Bias of Damage Awards and Free Options in Securities Litigation

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Abstract

Damage measures in securities fraud cases are very imprecise because they are based on security price changes that reflect both the correction of previous misrepresentation and other independent information. Consequently, potential plaintiffs have a valuable "free option" to decide whether or not to file suit, and average damage awards are greater than actual damages, much greater when markets are volatile. The "Private Securities Litigation Reform Act of 1995" was intended to curb abusive litigation and to address the problem of excessive damage awards. Motivated by a misdiagnosis that excess awards are due to temporary price drops, the Act limits damages to the difference between the purchase price and the time-average trading price from the release of the corrective information until 90 days later or until the sale of the security, whichever is first. Unfortunately, the Act's modified measure of damages suffers from a more severe free option problem than did the traditional measure. Also, the Act introduced an additional new option to time the sale of the security; the effects of these options may be mitigated by the impact of the positive drift in stock prices over time, if the time-average price is not adjusted for market movements. As a result, the bias can be larger or smaller under the new Act, depending on how severe the real option problem is.

We propose an alternative approach to addressing the issue of excessive damages: courts should adopt a threshold of measured damages below which no damage would be awarded. The threshold would depend on several factors, most notably the volatility of the stock in the period under question. That is, damages will be awarded only if measured damages exceed the threshold, and awards would be capped by the formula presented in the Reform Act.

Introduction

The "Private Securities Litigation Reform Act of 1995"[1] (called the *Reform Act* hereafter) is intended to curb abusive securities fraud litigation. Among other things, the *Reform Act* caps the award of damages, raises the standard for what investors must allege at the pleading stage, and reforms the joint-and-several liability rule to limit the financial liability of accountants and underwriters.

In this paper we focus on the impact of the Reform Act on limiting excessive damage awards. According to the *Reform Act*, the maximum award of damages to plaintiffs is based on the 90-day average trading price after the corrective information is disseminated to the market. (As an exception, the average is taken up to the date of sale if the security is sold before the end of 90 days.) The stated intention of such a "bounce-back" period is to avoid market overreaction, i.e., the market crash effect, on the day when the corrective information is released, "thereby limiting damages to those losses caused by the fraud and not by other market conditions."[2] To support this argument, the Conference Report particularly cited Lev and de Villiers (1994), which argues that the stock price immediately following the disclosure does not reflect the true value of the security, and therefore, it is more appropriate to use the mean trading price over several days after the disclosure is made.

While damage awards and settlements in such securities fraud cases may be excessive, and this is consistent with our model, we disagree with the cause diagnosed by Lev and de Villers (1994). First, there are numerous articles which examine whether markets tend to overreact or not, and many find little support for significant over-reaction. To the extent that statistically significant over-reaction is found, its average magnitude is insignificant for practical purposes.[3] Second, directly addressing whether there exists such

[1]Public Law 104-67, 104 H.R. 1058, 1995.

[2]Conference Report 104-369 (to accompany H. R. 1058) Nov. 28, 1995 at page 42.

[3]See Boudoukh, Richardson, & Whitelaw (1994) and the related literature cited in that paper. While Lev & de Villers (1994) cited some research which suggests that the market may overreact to the bad news, implying a positive drift term for the stock in the post announcement period, there is a large body of literature which concludes that the opposite is true, at least when the corrective information is in the form of earnings announcement.

a "market overreaction" after bad news is released to the market, Beaver, Malernee, & Zollinger (1996) examine all stocks traded on the NYSE, AMEX and Nasdaq in 1993 that had a decline of twenty percent or more in a single day. They find that the market does not systematically overreact or underreact to unfavorable information. Likewise, Dickey and Mayer (1996) report an average bounce back of 1.7% of the price drop, with a median of -2.5%.

In our point of view, excessive damage awards in securities fraud cases come from another source: the "free option" problem. In general, basing compensation for damages on the difference between the purchase price and the price on the day that the misrepresentation is corrected can generate an average award larger than the actual damage. This is because there are many reasons stock prices move besides the effect of any misrepresentations, yet measuring damages by taking the difference in prices cannot separate the price effect of the misrepresentation from the price effect of everything else. The "free option" problem arises in cases when the measured effect of the underlying action can be positive or negative: the potential plaintiff will sue only when the measured effect turns out to be negative, and therefore average awarded damages grossly overstate average actual damages. This possibility is particularly common in securities law because stock prices are generally unpredictable, and are difficult to explain even with hindsight. Some scholars (see Cornell & Morgan (1990) and Levine (1991)) have proposed to use the Capital Asset Pricing Model (CAPM) to adjust the damages calculated such that the stock price is adjusted for the overall market move. This is a useful correction, but it does not go very far because the CAPM explains only a small fraction of the total volatility in stock prices.

