completely, in securities fraud cases,[7] but they are appealing whenever a reference asset bears the incidence of cognizable wrongdoing that is otherwise hard to measure. They are attractive because they are relatively cheap to implement and, representing as they do the aggregated wisdom of many motivated investors, may be less error-prone than alternative feasible methods of estimation.

But there's a problem with the logic of price drop damages. Semi strong form efficiency is not limited to the direct implications of a particular piece of news. Rather, market prices reflect the market's best guess about *all* its consequences. Because of this, when the misconduct is revealed, rational investors will impound *both* the harm from the misconduct *and* any expected legal consequences (as well as any other foreseeable collateral consequences). When these legal consequences include a damages award, the expected value of any net damages will be reflected in the initial drop.[8] This recursive structure means that price drop damages are systematically biased. Importantly, this bias does not stem from measurement problems or challenges to market efficiency. Rather, it follows from the very logic behind price drop damages: the claim that market prices impound the consequences of new information.

To show this, we develop a very simple model of price drop damages that allows us to parameterize the direction and magnitude of this bias (relative to the intrinsic harm that the damages award is meant to remedy). As our model makes clear, both depend on context-specific features of remedial law that have little if anything to do with a case's merits or the extent of the harm. The key factor is whether a person who buys the reference asset after the harm has come to light expects to benefit from a recovery or, alternatively, expects to pay for it. Consider, for example, "derivative" as against "direct" procedures for asserting a shareholder fiduciary claim. The line dividing the two kinds of claims can sometimes be murky,[9] but they entail a formal, remedial difference.

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[6] See, e.g., Daniel R. Fischel, *Use of Modern Theory in Securities Fraud Cases Involving Actively Traded Securities*, 38 Bus. Law. 1 (1982). We discuss the academic case more infra.

[7] The Supreme Court's decision in *Dura Pharmaceuticals, Inc. v. Broudo*, 544 U.S. 336 (2005), may have effectively required econometric evidence of a price drop for a case under Rule 10b-5 to defeat a motion for summary judgment.

[8] Stated differently, there is no acoustic separation between the wrongful conduct and remedial law. For the classic discussion of the problems this creates, see Meir Dan-Cohen, *Decision Rules and Conduct Rules: On Acoustic Separation in Criminal Law*, 97 Harv. L. Rev. 625 (1984).

[9] In Delaware, *Tooley v. Donaldson, Lufkin, & Jenrette, Inc.*, 845 A.2d 1031 (2004), offers the canonical but to some extent question-begging distinction. Derivative theories posit injury to the corporate entity, while direct theories posit injury to the suing shareholder's interests *qua* shareholder. Many applications are straightforward, but some are not.

In a derivative case, damages flow to the corporate entity and thus benefit investors who buy shares (the reference asset in question) after the misconduct comes to light.[10] In a direct case, by contrast, damages go to a class of investors that excludes new purchasers. This turns out to be the key factor in the direction of the bias inherent in price drop damages.

Our analysis has several payoffs. First, we provide a general framework for analyzing the impact of this form of recursiveness on price changes. Scholars in the field of securities regulation have long understood that stock price drops after an issuer makes corrective disclosure may reflect so-called "collateral damage" not traceable to the amount by which actionable deception had inflated the price,[11] including the company's share of any damages.[12] But, perhaps because the magnitude of bias in the securities fraud context is likely to be minimal, this awareness has not, to our knowledge, yielded a formal model, much less one that is general enough to accommodate other contexts and litigation structures.

Second, we outline the features of a claim that determine the direction and magnitude of the bias and offer a means through which, at least in theory, courts can correct for the bias inherent in price drop damages. We use plausible back-of-the-envelope parameter values to estimate the bias in two important settings: corporate derivative cases and securities fraud class actions. Our estimates suggest that price drop damages are likely to entail a large bias in the former setting—on the order of perhaps 1/3 of intrinsic harm—but a

[10] The *TripAdvisor* case discussed above was brought as a derivative claim.

[11] See e.g. Allen Ferrell and Atanu Saha, *The Loss Causation Requirement for Rule 10b-5 Causes of Action: The Implications of Dura Pharmaceuticals, Inc. v. Broudo*, 63 Bus. Law. 163, 181-85 (2007) (coining the term "collateral damage"); Bradford Cornell and James C. Rutten, *Collateral Damage and Securities Litigation*, 2009 Utah L. Rev. 717, 719 (2009) (claiming that "[t]he reaction to a corrective disclosure will commonly exceed—often by a large amount—the inflation caused by the original misstatement"); Richard A. Booth, *OOPs! The Inherent Ambiguity of Out-of-Pocket Damages in Securities Fraud Class Actions*, 46 J. Corp. L. 319 (2021) (arguing that collateral damage ought to be recoverable by derivative suit against misbehaving executives rather than through a securities fraud theory).

[12] Janet Cooper Alexander seems to have been the first to point out this specific issue some thirty years ago. See Janet Cooper Alexander, *The Value of Bad News in Securities Class Actions*, 41 UCLA L. Rev. 1421, 1435–40 (1994) (explaining that change in stock price after revelation of faulty disclosure should reflect assessments of the issuer's likely litigation costs and the value of a bar on subsequent purchasers' rights to sue for nondisclosure, in addition to the significance of new information for the company's future profitability); Janet Cooper Alexander, *Rethinking Damages in Securities Class Actions*, 48 Stan. L. Rev. 1487, 1492 n. 12 (1996) (noting that change in stock price after revelation of faulty disclosure could include factors other than the value increment attributable to new information, "such as the anticipated litigation costs to the company and the extinguishment of subsequent purchasers' right to sue over nondisclosure"). In a much more recent empirical working paper, Adam Callister estimates the magnitude of collateral damage in securities fraud litigation. Adam Callister, *Pricing in Securities Fraud* (Aug. 1, 2025) (working paper).

small one in the latter. In securities cases, given all the other factors at play, alternatives to price drop damages are likely to do more harm than good.

Finally, our model allows us to investigate the normative implications of price drop damages. In contexts in which bias is likely to be large, price drop damages can meaningfully understate harm and so deter misconduct suboptimally. This points to a tradeoff between the bias inherent in price drop damages and the challenges associated with alternative (typically direct) measures of damages. Because it can be calibrated to different legal contexts, our model can shed light on this tradeoff.

This paper contributes to several distinct strands of literature. Most obviously, it contributes to the longstanding literature that use formal models to shed light on core features of corporate law.[13] Second, it contributes to the voluminous literature on the use of event studies in securities law generally, and in securities fraud in particular.[14] Third, our paper relates to a growing literature studying fees in corporate and securities law.[15] Even more broadly, our paper contributes to the vast literature on damages, including optimal damages. Finally, our model serves as a reminder to scholars of law and finance: the arguments that support the use of stock price reactions to measure corporate and other events doesn't stop with the event itself.[16]

[13]For a recent example of this, see Ryan Bubb, Emiliano Catan & Holger Spamann, *Shareholder Rights and the Bargaining Structure in Control Transactions*, Working Paper (Sep. 3, 2024), available at `https://ssrn.com/abstract=4929197`.

[14]Examples include Sanjai Bhagat & Roberta Romano, *Event Studies and the Law: Part II: Empirical Studies of Corporate Law*, 4 Am. L. & Econ. Rev. 380 (2002); Michael J. Kaufman & John M. Wunderlich, *Regressing: The Troubling Dispositive Role of Event Studies in Securities Fraud Litigation*, 15 Stan. J.L. Bus. & Fin. 185 (2009); Jonah B. Gelbach, Eric Helland & Jonathan Klick, *Valid Inference in Single-Firm, Single-Event Studies*, 15 Am. L. & Econ. Rev. 495 (2013); Alon Brav & J.B. Heaton, *Event Studies in Securities Litigation: Low Power, Confounding Effects, and Bias*, 93 Washington U.L. Rev. 583 (2015); Andrew C. Baker, *Single-Firm Event Studies, Securities Fraud, and Financial Crisis: Problems of Inference*, 68 Stan. L. Rev. 1207 (2016); Jill E. Fisch, Jonah B. Gelbach & Jonathan Klick, *The Logic and Limits of Event Studies in Securities Fraud Litigation*, 96 Tx. L. Rev. 553 (2018); Taylor Dove, Davidson Heath & J.B. Heaton, *Bias-Corrected Estimation of Price Impact in Securities Litigation*, 21 Am. L. & Econ. Rev. 184 (2019); Jill E. Fisch & Jonah B. Gelbach, *Power and Statistical Significance in Securities Fraud Litigation*, 11 Harv. Bus. L. Rev. 55 (2021); Adriana Z. Robertson, Pat Akey & Mikhail Simutin, *Noisy Factors in Law*, 92 U. Chicago L. Rev. 769 (2025).

[15]Some recent contributions to this literature include Joseph A. Grundfest & Gal Dor, *Lodestar Multipliers in Delaware and Federal Attorney Fee Awards* Working Paper (Apr. 30, 2025), available at `https://ssrn.com/abstract=5237545`, Joseph A. Grundfest & Gal Dor, *Raising the Federal Eyebrow: The Incidence of Multipliers of Seven or More in Federal Class Action Fee Awards* Working Paper (Feb. 24, 2025), available at `https://ssrn.com/abstract=5152397`, Stephen J. Choi, Jessica M. Erickson & A.C. Pritchard, *Paying for Performance? Attorneys' Fees in Securities Fraud Class Actions* 21 J. Empirical L. Stud. 899 (2024).

[16]Our paper contributes to a thread in the corporate finance literature exploring the implications of "feedback"—that is, the equilibrium consequences of the fact that investors

The remainder of this paper proceeds as follows. Part I introduces price drop damages, as well as the conceptual and legal settings in which they arise. Part II presents our baseline model. Part III applies it to two settings: shareholder derivative litigation against corporate fiduciaries (Section III.A) and securities fraud class actions (Section III.B). In each setting, we use plausible parameter values to illustrate the likely magnitude and direction of the resulting bias. Then, in Section III.C, we adapt our model to parameterize optimal stock drop damages. In Part IV, we discuss the broader implications of our model. We then briefly conclude.

I. The Use of Price Drop Measures

In general, there are two ways for a court to assess the economic harm to the value of some asset.[17] The traditional approach is, we might say, direct. The fact finder hears evidence about what the plaintiffs' asset would have been worth but for the asserted injury and about what it is actually worth, and damages equal the difference. This task can become complicated. When the asset in question relates to a business enterprise, direct measurement often means sorting through a number of contestable assumptions and modeling decisions by expert witnesses about the future cash flows and risk profile of that business. In some situations, there is no practical alternative. But in others, an indirect approach may be available feasible. If a reference asset trades in a reasonably liquid market,[18] at least in principle, the fact finder can rely on changes in the market price of that asset as an objective measure of the economic harm. The logic is that of an event study, where the event is the news that the actionable harm has occurred. If the only thing that changes between T_0 and T_1 is the revelation of that information, the price change over that interval represents the marginal investor's view of the value (or rather

and managers reacting to an event may recursively anticipate others' reactions to it, and to second-order reactions, ad infinitum. One important application, for example, considers how managers might use stock price reactions to set investment policy. See, e.g., Qi Chen, Itay Goldstein & Wei Jiang, *Price Informativeness and Investmene Sensitivity to Stock Price*, 20 Rev. Fin. Stud. 619 (2007). For a review of the feedback literature, see Itay Goldstein, *Information in Financial Markets and Its Real Effects*, Rev. Fin. 1 (2023). More generally, law often makes reference to expectations (and the manifestation of expectations in prices) in assessing legal questions. As Eric Talley has explained, this generates its own circularity, which he has called the "pricing paradox." Eric Talley, *Expectations and Legal Doctrine*, *in* Paradoxes and Inconsistencies in the Law 183-204 (O. Perez & G. Taubner, eds. 2006).

[17] We use the term "asset" in the broad sense of something of value. This can include financial assets, real assets, or even intangible assets like human capital.

[18] For example, while a corporation does not itself trade in liquid market, its equity might. Accordingly, even if the asserted injury is to the corporation, as long the corporation is solvent, this injury will be reflected in the market price of the company's stock.

cost) of the harm. We refer to techniques for assessing harm that leverage market price reactions as price drop damages.

Using prices in this way appeals to core building blocks of modern finance theory. An important insight, first developed during the 1960s in relation to the market for publicly traded U.S. equities, is that public information is quickly impounded into stock prices.[19] Another way to put the idea is that the prices prevailing at any given time reflect then-available information.[20] It follows from this that price *changes* reflect *new* information.[21] If an analyst can isolate a brief window during which news of a harm is the only relevant, firm-specific news, the change (relative to changes in the prices of comparable stocks over the same interval) should offer an unbiased estimate of the harm's magnitude.

Scores of empirical studies support the view that market-implied estimates are hard to beat. For example, a question of perennial importance to retail investors is the extent to which a professional to whom they might entrust their savings can deliver risk-adjusted returns superior to what the individuals could achieve on their own. Mutual fund managers' performance relative to market indices has, therefore, been a topic of a whole branch of literature. The basic finding is that few managers can reliably beat the market, and fewer still do so net of fees.[22]

In light of the evidence, it might seem presumptuous for a judge to conclude that a court-centered valuation process will outperform (or even match) the very best professional investors. To be sure, there are conditions under which direct valuation will not seem so immodest. The market for U.S.-listed equities is uniquely liquid, making outperformance is especially unlikely; the probative value of asset prices in less liquid markets will be lower. And to the extent that litigation will uncover information not immediately available to public investors, the fact finder may enjoy at least the prospect of an edge.

[19]See, e.g., Eugene F. Fama, Lawrence Fisher, Michael C. Jensen & Richard Roll, *The Adjustment of Stock Prices to New Information*, 10 INT'L ECON. REV. 1 (1969).

[20]Eugene F. Fama, *The Behavior of Stock Market Prices*, 38 J. BUS. 34 (1965); Eugene F. Fama, *Risk, Return and Equilibrium*, 23 J. FIN. 29 (1968); Eugene F. Fama, *Efficient Capital Markets: A Review of Theory and Empirical Work*, 25 J. FIN. 383 (1970).

[21]The finance literature draws a distinction between fundamental efficiency and informational efficiency. In a market characterized by fundamental efficiency, the price of each asset is equal to the present value of its future cash flows. In contrast, an informationally efficient market is one where prices respond quickly and accurately to the arrival of new information that is relevant to cash flows and discount rates. The former implies the latter, but the latter does not imply the former *See* ADRIANA Z. ROBERTSON, FINANCE FOR LAWYERS (2025). In general, informational efficiency is sufficient to justify the use of price drop damages.

[22]For a starting point in the literature, see, e.g., Michael C. Jensen, *The Performance of Mutual Funds in the Period 1945-1964*, 23 J. FIN. 389 (1968); Eugene F. Fama & Kenneth R. French, *Luck versus Skill in the Cross-Section of Mutual Fund Returns,* 65 J. FIN. 1915 (2010). See also Jonathan B. Berk & Richard C. Green, *Mutual Fund Flows and Performance in Rational Markets*, 112 J. POL. ECON. 1269 (2004).

Still, decades of finance research underscores the power of aggregating the assessment of motivated investors. If a financial asset is available that can provide a clean proxy for value, it's tempting to use that.

While the influence of finance theory on legal practice has been uneven but, it has tended to grow over time, as generations of lawyers who grew up learning about "semi-strong form efficiency" have taken the bench. Securities litigation was the first place where the theory of price drop damages became accepted. The standard measure of damages in a securities class action is "out-of-pocket" damages:[23] the "difference between the price [plaintffs] paid and the 'value' of the stock."[24] By the mid-1970s, a bright law student was able to see that, in light of the efficient capital markets hypothesis, experts could use a "market" model to estimate price inflation.[25] An influential 1982 article by Dan Fischel, who would go on to become perhaps the most renowned damages expert in the business, laid out systematically how stock price changes could—and in his view *should*—be used, with appropriate adjustments, to "determin[e] the existence and amount of injury in open market trading cases."[26] That approach won out.[27] In modern securities litigation, competing event studies dominate the estimation of damages.[28] Indeed, share price reactions have

[23]Robert B. Thompson, *The Measure of Recovery Under Rule 10b-5: A Restitution Alternative to Tort Damages*, 37 VAND. L. REV. 349, 356 (1984) ("Out of pocket damages are the usual form of relief available for a rule 10b-5 violation. The measure awards the victim of fraud the difference between the price the victim paid . . . and the actual value that the victim received in the transaction." (citing L. Loss, Fundamentals of Securities Regulation 1122-34 (1983)).); see also Elizabeth Chamblee Burch, *Reassessing Damages in Securities Fraud Class Actions*, 66 MARYLAND L. REV. 348 (2007). To be sure, this measure of damages has been roundly criticized, particularly in a market where investors are able to hold diversified portfolios. For a classic discussion of this problem, see Frank H. Easterbrook & Daniel R. Fischel, *Optimal Damages in Securities Cases*, 52 U. CHI. L. REV. 611 (1985).

[24]*Acticon AG v. China N. E. Petroleum Holdings Ltd.*, 692 F.3d 34, 40 (2d Cir. 2012) (cleaned up). See also *In re Barrick Gold Sec. Litig.*, 314 F.R.D. 91, 106 (S.D.N.Y. 2016) (interpreting the quotation from *Acticon* as containing an implicit "true" before "value"), *Rougier v. Applied Optoelectronics, Inc.*, No. 4:17-CV-02399, 2019 WL 6111303, at *15 (S.D. Tex. Nov. 13, 2019), report and recommendation adopted, No. 4:17-CV-2399, 2019 WL 7020349 (S.D. Tex. Dec. 20, 2019) (describing out-of-pocket losses as "the difference between the price paid for the stock and the "but for" value of the stock, or what its value would have been absent the misrepresentations and omissions.").

[25]Philip J. Leas, *The Measure of Damages in Rule 10b-5 Cases Involving Actively Traded Securities*, 26 STAN. L. REV. 371, 386-90 (1974).

[26]Daniel R. Fischel, *Use of Modern Finance Theory in Securities Fraud Cases Involving Actively Traded Securities*, 38 BUS. LAW. 1 (1982); see also Frank H. Easterbrook & Daniel R. Fischel, *Optimal Damages in Securities Cases*, 52 U. CHI. L. REV. 611, 626 (1985) (asserting that the drop in a security's price *is* "what courts often call the 'out-of-pocket' loss"); FRANK H. EASTERBROOK & DANIEL R. FISCHEL, THE ECONOMIC STRUCTURE OF CORPORATE LAW 326-29 (1990).

[27]For a perceptive history of damages calculation in securities cases, see Allen Ferrell, *Hidden History of Securities Damages*, 1 U. CHI. BUS. L. REV. (2022).

[28]For a detailed, albeit somewhat dated, discussion of the calculation of damages

become so central to modern class actions under the federal securities laws that many lawsuits boil down to battles over whether and when evidence of putative price movement can be introduced.[29]

The insight that a court can leverage markets to weigh harm has spread beyond securities litigation. Price drops can be used to assess damages in a wide range of situations, including breaches of contract, business torts, and fiduciary misdeeds. The limiting conditions are only that (1) a reference asset trading in a liquid market plausibly reflects the event and (2) information about the event reaches trading investors roughly simultaneously. As early as the late-1980s, Merritt Fox noticed (with some skepticism) that the generality of the underlying financial theory meant—was meaning—that a "market" model would influence discussion of all areas of law "regulating firms and their management."[30] The evolution of Delaware appraisal jurisprudence illustrates just such a trend toward greater reliance on market prices. When a company is acquired, shareholders have a statutory right to reject the deal consideration and instead get a fraction of the value of the standalone business proportional to their shares.[31] Chancery judges needing to appraise the value of the pre-merger shares used to value the target company's business from scratch. Recently, though, the Delaware Supreme Court has opined that pre-merger announcement trading price represents the presumptive value, if market processes were allowed to run their course and no major non-public information belies it.[32]

In a similar spirit, VC Laster's *TripAdvisor* opinion, discussed above, signals not only a willingness of the Court of Chancery to rely on stock price

in 10b-5 class actions, see Kristin M. Feitzinger "Estimating Recoverable Damages in Rule 10b-5 Securities Class Actions," CORNERSTONE RESEARCH (2014), *available at* https://www.cornerstone.com/wp-content/uploads/2014/01/Estimating-Recoverable-Damages-in-Rule-10b-5-Securities-Class-Actions.pdf.

[29]For example, the dispute before the Supreme Court in *Halliburton II* boils down to a question of whether the defendant can introduce an event study at the class certification stage. Halliburton Co. v. Erica P. John Fund, Inc., 573 U.S. 258 (2014).

[30]Merritt B. Fox, *The Role of the Market Model in Corporate Law Analysis: A Comment on Weiss and White*, 76 CAL. L. REV. 1015 (1988).

[31]D.G.C.L. §262(a).