All numbers reported in tables in the paper are from stock prices simulated using a trinomial model of option pricing that is a close relative of the binomial model of Cox, Ross, and Rubinstein [1977] and the model of Black and Scholes [1973]. Calculations use a daily time interval, a reasonable assumed mean return, and a range of volatilities. This methodology allows us to simulate stock prices and predict the impact of various changes in the damage measure.

For examples, see Ball & Brown (1968); Foster, Olsen, & Shevlin(1984); and Bernard & Thomas (1989).

Section 1 investigates the free option for a traditional out-of-pocket damage measure based on the change in price between the day of purchase and the day of the corrective announcement. Our simulation demonstrates that the free option makes the average damage award larger than the actual damage. The bias is increasing in the stock's volatility and decreasing in the level of actual damages. When actual damages are large and volatility is small, the damage measure is almost always positive and consequently the free option's value of choosing strategically whether to sue is small.

The impact of going to the Reform Act's 90-day average price is explored in Section 2. There are two significant offsetting effects. First, using the average price contaminates the measure with price changes due to information arrival in the 90 days following the corrective information. This effect increases the bias due to the free option effect. The offsetting effect arises because the Reform Act's wording of the limit on damage awards does not seem to permit adjustment using the CAPM for overall market moves. Removing this traditional adjustment makes the bias smaller, since it restores the tendency of the upwards trend in stock prices. The two effects are typically of a similar order of magnitude. When volatility is large and actual damages small, the bias is larger using a 90-day average price, while when volatility is low and actual damages are large, the bias is smaller or perhaps even negative using a 90-day average price. In most cases, changing to the Reform Act's measure is probably irrelevant and does not address the bias. It is ironic that the Reform Act's measure does particularly badly in the sort of turbulent markets that motivated the reform.

Potential litigants have a second option deriving from the fact that a sale within the 90-day period that follows the corrective information terminates the interval of dates over which the time-average is computed. If, for example, the current price is smaller than the average price, the shrewd potential litigant knows that the average price will fall over time, predictably increasing measured damages, and will therefore refrain from selling. However, if the market price is much higher than the average so far, it pays to sell immediately to keep the average price from rising and the damage award from decreasing. Valuing the benefit from this second option is a variant of traditional option pricing problems, and the impact on the bias is shown in Section 3.

The damage measure proposed by the Reform Act sets a maximum, or upper bound, for damage awards. Since this measure does not specify the formula for computing damages beyond setting the upper bound, nor does it resolve the issue of excessive damages, we propose a modified measure that is consistent with the Reform Act yet is better in reducing excessive damages. Our proposal calls for applying the Act's damage measure, but only subject to a threshold indicating that measured damages are not too small compared to the normal statistical variation; below the threshold no damages would be awarded. The intuition here is that if measured damages are too small, they are probably the result of the stock's volatility rather than a material misrepresentation. The threshold is qualitatively similar to imposing a requirements of statistical significance. The threshold depends on several things, most importantly the volatility of the stock. It is important in applying the threshold to use a volatility for the period, not just a historical volatility that may have come from quieter times. The threshold and its impact are discussed in Section 4.

Before turning to the analysis, we should note that this paper is concerned solely with the question of bias in measuring out-of-pocket damages, not with the broader economic question of whether society is better off with that rule.

1 The Out-of-Pocket Damage Measure and the Free Option

The measure of damages for violation of Rule 10b-5 has always been somewhat ambiguous because Section 10(b) of the 1934 Securities Exchange Act and Rule 10b-5 specify no measure of damages, and the case law has not been uniform. The out-of-pocket measure is probably the most popular one and has survived review by the Supreme Court.[4] The out-of-pocket measure attempts to compensate the plaintiff for damages suffered due to misrepresentation or omission of material information. The Tenth Circuit has defined a plaintiff's recovery under the out-of-pocket rule as "the difference between the contract price, or the price paid, and the real or actual value at the date of sale." The recovery for a seller is defined similarly.[5] The difficulty in implementing the out-of-pocket measure is how to define what the "true value" of the security is. Typically, it is assumed that the price of the security on the day the corrective information gets disseminated to the market reflects the "true value," which is argued to be consistent with the efficient market hypothesis.

In practice, the change in market price is adjusted for overall movements in the stock market, to attempt a better job of isolating the mispricing of the particular stock. This adjustment, based on the CAPM, can improve the accuracy of the measure but not by very much (A brief introduction to the CAPM adjustment and its effectiveness are given in Appendix I). This

[4] *Affiliated Ute Citizens*, 406 U.S. 128 (1972), at page 155.