[32]See *Dell v. Magnetar Global Event Driven Master Fund* ("Dell"), 177 A.3d 1, 5 (Del. 2017) (holding that Vice Chancellor Laster had erred in giving no weight to the market price). Later, in *Verition Partners Master Fund Ltd. v. Aruba Networks, Inc.*, 210 A.3d 128, 130 (Del. 2019), the court emphasized "deal price minus synergies" rather than the stock's pre-announcement trading price. But that seems to have been on account of the importance of non-public information in the case. *Id.* at 138. The fact that "fair value" excludes synergies, and that Delaware courts have become more focused on excluding such synergies in the context of appraisal, represents another instance where market prices likely reflect legal rules: if prospective merger arb traders anticipate that the award under §262 will exclude synergies, this anticipation should affect the ex ante market price for the stock. These considerations also relate to the legal certainty issues discussed in Part IV.A. We thank Elizabeth Pollman for this insight.

changes in derivative litigation but an (impressively nuanced) appreciation of the underlying finance theory. We quote from the opinion at length because it shows the sophistication with which modern courts can think about price drop damages:

> [T]he change in the Company's trading price [on the announcement date] should help quantify the harm, if any, caused by the conversion. As long as the market for the Company's common stock is semi-strong-form efficient, then the price reaction should be indicative. Note that the stock price need not fairly approximate a pro rata share of the Company's intrinsic value for the price reaction to matter. As long as any pricing disconnects remains consistent across variables other than the governing law, the price impact should provide insight.
>
> Not only that, but the announcement of the conversion should have a relatively clean price impact. The Company's conversion was not conditioned on a majority-of-the-minority vote, so nothing could prevent [the controller] from implementing it. There is, of course, always some uncertainty about whether a transaction will close, but here, the likelihood of closure would have been high. The price reactions to other events, such as the announcement of the vote or the filing of this litigation, may provide additional data points.
>
> . . . Because of the narrow issue that this case presents, it seems likely that the court will have a sufficiently reliable basis to craft a monetary award for any harm that the Company's stockholders suffer. A judgment against the defendants in that amount should provide the plaintiff with a fully adequate remedy.[33]

To say that price drop measurement is an established, and probably growing, approach to damages calculation is not to suggest that it has escaped criticism. Because price drop measurement is an application of event study-based causal inference, the familiar assumptions undergirding academic use of event studies also bear on damages calculation. No surprise, then, that a substantial academic literature has emerged in the last decade taking issue with the way experts use event studies in litigation.[34] Most of the commentary has addressed securities fraud litigation specifically, but some criticisms, especially of single-firm event studies, have a wider application. The thrust of criticism has related to implementation rather than intractable theoretical problems, and generally fall into one of two categories. The first cluster of critiques identifies empirical challenges associated with measuring price drops. The second

[33] Id. at 286.
[34] Examples include the long list of papers cited in footnote 14.

group identifies challenges the application of the efficient markets hypothesis.[35] Our critique is different: our model assumes that price changes can be measured perfectly and that semi-strong form efficiency holds for the relevant asset.[36] In that sense, our model represents the best possible setting for price drop damages. At the same time, our analysis complements what is perhaps the general lesson of recent literature, namely that price drop measurement is less appealing when one looks closely than it is at 30,000 feet.

II. The Model

This Part lays out our model. Section II.A outlines a general framework that can be applied in a wide variety of contexts. Section II.B highlights the importance of the incidence of damages recovery, comparing settings in which those who purchase the reference asset after the misconduct has come to light benefit to those in which they do not. Section II.C extends the model by allowing for information leakage.

A. Basic Setup

Suppose that at T_1, the world leans about some putatively actionable misconduct that has occurred at some point in the past. Suppose further that there exists some reference asset that trades in a semi-strong form efficient market. Importantly, the reference asset is such that the harm from the misconduct will be reflected in its market price. Denote that harm as H.[37] The moment of ignorance immediately before this revelation is T_0. The price of the reference asset is P_0 and P_1 at T_0 and T_1, respectively.

Let the amount of a prospective damages award that will benefit those who acquire the asset on or after T_1 be D. This could represent a direct payment to the T_1 owner of the asset or, in the case of shareholders in a corporation,

[35] Other scholars have raised more conceptual issues with the use of stock prices in crafting remedies. *See, e.g.,* Zohar Goshen & Zvi Wiener, *The Value of the Freezeout Option*, *in* World Scientific Reference on Contingent Claims Analysis in Corporate Finance 471-496 (2019) (discussing this in the freezeout context), Zohar Goshen & Assaf Hamdani, *Corporate Control, Dual Class, and the Limits of Judicial Review*, 120 Columbia L. Rev. 941, (2020) (discussing this in the dual class recapitalization context).

[36] In proposition 2, we allow for the possibility of leakage: the idea that market participants may have some inclining of the harm. Still, even with that extension, the model continues to assume that the market is able to quickly and accurate impound all newly arriving publicly available information into prices.

[37] H may or may not be observable. If someone embezzles \$100 from a corporate treasury, H is \$100 divided by the number of outstanding shares. But most cases are not so simple. A further complication is that in some instances, only part of the harm associated with the misconduct will be actionable. This is related to the "collateral damage" problem discussed above. *See supra* note 11. Because it has already been the subject of extensive scholarly analysis, we abstract away from it in our model.

the per-share value of an award to the corporation. Naturally, D will depend on the prevailing damages rule as well as the facts of the case. Assume that at T_1, market participants know D or can form an unbiased estimate of its expected value ($E[D]$). Importantly, D excludes damages that will not benefit purchasers on or after T_1. So, for example, if the applicable legal rule provides that any damages award will be paid to the T_0 owner of the asset *and not to someone who purchased the asset on or after* T_1, $D = 0$. The reason for this is simple: those damages are like a dividend with a record date of T_0. To be sure, they will benefit the T_0 owners. But because the T_1 purchasers of the asset will not benefit from the award, the award does not represent part of what a T_1 purchaser is getting when she purchases the asset.

Finally, let C be the costs of the litigation, again from the perspective of the T_1 purchaser. In the corporate context, these would include out-of-pocket costs such as attorneys' fees and the company's share of any damages to be paid, as well as indirect costs such as incremental insurance premia and the opportunity cost of managerial distraction. In the context of a fine, or of a direct claim, this would include the company's share of any fine or damages award.

Award-generating litigation is not always certain. The law might be unclear, or the plaintiffs' legal theory may be a stretch. Even if it is strong on the law, evidence may be scarce. Plaintiffs' lawyers (or other financiers) will not want to pursue litigation unless expected fees exceed their own cost of capital. We model uncertainty about litigation with the parameter π, which represents the consensus estimate at T_1 of the likelihood that plaintiffs will recover. It follows that recovery—and associated costs—are zero with probability $(1 - \pi)$.[38] For simplicity, we ignore the time value of money.[39]

In a market characterized by semi-strong form efficiency, the price of the reference asset is

$$P_1 = P_0 - E[H] + \pi(E[D] - E[C]) \quad (1)$$

This relationship is intuitive. Since T_0 and T_1 are assumed to be moments apart, the price at T_1 is equal to the price at T_0, minus the expected value of the intrinsic harm.[40] On top of that, we add the anticipated results of litigation

[38] For simplicity, we assume that expected costs are zero if the plaintiffs lose. This is because the costs that do not scale with the damages award are not subject to the recursive structure that we are focused on. It is trivial to add a fixed cost of litigation to the model.

[39] Appropriately measured pre-judgment interest should fully account for the time value of money. To the extent that it does not, it is straightforward to redefine the expected net damages award as the present value of any such award. As long as the discount rate is positive, this refinement will dampen the recursive effect of price drop damages.

[40] Equation 1 ignores any tax consequences associated with the payment or receipt of damages awards. We continue to abstract away from any such consequences in the remainder of this analysis.

about the event, net of costs, scaled by the probability that the plaintiff wins at trial.[41]

Using price reaction to calculate damages implies that the recovery is a function of the price change.

$$D = f(P_1 - P_0)$$

In many contexts, the relevant costs are also a function of the damage award. For example, in the corporate derivative context, the shareholders (via the corporation) recover the damages *minus attorneys' fees*, which are typically a fraction of the damages award. In the securities fraud context, the cost to the company (which, of course, come out of the share value at T_1) include the company's share of the damages award that will be paid to the T_0 shareholders. To the extent that costs associated with the damages award (again, from the perspective of the T_1 shareholders) are a function of that award, we have

$$C = g(P_1 - P_0)$$

These equations are very general. Still, we can make three threshold observations. First, it is easy to see that, absent unusual circumstances, the price reaction will not equal the expected harm ($P_1 - P_0 \neq E[H]$). Second, what distinguishes price drop damages from traditional or direct measures of damages is the fact that both D and C are functions of $P_1 - P_0$. By contrast, a judge using a direct approach simply estimates H—we might call this H^*—and awards damages of $D = H^*$. Finally, the specific form of $f(\cdot)$ and $g(\cdot)$ matter immensely.

B. Solving the Basic Model

We begin with a very simple price drop damages regime, in which the damages are

$$D = -(P_1 - P_0) = (P_0 - P_1) \tag{2}$$

This is consistent with a strong form of VC Laster's statement in *TripAdvisor*. More than providing "insight" or being "indicative," this regime is one in which the damage award is equal to the change in the share price (controlling for changes in comparable shares, a qualification we will not make again). Since plaintiffs will only bring a claim for price drop damages when the stock price has fallen, litigation will only occur when $P_1 < P_0$.

[41] The inclusion of the $\pi(E[D]-E[C])$ term implies that the market can form an unbiased expectation of the damages award, as well as the probability that it will be awarded. We note that this assumption does not mean that the market's expectation is perfect in any given case, only that it is not systematically and predictably wrong. This, of course, is the same assumption that undergirds a reliance on price reactions in the first place.

We further assume that costs are a linear function of the damages award. The net award is therefore

$$E[D] - E[C] = -\phi(P_1 - P_0) = \phi(P_0 - P_1) \tag{3}$$

for some constant $-1 \leq \phi \leq 1$. Restricting ϕ to this range still allows our model to cover a broad range of settings. At one extreme, $\phi = 1$ implies that, if the litigation succeeds, the full value of the price drop will be awarded to the benefit of whoever owns the asset at T_1. At the other extreme, if $\phi = -1$, successful litigation will mean that the T_1 owner will be out the full value of the price drop.[42] Intermediate positive (negative) values of ϕ imply that the T_1 owner will receive (be on the hook for) a fraction of the price drop.

Consider the corporate derivative context. The reference asset is the company's equity, and the shareholders expect to benefit from any damages that are awarded, net of attorneys' fees. Under a standard contingency arrangement, fees will be a fraction $0 < \beta < 1$ of the damages award. Consequently, the shareholders will recover $\phi = 1 - \beta$ of the damages in the event that they prevail. Accordingly, their net recovery (conditional on prevailing) is $\phi(P_0 - P_1)$ for some $0 < \phi < 1$.

In contrast, if the T_1 purchasers of the asset expect to be the ones financing some fraction of the damages award, then $-1 \leq \phi < 0$. For example, if investors expect that the T_0 shareholders will get an award equal to the price drop, and expect that insurance will cover a fraction $0 < \beta < 1$ of the payout, then $\phi = -(1 - \beta)$.

Substituting equation 3 into 1, we have

$$P_1 = P_0 - E[H] + \pi\phi(P_0 - P_1) \tag{4}$$

This leads to

Proposition 1. *Under a price drop damages rule, the price drop, as well as the expected damages, are*

$$D = \frac{E[H]}{1 + \pi\phi} \tag{5}$$

as long as $\pi\phi \neq -1$.

Proposition 1 implies that, for any $\pi\phi \neq 0$ (which is to say, unless $\pi = 0$, $\phi = 0$, or both), price drop damages will produce a biased measure of damages. The direction of the bias depends on whether ϕ is positive (implying a positive net recovery to the T_1 purchaser of the asset) or negative.

To explore this bias, we begin by noting that if $\phi = 0$, equation 5 reduces to $D = E[H]$ and the price reaction is an unbiased measure of the expected

[42] In principle, ϕ can be even less than -1, implying that the T_1 owner will be out more than the full value of the price drop. Our model can accommodate this as long as $\pi\phi > -1$.

harm for any value of π. This implies, of course, that the T_1 purchasers' share of any net recovery is zero. Intuitively, this makes sense: this amounts to saying that, from the perspective of a prospective purchaser, the value of the reference asset is independent of the result of the litigation. This could arise, for example, if damages are covered by insurance and are being paid to some third party (including the T_0 owners). In that case, price drop damages have no effect on P_1. Put another way, if $\phi = 0$, the price reaction will accurately reflect the expected harm regardless of the likelihood that the plaintiffs will prevail in litigation.[43]

If $0 < \phi \leq 1$ and $\pi = 1$ (implying that recovery is certain), the damages award will understate the expected harm. Intuitively, this is because the effect of any net recovery will be impounded into the price reaction at T_1. If the market anticipates a recovery equal to a positive fraction of the decline in the price, this expected recovery dampens the price drop. Even with this recovery, however, the price still drops. This again is intuitive: with no price drop, there would be no recovery, which would leave the asset owners to suffer the entirety of the harm. This, therefore, cannot be an equilibrium. At the limit, if $\phi = 1$ (which implies that the net recovery to the T_1 purchaser is equal to the damages award, which is, in turn, equal to the price reaction), the price reaction will be equal to exactly half of expected harm.

Introducing uncertainty about recovery (i.e., $0 < \pi < 1$) increases damages awards. Intuitively, this is because the prospect of a zero recovery dampens the effect of the damages award on the price reaction. Consequently, for $0 < \phi \leq 1$, uncertainty about recovery causes the price to fall by more than it would under certain recovery, leading to a larger award. Of course, these damages are, by assumption, only awarded in π fraction of instances where misconduct occurs.[44]

At the limit, if $\pi = 0$, the price reaction collapses to $E[H]$ and damages become fully compensatory. This makes sense: if the market does not expect any recovery at all, there is no dampening effect. Of course, in any equilibrium in which $\pi = 0$, it must be the case that no recovery is ever provided. For it to be otherwise would be a violation of rational expectations.

In contrast, if $-1 \leq \phi < 0$, price drop damages overstate harm. Intuitively, this is because in cases where the net recovery to the T_1 owners is negative, the price drop when the harm is revealed reflects both the harm itself and the expected net payout. This overstatement is larger when π is larger, since the

[43] This suggests that, at least in certain settings, we can make price drop damages more appealing—in the sense of providing a better estimate of the harm from the underlying misconduct—by changing how damages awards are paid. We return to this in Section IV.C.

[44] Note that this dynamic is the opposite of what we would expect under standard models of litigation and settlement where damages are not determined by the price drop. There, a higher probability of prevailing in litigation typically means that the claim has a higher expected value.

probability of having to make that net payout is larger. It is also larger when ϕ is smaller (i.e., more negative), since a smaller ϕ implies a larger net payout, which reduces the value of the reference asset. At the limit, as the probability of a payout approaches certainty (i.e., $\pi \to 1$) and the net payout approaches -1 (i.e., the full amount of the price drop is paid out to a third party), the damages award approaches infinity.[45]

C. Price Drop Damages and Information Leakage

So far, we have assumed that the expected harm from the misconduct is impounded into prices only (and entirely) at T_1. In other words, the consensus view at T_0 is that the probability of the harm is 0.

This may reasonably approximate reality in some instances, but in many others market participants will have assigned a non-zero probability to the event before it is announced publicly. This could be because of leaks, rumors, or correlated news, or simply because investors are conscious that bad things sometimes happen.[46] For the sake of simplicity, we refer to any source of impoundment before T_1 as leaked information.

Leaked information will cause the price reaction $(P_1 - P_0)$ to understate the "true" drop. Intuitively, this is because the observed P_0 already impounds the harm, scaled by the pre-announcement perceived probability that it will arise. This is a classic problem in employing event studies, as well as any other use of price movements.

To explore this possibility, we define P^* as the T_0 price that "would have been" had investors not anticipated the harm. P^* is unobservable but serves as a benchmark. To allow for the possibility of leakage, we define ρ as the market's consensus view of the probability, as of T_0, that the harm will occur at T_1. This yields the formula:

$$P_0 = (1 - \rho)P^* + \rho P_1 \tag{6}$$

The first term ($(1 - \rho)P^*$) captures the value of the reference asset in the absence of the misconduct, multiplied by the assessed probability (as of T_0) that the misconduct does not occur. The second term (ρP_1) captures the value of the reference asset conditional on the misconduct, multiplied by the assessed probability (again as of T_0) of the misconduct. That value, of course, is simply P_1. We can then write P_1 as

[45] In practice, of course, assets that are claims on entities with limited liability cannot take negative values. So, for example, when the reference asset is equity in a corporation, the largest possible price drop, and therefore the largest possible damages award, is P_0.

[46] For example, even with no leaks about the plans of any particular company, news that a stream of controlled companies is leaving Delaware might raise the perceived likelihood that other, otherwise similar Delaware incorporated controlled companies, might also announce a departure.

$$P_1 = P^* - E[H] + \pi(E[D] - E[C]) \tag{7}$$

The difference between equations 1 and 7 is that the first term is now P^* rather than P_0. This reflects the fact that P_0 is now "polluted" by the non-zero possibility of the harm and ensuing recovery. Instead, we write P_1 as the "true" value as of T_0 (assuming no harm), minus the harm, plus the expected recovery less costs.

This leads to

Proposition 2. *If the ex ante probability of the harm is ρ, as long as $\pi\phi \neq -1$ and $\pi\phi \neq 1$,*

a) the damages award under price drop damages will be

$$D = \frac{E[H](1-\rho)}{1+\pi\phi(1-\rho)} \tag{8}$$

b) the damages in the presence of leakage ($0 < \rho \leq 1$) will be lower than they would have been in the absence of leakage ($\rho = 0$),

c) the damages award will be smaller than the harm if

$$\rho > \frac{-\pi\phi}{1-\pi\phi}$$

d) the damages award will be greater than the harm if

$$\rho < \frac{-\pi\phi}{1-\pi\phi}$$

e) the damages award will be equal to the harm if

$$\rho = \frac{-\pi\phi}{1-\pi\phi}$$

Leakage reduces price drop damages by bringing P_0 closer to P_1. Accordingly, a damages award equal to that drop will also be lower. Intuitively, this happens because part of the harm from the misconduct is already reflected in P_0. The drop between T_0 and T_1 (measured by $P_1 - P_0$) will therefore be smaller than it would be in the absence of the leakage. At the extreme, if $\rho = 1$, equation 8 reduces to $D = 0$. This makes sense: $\rho = 1$ implies that, at T_0, the market is already certain about the misconduct and the expected harm arising from it. Effectively, this means that there is no new information at T_1, and therefore no change in the price of the reference asset between P_0 and P_1.

If $0 < \phi \leq 1$, this implies that leakage will cause the damages award to understate the harm by more than it would in the absence of leakage. In other words, leakage exacerbates the bias in price drop damages.

Leakage also reduces the size of the award if $-1 \leq \phi \leq 0$. Note, however, that while the effect on the direction of the award is the same, the effect on the *bias* is reversed. This is because the damages award was already "too small" when $\phi > 0$. Making it smaller therefore brings it further away from $E[H]$. In contrast, when $\phi < 0$, the bias caused the award to be too large. Accordingly, reducing the size of the award actually reduces the magnitude of the bias. Indeed, if the amount of leakage is large enough, the bias reverses, and price drop damages *understate* the extent of the harm.

III. Applying the Model

In this Part, we apply the model developed in Part II to two important litigation contexts: Shareholder derivative litigation (Section III.A) and securities fraud class actions (Section III.B). For each, we calibrate the model using plausible parameter estimates. This allows us to gauge the likely magnitude of the bias inherent in price drop damages in those settings. Finally, in Section III.C, we use the model to develop a variation of stock drop damages that provide optimal deterrence.

A. Derivative Fiduciary Litigation

Derivative claims make up an important part of the universe of shareholder litigation. In a typical derivative case under Delaware law, a shareholder alleges that one or more corporate fiduciaries (directors, officers, or controlling shareholders) has breached a duty of loyalty to the company and that the board is too close to the putative misconduct to be entrusted with asserting the company's interests. If a court finds that the directors are compromised in this sense, it may allow the shareholder to pursue the company's claims on its behalf. Importantly, though, the *company's* rights are at stake, not the rights of the shareholder who happens to lead the litigation.[47] Consequently, any damages or settlement proceeds the case brings in (net of attorney's fees)

[47] In Delaware, these claims are heard in the Court of Chancery. In the tradition of courts of equity, the Chancery Court's "powers are complete to fashion any form of equitable and monetary relief as may be appropriate. In determining damages, the powers of the Court of Chancery are very broad in fashioning equitable and monetary relief . . . as may be appropriate." *Basho Techs. Holdco B, LLC v. Georgetown Basho Invs., LLC*, No. CV 11802-VCL, 2018 WL 3326693, at *43 (Del. Ch. July 6, 2018), aff'd sub nom. *Davenport v. Basho Techs. Holdco B, LLC*, 221 A.3d 100 (Del. 2019) (cleaned up). This can include recission of a transaction, or, if that is impractical, its monetary equivalent—rescissory damages. Id. at *49

are paid to the corporate treasury. Fees are typically a fraction of the total recovery, allowing us to write $\phi = 1-\beta > 0$, where $0 < \beta < 1$ is the contingency rate. By substituting estimated values of β, π and ρ into equation 8, we can calibrate the model to estimate the extent of the bias inherent in price drop damages in derivative cases.[48]

We begin with β. Under Delaware law, plaintiffs' attorneys are "entitled to a fair percentage of the benefit inuring to [the company] and its stockholders."[49] Formally, that percentage is supposed to be determined by a five-factor test, but "Delaware courts have assigned the greatest weight to the benefit achieved in litigation."[50] Chancellor McCormick recently explained that courts commonly award plaintiffs' lawyers a fraction of the benefit they achieve for the company, with the size of the fraction depending on the "stage of case" at which the litigation is resolved: "When a case resolves early, the guideline range is 10–15%. When a case resolves after meaningful litigation efforts, including multiple depositions and some level of motion practice, the guideline range is 15–25%. The highest percentage of 33% is reserved for plaintiffs who prevail after trial."[51]

Accordingly, while the value of β varies in the real world, it does so in a predictable way. For simplicity, suppose that $\beta = 1/4$ for a particular case, $\pi = 1$ (meaning that recovery is certain), and $\rho = 0$ (implying no leakage). Then equation 8 yields $D = \frac{4}{7}E[H]$. In other words, the stock price reaction is only about 57% of the true expected harm from the action.