[5] For more on different damage measures see Lee(1987), which details various measures and related difficulties, and Thompson (1996). Other measures the court sometimes adopt include the benefit-of-bargain, the cover measure, and the rescission and restitution measure. The benefit-of-bargain measure differs from the out-of-pocket measure by focusing on how much the plaintiff could potentially gain had the misrepresentation been true. A cover measure of damages provides a measure of damages for a defrauded *seller*. It equals the difference between the price at which plaintiff sold the security and the highest price the security reached within a reasonable time after the withheld information was disclosed publicly. The *Chasins* measure provides a measure of damages for a defrauded *buyer*. It awards a defrauded plaintiff the value of the consideration paid minus the lowest value the security reaches within a reasonable time after the fraud is discovered or should have been discovered. A rescission and restitution approach allows a defrauded investor to recover the entire purchase price.

adjustment is of interest to us mostly because it may no longer be possible to apply the adjustment under the Reform Act. The *Reform Act* specifies that damage awards will not exceed the difference between the purchase price and the mean trading price during the 90-day period beginning on the date on which the correcting information is disseminated to the market.

Many people seem to think that using market prices in the out-of-pocket measure of damages tends to create awards that exceed actual damages resulting from misstatements or omissions of material information. As an empirical matter, this is hard to determine because actual damages are difficult to measure; this explains why the academic literature focuses on anecdotes and has little hard evidence. Nonetheless, the literature does seem to agree there are excess damages, and that is consistent with our analysis. What is more contentious is the reason for damage awards that are too large; the reason is important because it influences our evaluation of different policies that attempt to correct the problem.

In particular, Lev and de Villiers (1994), which was cited prominently in the Conference Report to the 1995 Act, argues that damage awards are too high because they are influenced too much by temporary drops in the stock price. Although this work has been successful in influencing legislation, it has not identified the real source of excessive damage awards. The preponderance of evidence is that stock prices are efficient or nearly efficient, while the notion of temporary changes in stock prices espoused by Lev and de Villiers would imply substantial inefficiency in stock prices. Not surprisingly, the remedy in the *Reform Act*, which treats the wrong disease, is ineffective, as documented by Beaver, Malernee, and Zollinger (1996) and by Dickey and Mayer (1996), as is further discussed below in Section 2.

It is our thesis that the large damage awards are due to two features of the world. The first feature is that stock prices are very volatile and react to the arrival of different kinds of news, not just news correcting the misrepresentation. The second feature is that people who buy shares will file suit only when the out-of-pocket measure indicates they have lost money.[6] Together,

[6]This is similar to, but quite different from, the arguments about litigation contingent on whether the expected award covers costs. In that case, we might find average damages conditional on a suit are larger than the average actual damages, due to the fact that only cases with large damages are litigated or settled. However, in that case, overall

these two features imply that an investor contemplating litigation has a "free option", and damage awards could be substantial even when there is little or no actual damage.

An example illustrates the free option. Suppose the fair price of a security is \$20 at time $t = -1$. This price could move, with equal probabilities 1/2 and 1/2, up to \$30 or down to \$10 by time $t = 0$. Further assume that the misrepresentation makes investors believe that the value at $t = -1$ was \$28, \$8 too high, and that some shareholders bought the security at $t = -1$ for the inflated price of \$28. Also assume that the misrepresentation is revealed at $t = 0$.

According to the out-of-pocket measure of damages, an investor who purchased the security at \$28 per share should be compensated for \$18 when the stock is down to \$10 per share at $t = 0$, and -\$2 when the stock goes up to \$30 per share. Of course, the investor would not file a suit in the latter case, and therefore he will receive \$18 half the time and \$0 half the time. Thus, the expected damage award is \$9 share, which exceeds the actual damage to the plaintiff, which is \$8 per share in this case.

Of course, if the court could ask the plaintiff to return the \$2 per share when the stock price rises, then there would be no excessive damage awards. This is an issue that stems from the structure of the legal system and the choice given to plaintiffs concerning whether to pursue a lawsuit. The point is that while damage awards based on the average stock price would make the investor whole, the same awards conditioned on a fall in stock price are too great. In effect, the investor collects on the downside but does not pay on the upside, which is the same as owning a put option.

There is an extreme case in which the actual damages are so large that under any conceivable increase in the stock price measured damages are not negative. If the misrepresentation mispriced the security by \$15 in the previous example, so the investor paid \$35 for something that went down to either \$10 or \$30, then damage awards would be \$25 half the time and \$5 half

damages are too small because some cases with positive damages are not litigated. In our analysis, damages are too large because the only cases not litigated are the ones in which the damages are negative. If we added costs, either effect could dominate, although the large randomness in security returns would weigh towards the free option effect.

Average Award per $100 Share Purchase: Traditional Measure Adjusted for Overall Market Moves, Given a Correction Date One Month After the Original Purchase					
actual damages	annualized standard deviation .... normal .... turbulent				
	20%	40%	60%	80%	100%
0	2.3	4.6	6.9	9.2	11.5
5	5.6	7.5	9.7	11.9	14.2
10	10.1	11.2	13.1	15.1	17.2
20	20.0	20.2	21.1	22.5	24.2
40	40.0	40.0	40.1	40.4	41.1

Table 1: Value of the free option: purchase one month prior to the corrective information

The table uses a trinomial model to compare actual damages to the average awarded damages where the damage measure is equal to the decline in the stock price from the day of the purchase to the day when the corrective information was announced. The mismeasurement is due to the fact that the actual damages represent only a portion of the price change and that the investor has a free option to sue or not, and does not sue when the measured damages are negative. Appendix II provides the details of the trinomial model that was used to create the numbers in this table. The mean damage award is significant even when the misrepresentation is immaterial, and the bias is particularly large in turbulent times, for example during a market crash.

the time, or $15 on average, an amount that would make the investor whole. It is really the option *not* to litigate, not the option to litigate, that is the free option that adds value. Given the high degree of volatility in security returns, we think of this extreme case as being uncommon in practice.