Companies embroiled in shareholder litigation may, of course, incur resulting costs even if an insurance policy covers out-of-pocket expenses. This is so because counterparties—especially the company's D&O insurer—may update their assessments of the relevant risks associated with doing business with the company.[52] Our model can accommodate a simplified version of this phe-

[48]Insolvent companies pose a complication that goes beyond the scope of our model. Accordingly, we restrict attention to companies that are solvent and are outside any "zone of insolvency."

[49]*In re Dell Techs. Inc. Class V S'holders Litig.*, 326 A.3d 686, 698 (Del. 2024).

[50]Id. at 699. The other four factors are (1) the time and effort of counsel; (2) the relative complexities of the litigation; (3) any contingency factor; and (4) the standing and ability of counsel involved.

[51] *Tornetta v. Musk*, 326 A.3d 1203, 1237 (Del. Ch.), judgment entered, (Del. Ch. 2024) (cleaned up).

[52]We make three observations on this point. First, in a market with actuarially fair insurance, the change in the present value of the future insurance premia will reflect the change in the expected value of claims against the policy. Second, insurers selling D&O policies to corporate clients presumably do not expect the average number of claims to be zero. Nevertheless, while a single claim says little about whether a company's firm-specific *level* of risk is higher or lower than what the insurer anticipated, the *marginal* impact is still positive. Accordingly, the relationship between a claim today and the present value of future insurance premia is still (weakly) positive. Third, a claim against one company can be informative about future claims of this kind against both the company itself and other companies in the

nomenon through a reinterpretation of β. For simplicity, we do so by assuming that the incremental costs of doing business that are attributable to the fact of litigation are a fraction of the damages award $D = P_0 - P_1$. This allows us simply to redefine β to be $\beta = \beta_1 + \beta_2$, where β_1 is the fraction of the damages awarded as attorneys fees and β_2 is the extent to which the claim will increase the company's future insurance premia and any other costs of doing business. As long as $0 < \beta = \beta_1 + \beta_2 \leq 2$, the analysis in propositions 1 and 2 continue to hold.

Next, we turn to π. The model assumes that market participants at T_1 correctly estimate the likelihood that plaintiffs will prevail. Note, however, that this does not mean either that π is the same for all companies (or all claims with respect to a given company)[53] or that courts or parties can observe it. Our simplifying assumption is only that the market's consensus estimate of π is correct on average *for the specific company in relation to the specific misconduct.*

The incentives of skilled plaintiffs' lawyers are an important driver of π. Other things equal, profit maximizing plaintiffs' attorneys will prioritize claims for which they expect larger fee awards in dollar terms. While attracting qualified counsel is only one aspect of the probability of recovery—the plaintiffs still have to win at trial or reach a settlement—it is an important one.

Together, these observations point to three factors that are likely to be associated with a higher π. One is the size of the company, both because larger companies face more public scrutiny and because the same per-share attorneys' fee award represents a larger dollar value at a larger company. Another is the contingency fee rate attorneys expect to earn (β). A higher β means stronger

market. For example, an unexpected claim against a policy held by Company A may cause the insurer to update its beliefs about Company A's governance practices, its susceptibility to future litigation, or other relevant corporate characteristics. But it may also cause the insurer to update its beliefs about the overall level of fiduciary litigation in the market, as well as the likely insurance payouts associated with that litigation. These three observations combine to imply that a payout from Company A's policy due to a corporate derivative action is likely to increase the present value of the future premia by substantially less than the value of the claim. For evidence that insurers in fact risk rate corporate governance, see Tom Baker & Sean J. Griffith, *Predicting Corporate Governance Risk: Evidence from the Directors' and Officers' Liability Insurance Market*, 74 U. Chi. L. Rev. 487 (2007).

[53]Indeed, there are good reasons to expect the probability of corporate derivative litigation to vary across corporations and across putatively injurious news items. Other things equal, we might expect a higher likelihood of litigation—and of successful litigation—at companies that are subject to more scrutiny, whether it be by the financial press, investors, regulators, or some other group. To be clear, this is not a statement about the average level of shareholder derivative litigation at such companies. Rather, it is a statement about the likelihood of shareholder derivative litigation *conditional on harmful corporate conduct that gives rise to a derivative claim.* Companies that are larger and are subject to more scrutiny might be much less likely to engage in such conduct while still being more likely to be the subject of litigation conditional on the occurrence of such conduct.

incentives for plaintiffs' attorneys to seek out and vindicate claims on behalf of the shareholders. The third is the observed magnitude of the price drop ($P_0 - P_1$). A larger price drop increases the likelihood that the putative claim will come to the attention of talented lawyers. It also increases both the probability of a recovery conditional on litigation (because proof on the merits tends to be easier as harm increases) and the expected award (which translates into a larger expected fee).

Varying π has a substantial impact on the magnitude of price drop damages. Returning to the back-of-the-envelope estimate of $\beta = 1/4$, if we reduce π to 1/2 (implying a consensus forecast of a 50% chance of recovery), equation 8 yields

$$D = \frac{E[H]}{1 + (1/2)(3/4)} = \frac{8}{11}E[H] \approx 0.73E[H]$$

In other words, price drop damages will represent about 75% of the harm suffered by shareholders, compared to about 57% when $\pi = 1$.

Now suppose that $\rho = 1/10$ (implying a consensus expectation at T_0 that there is a 10% chance of the harm that will be revealed at T_1). Then we have

$$D = \frac{E[H](9/10)}{1 + (1/2)(3/4)(9/10)} = \frac{72}{107}E[H] \approx 0.67E[H]$$

Comparing this result with the one immediately above, we can see that a modest amount of leakage reduced price drop damages by about 11% (from about 75% to about 67%).

Of course, these are just some of the myriad of different parameter values. Figure 1 uses equation 8 to plot the fraction of the expected intrinsic harm ($E[H]$) that price drop damages capture for different values of π and ρ, assuming $\beta = 1/4$. The lighter shaded areas are those for which price drop damages represent a smaller fraction of the true harm—in other words, where the bias is larger. In contrast, the darker shaded areas are those for which the bias is smaller—where price drop damages represent a larger share of the true harm. As our theoretical discussion in Part II anticipated, the bias is larger when π (the probability of recovery) is larger, which occurs when we move to the right along the x-axis, and when ρ (information leakage) is larger, which occurs when we move up along the y-axis.

B. Securities Class Actions

The structure of typical securities class actions is quite different. The allegations underlying a standard Rule 10b-5[54] class action takes the following form: someone lies or otherwise deceives market participants about facts that bear on the value of a security (generally stock). As a result of the deception, a

[54] SEC Rule 10b-5; 15 U.S.C. §78a et seq.

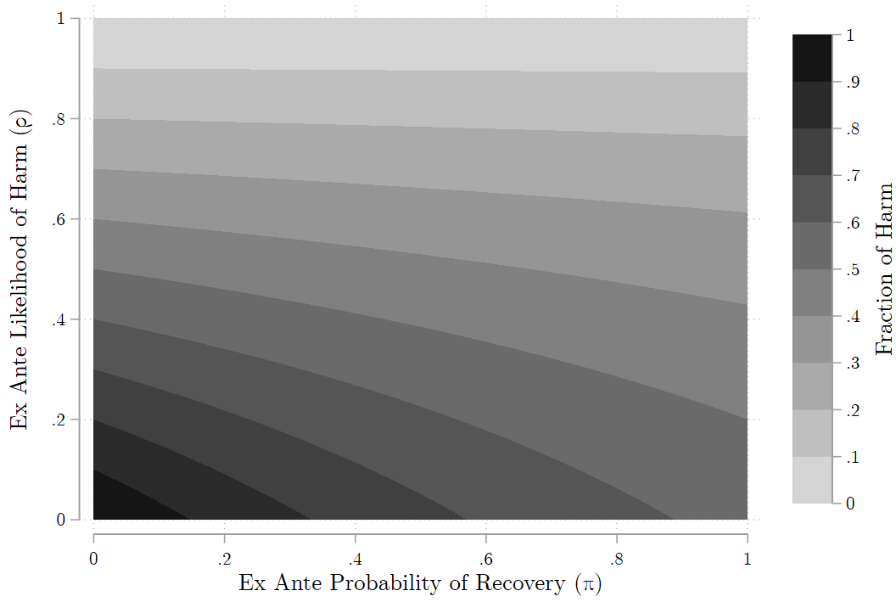

Figure 1. Fraction of Total Harm Captured by Price Drop Damages in Corporate Derivative Cases

This figure uses equation 8 to plot the fraction of the expected harm ($E[H]$) that is captured by price drop damages for different values of π and ρ, assuming $\beta = 1/4$.

set of investors buy the stock at an inflated price. Later, when the truth is revealed, the price falls.[55]

In such cases, the plaintiff class typically consists of investors who purchased shares during the period of the deception and continued to hold them until the truth was revealed. So, for example, if the relevant lie occurred at T_0 and the truth was revealed at T_1, the class would consist of investors who bought between T_0 and T_1 *and* who still held those shares at T_1.[56] We use γ to denote that fraction.

Damages are the amount by which the actionable deception caused class members to overpay. Sometimes, this overpayment is the result of an un-

[55] Less commonly, fraud artificially lowers the value of the securities. In such cases, the plaintiff class will consist of investors who purchased before the deception and sold during the period of price deflation. The analysis is largely the same, with the sign on the damages analysis is flipped.

[56] Investors who purchased at inflated prices during the period of the fraud but sold before the truth was revealed—sometimes called "in-and-out purchasers" generally cannot recover because they will fail to satisfy the loss causation requirement of the cause of action. *See In re Flag Telecom Holdings, Ltd. Sec. Litig.*, 574 F.3d 29, 40-1 (2d Cir. 2009).

warranted price increase: think of a CEO making an unanticipated (false) announcement that her company has discovered gold. Alternatively, the putative deception arises from attempts to conceal bad news. Because there is no "price jump" to measure in such cases, expert witnesses typically use the price *drop* when the truth is revealed to estimate the financial importance of the facts at issue.

In contrast to a corporate derivative case, any recovery to the plaintiffs is paid to the shareholders directly. The company, and therefore the holders of its shares after T_1, do not benefit. Indeed, the issuer is often a defendant liable alongside the individuals whose conduct forms the basis of the case. Accordingly, this is a context in which $-1 \leq \phi < 0$. That is, ϕ is a *cost* to the issuer. Specifically, it represents the fraction of the damages award, in cases where one is paid, that the company must bear (including non-pecuniary as well as out-of-pocket costs associated with the litigation).