To obtain an idea of the order of magnitude of the mismeasurement of damages due to the free option problem, we have used a trinomial model detailed in Appendix II. Tables 1 and 2 compare actual damages with the average awarded damages; the excess of the average award over actual damages is the value of the free option. As in the simple examples, the average award is the average across random contingencies of positive awards in contingencies when the measure is positive and zero awards when the measure is negative. Of course, if we were to look at a dataset of settlements or judgments, we

Average Award per $100 Share Purchase: Traditional Measure Adjusted for Overall Market Moves, Given a Correction Date Four Months After the Original Purchase					
actual damages	annualized standard deviation .... normal .... turbulent				
	20%	40%	60%	80%	100%
0	4.6	9.2	13.8	18.4	23.0
5	7.5	11.9	16.5	21.0	25.6
10	11.2	15.1	19.4	23.9	28.4
20	20.2	22.5	26.1	30.1	34.4
40	40.0	40.4	42.1	44.9	48.4

Table 2: Value of the free option: purchase four months prior to the corrective information
This table is comparable to Table 1 but assumes that the misrepresentation is corrected four months, not one month, after the purchase. The impact of the additional time is almost identical to the impact of additional volatility, since having the time prior to the correction multiplied by four means four times the variance or twice the standard deviation.

would obtain a higher number because we would not be including the zero-damage outcomes. Instead, we would be averaging only over the positive awards. However, looking at all outcomes, positive and zero, is appropriate for the economic question we are asking on whether the agent is compensated correctly on average, *ex ante*.[7]

Volatility and the length of time between the purchase and the correction of the misrepresentation are both important determinants of the value of the free option. Table 1 assumes one month passes between the purchase of the security and the release of corrective information, while Table 2 assumes a four month interval.[8] In fact, additional passage of time and additional

[7]We might imagine that risk aversion would justify higher average compensation as a reward for taking risk. However, this additional compensation should be small because of the value of diversification and because of the agent's revealed willingness to face the risk of stock ownership.

[8]In principle, we could think about the time until corrective information comes out as random and we could even have some probability that the misstatement was never discovered. Such considerations would, however, take us far afield.

volatility in the stock market both increase the value of the free option for exactly the same reason: in both cases, additional information arrival further contaminates the quality of the price change as a measure of actual damages. The worse the quality of the price change as a measure, the greater the value of the free option to opt in or out of litigation based on the confounding information. Quantitatively, doubling the standard deviation increases the variance by a factor of four, as does multiplying the amount of time by four. This is why real option values in Table 2 are essentially equal to the values for double the standard deviation in Table 1.

In interpreting the tables, we think of a volatility of 40% as typical of a small- to medium-sized firm that might typically be involved in such a suit. A volatility of 20% is probably a bit low, even for a stable "blue-chip" stock. The higher volatilities are appropriate for times of great turbulence in the stock market, as around a market crash. During turbulent times, volatilities can be much higher than usual. For example, the one-day fall in market indices during the crash in 1987 was over 20%, and was roughly equal to one year's typical move in the index. This extremely high level of volatility does not persist for many months, so we do not want to get carried away with assuming large volatilities over many months. However, the large standard deviations in Tables 1 and 2 do seem like reasonable values for turbulent periods.

Even when the misrepresentation is not material, and therefore actual damages are zero, average awarded damages are substantial. For example, when volatility is 40% and corrective information is revealed after one month, the average awarded damages overall (including cases when suits are not filed) are 4.6%. In other words, someone who buys 100 shares at $100 each and sells one month later after the dissemination of corrective information can collect on average liability payments of $(4.6/100) \times 100 \times \$100$ or $460 (before accounting for litigation costs). In this example the awarded damages are purely the result of the free option, since there are no actual damages in this case.

The results in this section assume no drift in stock prices, which is the natural assumption if we assume that stock price changes are adjusted by the common method (using the CAPM or security market line) to remove the mean return and the part of the return that is correlated with the market. In this case, it is appropriate to interpret the standard deviation as the idiosyncratic part of the overall volatility of the stock. This part is due to arrival of information unrelated to stock movements as a whole. In practice, the market explains only a small part of a stock's movement and the overall standard deviation is not much different from the idiosyncratic standard deviation.