In order to calibrate the model, we need a plausible estimate of ϕ. As a threshold matter, we note that while most corporate defendants have substantial D&O insurance, it is not uncommon for some fraction of the damages award to come directly from the corporate treasury. Accordingly, we assume that the company will be responsible for a fraction of the total damages and we use $0 \leq \delta \leq 1$ to denote the market's consensus forecast of that fraction. We can therefore write $\phi = -\gamma\delta$: the net payout (conditional on the plaintiffs prevailing) is the fraction of the shareholder base that is eligible to recover times the fraction of the award that comes out of the corporate treasury.

This allows us to rewrite equation 8 as

$$D = \frac{E[H](1-\rho)}{1-\pi\delta\gamma(1-\rho)}$$

Substituting values for γ, δ, π, and ρ thus allows us to estimate the extent to which price drop damages overstate harm in this context.[57] We also note, as we did in Section III.A, that the market need not estimate the same δ and γ at T_1 for all claims or all companies. As in that discussion, we can identify several factors likely to influence these parameters. We find that for plausible parameter values, the overstatement is likely to be small.

We begin with γ (the fraction of shareholders that are members of the class). Empirical data on the typical size of the plaintiff class in securities class actions (again, as a percentage of all shares in the company) is hard to come by, but plausible estimates are somewhere in the range of 2/5 for mega-cap companies (over \$200 B in market cap) to a little under 1/4 for micro-cap

[57] We can make one observation before we even turn to empirical estimates: because γ, δ and π are all (weakly) between zero and one, the product of all three tends toward zero. This is even more the case if one or more of these numbers is substantially less than 1.

companies (under $10 B in market cap).[58] These provide reasonable back-of-the-envelope parameter values for calibrating our model.[59]

Next, we turn to δ (the fraction of the recovery paid out of the corporate treasury). Empirical data on the source of funds used to pay damages awards (and settlements) is also sparse, but the available evidence makes clear that the bulk of damages are typically paid for out of the proceeds of D&O insurance policies, with a smaller contribution by the corporation. For example, Klausner, Hegland, and Goforth report that, in a sample of 253 settled claims filed between 2006 and 2010, insurance policies paid the entire claim 57% of the time.[60] A further 28% of the time, they found that the insurer payed some, but not all of the claim, leaving 15% where the insurer paid nothing.[61] The bulk of these cases (over 2/3) settled for under $15 million, and within that group, the insurer paid, on average, roughly 80% of the settlement.[62] The contribution of insurance declined as the claim amount became larger, to about 2/3 for claims between $15 and $50 million (39 cases), just over half for those between $50 and $100 million (10 cases), and roughly 20% for those between $100 and $400 million (9 cases).[63] Among the five cases that settled for over $400 million, the authors report that they were able to confirm that no insurance was paid in four, with no information available in the fifth.[64]

These findings indicate that the fraction of the damages that will be paid out of corporate assets (as opposed to by an insurance policy or other third

---

[58] These estimates are calculated as follows. We begin with the Two Trader Model presented by Finnerty and Pushner. John D. Finnerty & George Pushner, *An Improved Two-Trader Model for Measuring Damages in Securities Fraud Class Actions*, 8 Stan. J.L. Bus. & Fin. 213 (2003). We use their preferred 20/80 split between active and passive investors, assume two years of trading (504 trading days), and obtain 2024 median daily float-turnover rates from CRSP. We then apply the median approved claims rate figure of 58.2% from Galley et al. Catherine J. Galley, Nicholas D. Yavorsky, Filipe Lacerda & Chady Gemayel, *Approved Claims Rates in Securities Class Actions: Evidence from 2015–2018 Rule 10b-5 Settlements*, Cornerstone Research (May 14, 2020), *available at* `https://www.cornerstone.com/insights/articles/approved-claims-rates-in-securities-class-actions-evidence-from-2015-2018-rule-10b-5-settlements`. This yields the follows estimates: Mega-cap (>$200B): 41.0%; Large-cap ($40B-$200B): 35.9%; Mid-cap ($10-$40B): 29.9%; Small-cap (<$10B): 23.5%.

[59] We also note that while γ is, in theory, knowable at T_1, it may take the market a bit of time to estimate it. Notwithstanding this, it seems plausible that in a liquid market for public securities, sophisticated market participants should be able to come up with a pretty good estimate before the end of the trading day on T_1.

[60] Michael Klausner, Jason Hegland & Matthew Goforth, *How Protective Is D&O Insurance in Securities Class Actions?—An Update*, 26 PLUS J. 1, 1 (2013). This is broadly consistent with the 53% Klausner and Hegland found in a prior paper, which looked at 443 settled class actions filed between 2000 and 2003. Michael Klausner & Jason Hegland, *How Protective is D&O Insurance in Securities Class Actions?—Part I* 23 PLUS J. 1, 1 (2010).

[61] Klausner et al, *supra* note 60 at 1.

[62] Id. at 2

[63] Id.

[64] Id.

party) tend to vary across claims. Other things equal, we can identify three factors that are associated with higher values of δ. The first is the size of the company. While D&O policy limits tend to increase with the size of the company, the increase is non-linear. Very large companies tend to have policy limits that are lower, as a percentage of the value of the company, than mid-sized companies.

The second is the size of the price drop $(P_0 - P_1)$, since larger price drops tend to be associated with higher total damages awards. These awards, in turn, are more likely to exceed the limits on the company's D&O policy. For the same reason, δ is likely to be higher when the fraction of shareholders that are members of the class (γ) is larger.

Finally, we turn to π (the likelihood of recovery). The factors identified in our discussion of the corporate derivative context are likely to apply in the securities context: the size of the company, the share that plaintiffs' attorneys can expect to recover, the magnitude of the price drop, and the extent of the expected harm.[65]

Selecting, somewhat arbitrarily, values of $\pi = 1/2$ and $\rho = 0$ (implying a 50% chance that the plaintiffs will recover and no information leakage), and assuming that $\delta = 1/4$ (i.e, the company will be on the hook for a quarter of the damages award) and $\gamma = 1/3$ (a third of shareholders are members of the class), equation 8 yields

$$D = \frac{E[H]}{1 - (1/2)(1/4)(1/3)} = \frac{24}{23}E[H] \approx 1.04E[H].$$

Given all the other factors that cause damages to deviate from real world injuries, this 4% bias is extremely modest. It takes fairly extreme "worst case" parameter values (perhaps reminiscent of a massive drop at a mega cap company), for the bias to become substantial. For example, if $\pi = 3/4$ (assuming a 75% chance of recovery), $\delta = 4/5$ (insurance only pays 20% the settlement), and $\gamma = 2/5$ (the estimate for mega-cap companies), and $\rho = 0$, equation 8 yields a bias of 32%.

Figure 2 plots the fraction of the expected harm ($E[H]$) that is captured by price drop damages for different values of π and δ, assuming $\gamma = 1/3$ and $\rho = 0$. As in Figure 1, the lighter shaded areas are those where price drop damages represent a smaller fraction of the true harm. However, since price drop damages overstate the harm in securities fraud cases, these are instances where the bias is *smaller*. In contrast, the darker shaded areas are those where the bias is larger—where price drop damages overstate the true harm by even more. Figure 2 makes clear that for most ordinary claims, the bias is likely to be less than 10%.

[65] See discussion Section III.A.

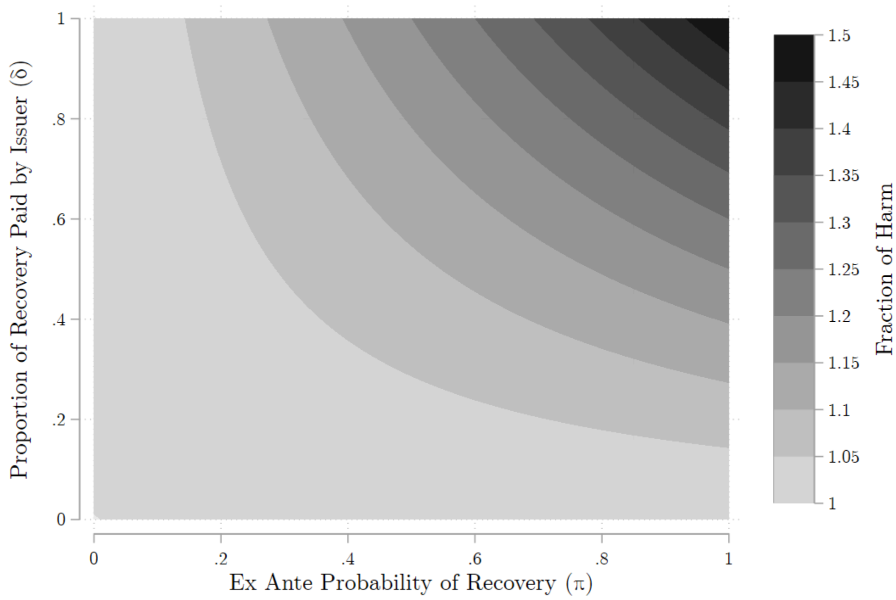

Figure 2. Fraction of Total Harm Captured by Price Drop Damages in Securities Fraud Cases

This figure uses equation 8 to plot the fraction of the expected harm ($E[H]$) that is captured by price drop damages for different values of π and δ, assuming $\gamma = 1/3$ and $\rho = 0$.

Note that part (b) of proposition 2 implies that setting ρ to zero in these calibrations maximizes the extent of the bias. Indeed, since $-1 \leq \phi = -\gamma\delta < 0$, part (c) of proposition 2 makes clear that for many plausible parameter values, even modest amounts of leakage will cause the bias to reverse. For example, if we return to the plausible parameter values of $\pi = 1/2$, $\delta = 1/4$, and $\gamma = 1/3$, the bias reverses as long as $\rho > 4\%$: Once the leakage gets higher than that, the damages will actually understate the extent of the harm. Even in the extreme example, which assumed $\pi = 3/4$, $\delta = 4/5$, and $\gamma = 2/5$, the bias reverses as long as $\rho > 19\%$. All of this may help to explain why the voluminous literature on damages in securities cases has paid relatively little attention to the bias, with the focus instead being on the problem of information leakage.

C. Scaling Damages to Optimize Deterrence

The central lesson of our model is that a rule tying damages to the change in the price of a reference asset after misconduct is revealed is inherently biased:

such an award will not, except in very unusual cases, be equal to the intrinsic harm from the misconduct. One reason this bias matters is that it undermines optimal deterrence. This is because, to a first approximation, the threat of liability forces actors to internalize the social costs of activity appropriately when $D = E[H]$, a condition that does not generally obtain under price drop damages.