The assumption of zero drift may seem peculiar around a market crash. It is worth noting, however, that just before the crash agents in the economy know volatility is high but do not know what direction the market is moving in. Also, if we adjust for market movements, some stocks go up and others go down. Studies have shown that the volatility of the idiosyncratic part of returns tends to be high when volatility of the overall market is high.

To summarize the results of the section, the traditional out-of-pocket measure of damages generates a free option: a potential plaintiff can choose whether to sue, based in part on information contaminating the damage measure that has nothing to do with the misrepresentation that is alleged to have caused the damages. Because there will be a suit when measured damages are too high but not when measure damages are too low (by far enough), the average award under the traditional damage measure is too high. The bias in the average measured damages is particularly large when the volatility is high or the wait for corrective information is long. The bias tends to become smaller as the actual damage rises.

2 Computing Damages Using 90-day Average Prices

The Reform Act specifies that damage awards should not exceed the difference between the purchase price and the average of prices taken from the correction of the misinformation until 90 days later or until sale of the security, whichever comes first. Because of the "no greater than" clause, the Reform Act leaves a lot of room for specification of actual damage awards. Our analysis considers the amount of bias that would arise from using the upper bound given in the Reform Act as the measure of damages. In this section, we consider the damage measure using an average of prices during

prices			award	award
time = -1	time = 0	time = 1	single price	time average
$28	$10	$0	$18	$23
$28	$10	$20	$18	$13
$28	$30	$20	$0	$3
$28	$30	$40	$0	$0

Table 3: Prices and Damage Award in an Example

This example illustrates why damages can be even higher under the averaging rule. Adding noise makes it profitable to sue in some contingencies that were not profitable when damages are based on the price at the time when the corrective information is revealed.

the 90-day following the dissemination of the corrective information. In Section 3, we consider the value of the shareholder's option to sell during these 90 days.

The 90-day average specified in the Reform Act increase the value of the investor's free option and the related bias in damage awards. This is because including later prices in the calculation of damages only contaminates the measure with additional information that arrives subsequently once the correction has already been made. A second possible effect of the Reform Act is that it may no longer be possible to use an adjustment for overall market moves; we leave this second point aside for the moment and return to it later in the section.

An example may serve to illustrate why averaging over an extended period degrades the quality of the damage estimate. In this example, which builds on the example presented in section 1, we will have averaging over two dates for simplicity. Recall that the fair price is $20 at time $t = -1$, and that could move, with equal probabilities 1/2 and 1/2, up to $30 or down to $10 by time $t = 0$. Further assume that the misrepresentation makes investors believe the value at $t = -1$ was $28, $8 too high, and that some shareholders bought the security at $t = -1$ for the inflated price of $28. Also assume that the misrepresentation is revealed at $t = 0$. Subsequently, at $t = 1$, the price could again move up or down $10 with equal probabilities 1/2 and 1/2. Thus the price movements and computed damages in the four equally probable cases are as shown in Table 3.

For example, in the first contingency, described by the first line in the table, the true value is \$20, the purchase price is \$28, the price at $t = 0$ is \$10 and the price at $t = 1$ is \$0. Damages based on the $t = 0$ price, without averaging, are \$28 - \$10 = \$18, while damages based on the average price are \$28 - (\$10 + \$0)/2 = \$23. The average damage award based on the $t = 1$ price is (\$18 + \$18 + \$0 + \$0)/4 = \$9, while the average damage award based on the time-average price is (\$23 + \$13 + \$3 + \$0) = \$9.75. The additional value of the option is based on the fact that the investor can decide more finely (distinguishing the third and fourth cases) when to sue. This is related to the basic result from option pricing theory that an option is more valuable the more volatile is the value of the underlying asset.

Realistic estimates of the change in damages due to the decreased accuracy of using a 90-day average price instead of the single price on the correction date can be seen by comparing Table 4 with Table 1. The increase in the bias is not huge, but is disappointing in a reform that is supposed to reduce the bias. The increase in the bias is largest when actual damages are small and the standard deviation of returns is large.

Now, let us return to the second possible impact of the Reform Act. One literal reading of the Act suggests that the 90-day average price used to compute damages cannot be adjusted for overall market returns as has been done in the past. Combined with the relatively long time period associated with a 90-day average, the fact that stock prices tend to rise on average will tend to reduce the award in the absence of the adjustment. A typical magnitude of the effect is shown in Table 5. The good news is that there is usually a reduction of the bias that is introduced by time-averaging in Table 4. In what we think would be the most typical cases, the two effects are roughly offseting, which is consistent with the empirical observation of Beaver, Malernee, and Zollinger (1996) and Dickey and Mayer (1996). Nonetheless, a comparison of Table 1 and Table 5 reveals that the overall bias increases when the actual damages are small and the volatility is large, while the bias becomes negative when actual damages are large and the volatility is small, a case when the bias was negligible before. This pattern reflects the relative importance of the free option in various cases. The free option effect is relatively unimportant when damages are large and volatility is small, since in this case the damage measure is nearly always positive and commitment to sue all the time is not much different from having an option. These are the cases where the