In principle, judges could compensate for the bias inherent in price drop damages. To show how this would work, we introduce an adjustment factor $\alpha \in \mathbb{R}$—a factor by which "simple" price drop damages could be scaled to yield a "feedback-adjusted" measure such that $D = E[H]$. The feedback-adjusted price drop damages rule is then

$$D = \alpha(P_0 - P_1) \tag{9}$$

and

$$\alpha(P_0 - P_1) = E[H]. \tag{10}$$

These imply

Proposition 3. *A feedback-adjusted price drop damages rule that causes the defendant to internalize the full cost of the harm to asset holders (i.e., one where $D = E[H]$) will*

a) award damages of

$$\frac{P_0 - P_1}{(1-\rho)(1-\pi\phi)} \tag{11}$$

b) that are larger than the price drop if

$$\rho > \frac{-\pi\phi}{1-\pi\phi}$$

c) smaller than the price drop if

$$\rho < \frac{-\pi\phi}{1-\pi\phi}$$

d) and equal to the price drop if

$$\rho = \frac{-\pi\phi}{1-\pi\phi}$$

as long as $\rho \neq 1$, $\pi\phi \neq -1$ and $\pi\phi \neq 1$.

To illustrate how scaling would work, consider a case in which $\pi = 1$ and $\rho = 0$ (i.e., recovery is certain and there is no leakage). If $\phi = 3/4$ (i.e., a purchaser of the reference asset at T_1 will benefit to the tune of 3/4 of the recovery), equation 11 implies that the damages award should be 4 times the price drop. This situation would correspond, for example, to the corporate derivative context with attorneys' fees of 25%. Note also that equation 11 is undefined if $\pi\phi = 1$ or if $\rho = 1$: as the expected net recovery to the asset holder approaches one, the damages award specified by equation 11 approaches infinity. The same is true as ρ approaches 1.

It is worth emphasizing that the price drop under a feedback-adjusted price drop damages rule will not be the same as it is under a simple price drop rule. Intuitively, this is because investors anticipate an adjustment when the damages rule calls for one. Put another way, in general, the price drop under a feedback-adjusted damages rule is not the same as under a simple price drop rule. [66]

Because parts (b) through (d) of proposition 3 relate the feedback-adjusted damages award to the price drop, this also implies that they do *not* relate it to the simple price drop damages award. Rather, the relationship between simple price drop damages and the feedback-adjusted award follows from parts (c) through (e) of proposition 2. To see why, recall that, by construction, the feedback-adjusted award is equal to $E[H]$. Because of this, simple price drop damages will be larger than (smaller than) feedback-adjusted damages when, and only when, they are larger than (smaller than) the expected harm.

Indeed, it is immediately clear from proposition 3 that feedback-adjusted price drop damages will be larger under the same conditions that led simple price drop damages to understate the expected harm—in other words, when simple price drop damages were "too small." This is exactly what we'd expect: in settings in which the bias inherent in simple price drop damages is negative (i.e., the damages are less than the expected harm), the magnitude of the price drop must be adjusted upward in order to reflect the true harm. For the same reason, the reverse is true when the bias is positive (i.e., simple price drop damages overstate the expected harm).

One obvious consequence is that, when $\rho > \frac{-\pi\phi}{1-\pi\phi}$, a feedback-adjusted regime is considerably more expensive (from the perspective of the defendant and/or its insurer) than a simple price drop rule. This, of course, is the point: under those conditions, the cost of the recovery under simple price drop damages was less than the expected harm. In contrast, when $\rho < \frac{-\pi\phi}{1-\pi\phi}$, this feedback-adjusted regime is cheaper than simple price drop damages. Note

[66] One consequence is that the adjustment factor α is, in general, not equal to the reciprocal of the multiplier on expected harm in the simple price drop damages setting. Since that multiplier is the bias term, this also implies that the adjustment factor is, in general, not equal to the reciprocal of the bias generated under a simple price drop damages rule.

that this implies that feedback-adjusted damages are always larger than simple price drop damages whenever the asset owner expects a positive net recovery in litigation ($\phi > 0$).

As appealing as a feedback-adjusted regime is in theory, it suffers from significant implementation challenges. In particular, the adjustment parameters relate to market participants' consensus beliefs and are not directly observable. That does not necessarily mean a court cannot estimate them. Finance scholars have offered methods that can be used to empirically estimate ρ from market information.[67] Under certain circumstances, it may be fairly easy to obtain plausible estimates of π and ϕ based on legal expertise. Nevertheless, uncertainty about these parameters can represent an important source of noise in estimating feedback-adjusted price drop damages. We return to this in Section IV.A.

IV. Implications

The path forward in light of our analysis depends on the available alternatives. While these alternatives are context dependent, there are several patterns that stand out. While we cannot provide a full accounting of every relevant context, in the Part we offer some suggestions for thinking through the real world implications of our analysis.

A. Uncertainty About the Ultimate Damages Rule Undermines Price Drop Damages

Crudely speaking, judges have three options in crafting a damages award: (simple) price drop damages, modified price drop damages, and direct damages measures. Importantly, the market will impound whatever it expects damages to be, regardless of the damages rule. And assuming that the market has rational expectations—the dominant paradigm in financial economics, and an important principle undergirding price drop damages in the first place—this expectation will be correct on average.

An uncertain damages rule—perhaps because the judge has discretion in deciding whether to award price drop damages or to craft a direct damages award, or because it is hard to anticipate what such a direct award will be, or because judges make *ad hoc* adjustments to price drops—does nothing to change this. Instead, all it does is make it harder to ascertain the market's consensus view. As a consequence of this, price drop damages under a highly

[67]See, e.g., Ashley Langer & Derek Lemoine, *What Were the Odds? Estimating the Market's Probability of Uncertain Events*, University of Arizona Working Paper 20-10 (2010) (offering two methods to estimate the change in the probability of an event based on market information).

uncertain damages regime will still be systematically inaccurate; it will just be hard to know the extent of the bias.[68] Nor does a high degree of uncertainty mean that price drop damages will be unbiased. Rather, the bias will vary systematically with the information available to, and beliefs of, market participants. It will just be hard to know, in the abstract, how they are inaccurate.

For the same reason, uncertainty will undermine, perhaps fatally, attempts to adjust price drop damages for optimal deterrence. As a threshold matter, the adjustment factor from equation 11 assumes that market participants are certain that equation 11 will be used to determine damages. In a world where judges might deviate from this rule, these expectations will not obtain, and the damages formula will no longer hold.

Even if the rule is clear, the adjustment factor from equation 11 becomes largely guesswork if the market's consensus view of the relevant parameters is hard to ascertain. These beliefs can vary considerably from one setting to another. Applying the adjustment factor from equation 11 is therefore more difficult in reality than it is on paper even under the best of circumstances. Moreover, for many plausible parameter values, even relatively small changes changes in those values can have very large effects on the resulting award.[69]

Factors that push damages awards away from the expected harm are problematic because they distort incentives. Making plaintiffs whole is important for inducing them to invest ex ante. Damages that are systematically under- or over-compensatory distort investment behavior, leading to suboptimal allocation of capital. Optimal damages also create appropriate incentives for ex post behavior: Forcing companies to internalize the costs of their behavior can lead

[68] One might worry that the modern remedial environment has already made hash out of the dream of optimal deterrence. An old but still accumulating literature in securities regulation takes issue with the very logic of current remedial law (without even considering the reliability of measurement techniques). See, e.g., Robert B. Thompson, *The Measure of Recovery Under Rule 10b-5: A Restitution Alternative to Tort Damages*, 37 VAND. L. REV. 349 (1984); James D. Cox, *Making Securities Fraud Class Actions Virtuous*, 39 ARIZ. L. REV. 497 (1997); John C. Coffee, Jr., *Reforming the Securities Class Action: An Essay on Deterrence and Its Implementation*, 106 COLUM. L. REV. 1534 (2006); Jill E. Fisch, *Confronting the Circularity Problem in Private Securities Litigation*, 2009 WISC. L. REV. 333; Merritt B. Fox, *Civil Liability and Mandatory Disclosure*, 109 COLUM. L. REV. 237 (2009). As a general matter, insurance can be a problem, too. Liability insurers can act as a mechanism to induce socially sensible precautions. See, e.g., Omri Ben-Shahar & Kyle D. Logue, *Outsourcing Regulation: How Insurance Reduces Moral Hazard*, 111 MICH. L. REV. 197 (2012). But in the context of corporate governance, at least, insurance may aggravate moral hazard by undermining the practical threat of liability for directors and officers. See Tom Baker & Sean J. Griffith, *The Missing Monitor in Corporate Governance: The Directors' and Officers' Liability Insurer*, 95 GEO. L.J. 1795 (2007).

[69] Specifically, this will tend to occur when the denominator in equation 11 is small. For example, suppose that the court's best guess of the parameters ρ, π and ϕ are 0.1, 0.75 and 0.75, respectively. A very modest error range of $\pm$ 0.05 (i.e., plus or minus 5 percentage points) on each of these estimates yields adjustment factors ranging from 2.06 to 3.27. Other starting estimates can yield even more extreme ranges.

to better monitoring (perhaps by the D&O insurer) and optimal "breach."[70]

The upshot of all of this is that uncertainty, including judicial discretion, adversely affects the use of price drop damages. This cuts in favor of a clear meta-rule: in any particular legal context, it is best to pick an approach (simple price drop damages, adjusted price drop damages, or a direct damages measure) and stick with it.[71] While judicial discretion can be highly valuable in some contexts (discussed in more detail in the next two sections), discretion with respect to the approach to damages is unlikely to ever be unhelpful.

B. Costs and Bias-Variance Tradeoff

The bias inherent in price drop damages that we uncover is not necessarily fatal to their use. Even if optimal price drop damages are infeasible—perhaps for the reasons discussed in Section IV.A—simple price drop damages may still be superior to alternative, direct measures.

As discussed in Part I, the intellectual basis for price drop damages is that the market has access to more information than even the most well informed individual and that self interested traders can be trusted to accurately discern the implications of that information. Even the most skilled judge, the thinking goes, will be outmatched by the combined wisdom of the crowd. In contrast, we would expect a neutral judge to be an unbiased adjudicator. This leads to a bias-variance tradeoff: A direct measure of damages is likely to be less precise, but there is no particular reason to expect it to be systematically biased.

To be sure, there is much that is missing from the discussion above. Perhaps most obviously, claims about the relative ability to assess the implications of the available information assume that the same information is available. But this is often not the case. At T_1, market participants are making assessment based only on the information available to the public at that time. It is quite possible for information relevant to assessing the harm (H) to come to light after T_1. As long as it does so before the trial wraps up (or litigation is otherwise concluded), a judge can make use of this new information in crafting a remedy. This new information can arise in different ways: it might become

[70] While optimal breach is typically discussed in the contract context, it can also arise in the fiduciary setting. Consider, for example, the circumstances of *TripAdvisor*. If the value to the controller from moving to Nevada (for example, because of the increased flexibility afforded to management) exceeds the cost to the minority shareholders (in the form of diminished litigation rights), it is socially optimal for the the company to move *even if doing so is a breach of the controller's and the board's fiduciary duties*. Optimal damages ensure that fiduciaries will breach when, and only well, doing so is socially optimal.

[71] Alternatively, courts could set damages according to a weighted average of a variety of methods. But using price drop damages as one of the methods creates its own circularity: the lower the weight on price drops, the more reliable price drop damages become. That leads to the temptation to put more weight on price drops, thereby undoing the gains in reliability.

public in the ordinary course, or it could come to light in the discovery process.

A second element that is missing from the simplified story is cost. For example, expert witnesses are often called upon to help craft a direct damages award. And while equally well resourced parties might expect to fight to a draw in the battle of the experts (leading to unbiased results), this can lead to an arms race. To be sure, costly experts will also be needed to asses price drop damages. But since their work is likely to be more constrained, these costs may well be lower.

C. Navigating the Tradeoff

Putting these pieces together, we can come up with some concrete suggestions. First, we can identify settings where the implications of our analysis are fairly clearcut. Specifically, our model helps to illuminate settings where the bias inherent in simple price drop damages is likely to be small. So, for example, assuming that the other concerns raised in the literature are adequately addressed, our results suggest that price drop damages may be the best available option in the securities fraud context. This is a setting where the bias inherent in price drop damages is likely to be small, and the ability of judges to craft an alternative remedy is severely limited.[72] The same advice would hold for fines in contexts where insurance or other other third parties are likely to cover a very large fraction of the award.

At the other extreme are settings where the bias is likely to be large and judges with highly specialized expertise can craft a tailored award for a harm that can more easily be measured in other ways. An obvious example of the latter is related party transactions, where an asset is sold or otherwise transferred to an insider at a price that plaintiffs allege is below its market value. Such a claim before an expert tribunal—an obvious example of which is the Delaware Chancery Court—is well suited for a direct measure of damages.

The most interesting question, of course, is what to do in intermediate cases. When the bias is likely to be large and the direct alternatives are weak, price drop damages may be the least bad option. *TripAdviser* may be such a setting.[73]

[72]While information that comes to light through discovery may be highly probative as to liability (and particularly scienter), it is less useful in assessing the magnitude of the harm. To the extent that it does, this too should be reflected in the share price wen it becomes known to the public.

[73]A doctrinal change could also make price drop damages more appealing in this setting. Specifically, causing recoveries in derivative litigation to be paid out to the T_0 shareholders like a dividend (with the record date for this special dividend retroactively set for a few days before the news of the misconduct came to light) would effectively mean that $\phi = 0$. This, of course, would cause the bias to disappear.

Conclusion

Price drop damages are biased because of an inherent recursive property: damages are a function of the price change, which is itself a function of anticipated damages. Our model allows us to characterize both the extent and direction of this bias and to estimate its magnitude in different litigation environments. Price drop damages understate harm, potentially by a large amount, when the damages award benefits those who purchase the reference asset after the harm comes to light. When the opposite is true, they will overstate the harm.

Our analysis also serves as a reminder for scholars. Under semi-strong form efficiency, price reactions impound *all* publicly available information. As a consequence of this, event studies provide a measure of not just the first order consequences of the event in question; they will also pick up its expected legal consequences. While this observation is, on some level, completely obvious, it is easy to overlook. Indeed, the eminent scholars who advocated for, and happily accepted, price drop damages appear to have done so for decades. In this way, our analysis might also offer a lesson in academic humility.

Proofs

Proof of Proposition 1.
We begin by noting that P_0, P_1, ϕ, and ϕ are known at T_1. Given this, substituting equation 3 into equation 1, we have

$$
\begin{aligned}
P_1 &= P_0 - E[H] + \pi\phi(P_1 - P_0) \\
P_0 - P_1 &= E[H] - \pi\phi(P_1 - P_0) \\
(P_0 - P_1)(1 + \pi\phi) &= E[H] \\
P_0 - P_1 &= \frac{E[H]}{1 + \pi\phi}
\end{aligned}
$$

Which is defined as long as $\pi\phi \neq -1$. □

Proof of Proposition 2.

a) Again, we begin by noting that P_0, P_1, and ϕ are known at T_1. Substituting equation 3 into equation 7 therefore gives

$$P_1 = P^* - E[H] + \pi\phi(P_0 - P_1) \tag{12}$$

Define $A = \pi\phi$. Then we can simplify equation 12 to:

$$
\begin{aligned}
P_1 &= P^* - E[H] + AP_0 - AP_1 \\
P_1(1 + A) &= P^* - E[H] + AP_0 \\
P_1 &= \frac{P^* - E[H] + AP_0}{1 + A}
\end{aligned} \tag{13}
$$

Since $\pi\phi \neq -1$, equation 13 is well defined. This allows us to write equation 6 as

$$
\begin{aligned}
P_0 &= (1 - \rho)P^* + \rho P_1 \\
P_0 &= (1 - \rho)P^* + \rho\frac{P^* - E[H] + AP_0}{1 + A} \\
[1 + A]P_0 &= (1 + A - \rho - \rho A)P^* + \rho[P^* - E[H] + AP_0] \\
[1 + A - \rho A]P_0 &= [1 + A - \rho A]P^* - \rho E[H] \\
P_0 &= P^* - \frac{\rho E[H]}{1 + A(1 - \rho)}
\end{aligned} \tag{14}
$$

We can now compute damages. Substituting equation 13 into equation 2 yields

$$D = P_0 - \frac{P^* - E[H] + AP_0}{1+A}$$
$$D = \frac{P_0 + AP_0 - P^* + E[H] - AP_0}{1+A}$$
$$D = \frac{P_0 - P^* + E[H]}{1+A} \tag{15}$$

Substituting equation 14 into 15 gives

$$D = \frac{P^* - \frac{\rho E[H]}{1+A(1-\rho)} - P^* + E[H]}{1+A}$$
$$D = \frac{P^* + AP^*(1-\rho) - \rho E[H] - P^* - AP^*(1-\rho) + E[H] - AE[H](1-\rho)}{[1+A(1-\rho)](1+A)}$$
$$D = E[H]\frac{1-\rho-A(1-\rho)}{[1+A(1-\rho)](1+A)}$$
$$D = E[H]\frac{(1+A)(1-\rho)}{[1+A(1-\rho)](1+A)}$$
$$D = E[H]\frac{1-\rho}{1+A(1-\rho)} \tag{16}$$

Finally, substituting back $A = \pi\phi$, we have

$$D = \frac{E[H](1-\rho)}{1+A(1-\rho)}$$
$$D = \frac{E[H](1-\rho)}{1+\pi\phi(1-\rho)}$$

b) The damages award will be less in the presence of leakage ($\rho > 0$) if

$$\frac{E[H](1-\rho)}{1+\pi\phi(1-\rho)} < \frac{E[H]}{1+\pi\phi}$$
$$\frac{(1-\rho)}{1+\pi\phi(1-\rho)} < \frac{1}{1+\pi\phi}$$

Since $1+\pi\phi(1-\rho) > 0$ and $1+\pi\phi > 0$, this implies

$$(1-\rho)(1+\pi\phi) < 1+\pi\phi(1-\rho)$$

Which holds for all $\rho > 0$

c) The damages award will be less than the harm if

$$\frac{E[H](1-\rho)}{1+\pi\phi(1-\rho)} < E[H]$$
$$\frac{(1-\rho)}{1+\pi\phi(1-\rho)} < 1$$

Since $1+\pi\phi(1-\rho) > 0$ and $\pi\phi \neq 1$, this implies

$$(1-\rho) < 1+\pi\phi(1-\rho)$$
$$-\rho < \pi\phi - \pi\phi\rho$$
$$\rho(\pi\phi - 1) < \pi\phi$$
$$\rho > \frac{\pi\phi}{\pi\phi - 1}$$
$$\rho > \frac{-\pi\phi}{1-\pi\phi}$$

d) The damages award will be greater than the harm if

$$\frac{E[H](1-\rho)}{1+\pi\phi(1-\rho)} > E[H]$$
$$\frac{(1-\rho)}{1+\pi\phi(1-\rho)} > 1$$

Since $1+\pi\phi(1-\rho) > 0$ and $\pi\phi \neq 1$, this implies

$$\rho < \frac{-\pi\phi}{1-\pi\phi}$$

e) The damages award will be equal to the harm if

$$\frac{E[H](1-\rho)}{1+\pi\phi(1-\rho)} = E[H]$$
$$\frac{(1-\rho)}{1+\pi\phi(1-\rho)} = 1$$

Since $1+\pi\phi(1-\rho) > 0$ and $\pi\phi \neq 1$, this implies

$$\rho = \frac{-\pi\phi}{1-\pi\phi}$$

□

Proof of Proposition 3.

a) Again, we begin by noting that P_0, P_1, and ϕ are known at T_1. Since we assume that the damages rule is known at T_1, it follows that α is also known. Substituting 9 into equation 7, we have

$$P_1 = P^* - E[H] + \alpha\pi\phi(P_0 - P_1)$$

Repeating the steps of the proof part (a) of proposition 2 with this modification and using equation and 10 rather than equation 2, we have

$$D = \alpha E[H] \frac{1-\rho}{1+\alpha A(1-\rho)}$$

We now solve for α such that $D = E[H]$

$$\begin{aligned}
E[H] &= \alpha E[H] \frac{1-\rho}{1+\alpha A(1-\rho)} \\
1 &= \alpha \frac{1-\rho}{1+\alpha A(1-\rho)} \\
1+\alpha A(1-\rho) &= \alpha(1-\rho) \\
\alpha[(1-\rho) - A(1-\rho) &= 1 \\
\alpha(1-\rho)(1-A) &= 1 \\
\alpha &= \frac{1}{(1-\rho)(1-A)} \\
\alpha &= \frac{1}{(1-\rho)(1-\pi\phi)}
\end{aligned}$$

This implies that

$$D = \frac{P_0 - P_1}{(1-\rho)(1-\pi\phi)}$$

b) The damages will be larger than the price drop if

$$\frac{P_0 - P_1}{(1-\rho)(1-\pi\phi)} > P_0 - P_1$$

Since $1 - \pi\phi > 0$ and $1 - \rho > 0$, this implies that

$$\begin{aligned}
\frac{1}{(1-\rho)(1-\pi\phi)} &> 1 \\
1 &> (1-\rho)(1-\pi\phi) \\
\rho(1-\pi\phi) &> -\pi\phi \\
\rho &> \frac{-\pi\phi}{(1-\pi\phi)}
\end{aligned}$$

c) The damages will be smaller than the price drop if

$$\frac{P_0 - P_1}{(1-\rho)(1-\pi\phi)} < P_0 - P_1$$

Since $(1 - \pi\phi) > 0$, this implies that

$$\rho < \frac{-\pi\phi}{(1-\pi\phi)}$$

d) The damages will be equal to the price drop if

$$\frac{P_0 - P_1}{(1-\rho)(1-\pi\phi)} = P_0 - P_1$$

Since $(1 - \pi\phi) > 0$, this implies that

$$\rho = \frac{-\pi\phi}{(1-\pi\phi)}$$

□