Average Award per $100 Share Purchase: Reform Act 90-day, Adjusted for Overall Market Moves, Given a Correction Date One Month After the Original Purchase					
actual damages	annualized standard deviation .... normal .... turbulent				
	20%	40%	60%	80%	100%
0	3.3	6.5	9.8	13.0	16.3
5	6.3	9.3	12.5	15.7	18.9
10	10.4	12.7	15.6	18.6	21.8
20	20.0	20.9	22.9	25.4	28.2
40	40.0	40.0	40.5	41.7	43.5

Table 4: Value of the free option: purchase one month prior to the corrective information

Using a 90-day average price is supposed to make the measurement of damages more accurate, but it actually makes it less accurate and therefore increases the value of the free option somewhat, as can be seen by comparing this table to Table 1. The reason is that damages can be awarded now for information that arrives after the corrective information but has nothing to do with the misrepresentation. This table assumes the same correction for overall market moves as in Table 1.

Average Award per $100 Share Purchase: Reform Act 90-day Measure Unadjusted for Market Moves, Given a Correction Date One Month After the Original Purchase					
actual damages	annualized standard deviation .... normal .... turbulent				
	20%	40%	60%	80%	100%
0	1.9	5.1	8.3	11.5	14.8
5	4.3	7.5	10.7	14.0	17.2
10	7.8	10.5	13.6	16.7	19.9
20	16.9	18.1	20.4	23.2	26.1
40	36.9	36.9	37.6	39.0	40.9

Table 5: Value of the free option, unadjusted for overall market movement
The wording of the Reform Act may not allow the commonly-used adjustment of damages for overall market moves. Without this adjustment, the general upwards drift of stock prices reduces the damage awards somewhat. This tends to reverse the increase in the bias caused by moving from using one price to using a 90-day average price we saw in moving from Table 1 to Table 4. The net effect (moving from Table 1 to this table) can be positive or negative.

change in volatility does not change the free option value much (it remains worthless) and the effect of the drift dominates.

To summarize the results of this section, basing damages on a 90-day average instead of a single price does not change the bias much in most ordinary cases, but can affect it significantly in one direction or the other in some extreme cases. This ambiguous result arises from offsetting effects of reducing the precision of the measure while reducing average damages due to a failure to adjust for the drift in the stock price. Overall, we probably should not take much comfort from the fact that, for the wrong reason, the change in the measure in the Reform Act does less harm than it might. To be fair, the Reform Act does leave open the possibility that the damages assessed can be less than those measured using the 90-day average price. We will return to some specific suggestions, including the imposition of a threshold below which damages cannot be awarded, in Section 4.

3 The Option to Sell to Lock In Damages

One interesting feature of the Reform Act we have not emphasized so far is the option of a potential plaintiff to sell before the 90 days are up. In this case, the average price is taken from the time of the corrective announcement until the sale date. Although market prices are not very predictable, the average price is predictable. For example, when the market price is below the average price, the average will fall over time, at least until the two are equal or cross. In this case, the plaintiff should refrain from selling to allow the average to fall which will increase the damage award under the Reform Act. Conversely, if the price is well above the current average, the plaintiff can predict that the average will rise in the short run and should sell to lock in the current award. If the current price is equal to the average or only slightly above, the option to sell strategically later is valuable, and it pays not to sell. Determining the exact optimal strategy is an option pricing problem that is only slightly nonstandard, and is easily handled by standard analysis. As a practical matter, plaintiffs can achieve something near the optimal value by following the basic rule of thumb we have discussed: sell when the price is significantly above the average.

Table 6 shows how the option to sell early affects damage award. In this case, the trinomial model uses standard option pricing techniques in a model with two state variables, the stock price and the average so far. The objective is a little different than in most option pricing problems, since we are maximizing the expected payoff, not its market value. (There may be a conceptual reason for maximizing market value instead. For our purposes, it does not matter much and this is easier to interpret.) This case is the motivation for using a trinomial model in the first place, since it is much easier to solve this sort of optimization in an arithmetic trinomial model than in a lognormal diffusion model.

To summarize, the option to time selling of the securities to lock in the average price is a significant source of value for potential plaintiffs. However, its potential is usually less than the value of the free option to decide whether the sue. The timing option will be relatively more valuable in cases with very large actual damages or low volatility in which the free option is not particularly valuable.

Average Award per $100 Share Purchase: Reform Act 90-day or Sale, Unadjusted for Market Moves, Given a Correction Date One Month After the Original Purchase					
actual damages	annualized standard deviation .... normal .... turbulent				
	20%	40%	60%	80%	100%
0	2.6	6.3	10.0	13.8	17.6
5	5.7	9.3	13.0	16.8	20.5
10	10.0	13.0	16.5	20.1	23.8
20	19.8	21.8	24.5	27.7	31.1
40	39.8	41.5	43.3	45.5	48.0

Table 6: Expected damages given the option to sell early
In the Reform Act, the 90-day average of prices is replaced by an average until sale if a sale occurs before 90 days are up. A shrewd potential plaintiff will time the sale of the asset to maximize the expected damages, for example by selling when the current price exceeds the average so far and therefore it can be predicted the average will rise, leading to smaller damages if there is no sale. This table is comparable to Tables 1 and 5.

4 A Threshold Improves the Damage Measure

Having a damage measure based on stock prices is appealing because stock prices are much easier to observe and interpret than other quantities within the firm. Unfortunately, as we have seen, using stock prices either in the traditional way or in the way specified by the Reform Act is a very inaccurate measure of damages and has a strong upwards bias. There is nothing we can do about the inaccuracy of the damage award given stock prices, but we can work to reduce the bias. If there were no uncertainty, we could simply undo a known bias directly. For example, assuming a standard deviation of 40%, we could note that in Table 6 we have measured damages of 9.3% correspond to actual damages of 5%, then we could simply award damages of 5% whenever there is no uncertainty and measured damages were 9.3%. Unfortunately, it is not so simple, since uncertainty implies that measured damages of 9.3% are an average of a lot of numbers, including many that are larger than

Average Award per $100 Share Purchase: Reform Act 90-day or Sale, Unadjusted and with Threshold, Given a Correction Date One Month After the Original Purchase					
actual damages	annualized standard deviation .... normal .... turbulent				
	20%	40%	60%	80%	100%
0	1.9	4.0	6.1	8.2	10.3
5	4.9	6.7	8.7	10.8	12.8
10	9.5	10.4	11.9	13.8	15.7
20	19.7	20.1	20.4	21.4	22.8
40	39.8	41.4	41.1	41.3	41.3
threshold	6.0	15.1	24.3	33.4	42.5

Table 7: Expected damages using a 90-day average price with a threshold equal to the standard deviation minus the mean over a period that spans from the purchase to 45 days subsequent to the corrective information. Having the threshold does not eliminate the bias entirely (nothing can), but it does reduce the bias in the worst cases.

9.3%. That is, actual damages of 5% lead to measured damages of 9.3% on average, but measured damages of 9.3% do not necessarily correspond to actual damages of 5%.

In order to reduce the problem of excessive damage awards without violating the cap on awards that is specified by the Reform Act, we propose using a threshold below which damages are not awarded. Below the threshold, the judge would award no damages because there is a very high likelihood that there are little or no actual damages. This threshold should depend on the volatility of the stock price, and in particular should be higher in times of high volatility (such as around a market crash).

Table 7 shows the effect of having a threshold equal to the standard deviation of the stock price minus the mean over the initial period from purchase until 45 days subsequent to the correction date. This table is comparable to Table 6 which has no threshold. For this threshold, the bias is still positive when actual damages are low or volatility is high, and negative when volatility is low and actual damages are high. While there is a limit to how well any adjustment can do, this rule seems to do a good job of reducing the bias and should eliminate many of the more abusive suits while still awarding more or less correct damage on average for the more substantive suits. To do better, we would have to award more than the cap that is specified in the Reform Act for extreme price declines and a negative amount when the price rises or declines a small amount. Of course, awarding a negative amount is not feasible since the potential plaintiff would have no incentive to sue.

5 Conclusion

A stock investor's options whether to litigate and when to sell introduce a bias in damage awards for securities fraud cases. The adjustment to damages in the Reform Act is ineffective and in some cases makes the problem worse. There is no perfect solution, but a threshold below which an award is not granted can reduce the bias significantly. The threshold should depend on the volatility of the security during the period in question, and not just on some historical average that may be smaller or larger.

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Appendix I: Using the CAPM to Adjust for Overall Market Moves

Financial theory tells us that investors base their decisions on assessments of risk and expected return. Two types of risk determine the price at which investors will trade a stock — market risk and firm-specific risk. Market risk is the potential for change in a stock price owing to the nature of the market and economy. It captures the reaction of individual stocks to the general market swings. Firm-specific risk reflects features unique to an individual company, including the risk of corporate mismanagement and fraud. Firm-specific risk can be eliminated through diversification, while market risk cannot. Based on this theory, the Capital-Asset Pricing Model (CAPM) tells us that the expected return of an asset should be positively related to the market risk exposure, but not to firm-specific exposure.

Using the CAPM model to estimate damages in "Fraud on the Market" cases, Cornell and Morgan (1990) describe the so called "value line" procedure. Assuming that the stock price at the end of the day on which the correcting information is disseminated reflects the stock's true value, one can extrapolate backwards the "true value" for every day the misrepresentation went uncorrected, with adjustment to market or industry movement during the same period. Out-of-Pocket damages are then the difference between the price the plaintiff paid and the "true value" on the purchase day, multiplied by the number of shares that the plaintiffs purchased. Levine (1991) also proposes a similar adjustment of the out-of-pocket measure to eliminate the volatility caused by market factors.

Unfortunately, the explanatory power of the CAPM model is low when the return of a company's stock is regressed on market returns. Researchers have found that the commonly used static CAPM model when β is assumed constant over time can only explain a small percentage of the variation in stock prices. For example, with the adjustment for seasonality, Lamoureux and Sanger (1989) find that the CAPM model can explain about 0 to 24% of the variations of stock returns for those listed on NYSE-AMEX, or about 1 to 21% of the variations of the stock returns for those traded on NASDAQ. Without the adjustment for seasonality, the explanatary power of the CAPM is even smaller. Roll (1988) finds that with hindsight the average adjusted R^2 is only about 0.20 with daily data, which means that only about 20% of the variation in the daily stock prices can be explained *ex post*.

In general, because of the weak explanatory power of the CAPM, adjusting the out-of-pocket measure by using the CAPM model is not adequate to separate price drops that are due to fraud from those due to the market move. This is especially true when the impact of the fraud is small and the volatility of the stock price is high (e.g. around a market crash[9]).

Appendix II: Details of the Simulation Model

The simulation is based on a standard trinomial model of stock returns. This is similar to the binomial model of Cox, Ross, and Rubinstein [1979], only with three possible stock outcomes (up, down, flat) instead of two. Having the extra step reduces cycling and improves convergence as the time grid gets finer. Conceptually, there is no important difference between what is done here and the binomial model or the Black-Scholes [1983] model. In fact, to make sure the results are robust to the specific assumptions, spot checks have verified that the results are almost the same (usually to the precision of the tables) in a Monte Carlo simulation with 1,000,000 stock price paths using lognormal returns like those in the Black-Scholes model. The computations in the simulations reported in the table do not use Monte Carlo random draws and instead compute expectations directly using the obvious recursive formulas as in option pricing or dynamic programming. This approach is slightly more reliable than Monte Carlo simulation, provides numerical convergence in one pass, and does not suffer from potential defects in the random number generator or rounding error from averaging many numbers.

Trading takes place at discrete times separated by intervals of length Δt. Date number 0 is the date the misinformation is corrected in the market, and the shares were purchased (perhaps through an IPO) k periods earlier,

[9] Around a market crash, both the volatility of the market indices and the volatility of individual stocks given market indices are high.

at date number $-k$, which occurs $k\Delta t$ periods before the release of information at date number 0. We consider simulated prices for n days following the correction, to be used for computing average prices, and we set $n = 0$ if we are computing damages based on the single price on the day of the correction. The price dynamics for a share of stock in the firm are driven by an underlying process q_i which can take on three values, drawn independently and identically across t:

$$(1) \quad q_i = \begin{cases} 2 & \text{with probability } \pi_u \\ 1 & \text{with probability } \pi_m \\ 0 & \text{with probability } \pi_d \end{cases} .$$

Then the stock price is an arithmetic random-walk-with-mean whose increments are a function of q plus a correction term d_i which is nonzero only on the correction date 0:

$$(2) \quad S_{-k} = 100$$

$$(3) \quad S_i = S_{i-1} + (q_i - 1)(100\sigma\sqrt{1.5\Delta t}) - d_i,$$

where

$$(4) \quad d_i = \begin{cases} \Gamma & \text{for } i = 0 \\ 0 & \text{otherwise} \end{cases} .$$

The initial price is \$100, but it would be \$100$-\Gamma$ if not for the misinformation. The probabilities π_u, π_m, and π_d are given by

$$(5) \quad \pi_u = \frac{1}{3} + \frac{\mu\Delta t}{2\sigma\sqrt{1.5\Delta t}}$$

$$(6) \quad \pi_m = \frac{1}{3}$$

and

$$(7) \quad \pi_d = \frac{1}{3} - \frac{\mu \Delta t}{2\sigma\sqrt{1.5\Delta t}},$$

which are chosen to give the stock a mean return of μ per unit time and a variance of return of σ^2 per unit time. In the simulation, the mean return μ we use is a normal sort of market return (15%/year) if we are looking at a measure based on raw returns, or zero if we are using the CAPM to adjust returns for market moves (since the mean of the market return being subtracted out cancels the stock's own mean). Each table reports a range of annual standard deviations.

Note that we are using "absolute" (not "relative") returns, that is, the size of the increments does not adjust when the stock price changes. This makes the computations easier because it makes the average stock price depends on accumulating the cumulative number of down moves and not more finely on the actual path. For example, if the stock price moves up and then down twice, the average price is the same as if it stayed unchanged or moved down and then up twice. Using relative returns would not make a big difference, based on our spot checks using a Monte Carlo simulation with 1,000,000 simulated stock price paths and a lognormal price process.

One feature of the return process is that the corrective information does not leak out between date $-k$ and date 0. However, the results reported in the paper would be exactly the same if some or all of the information were to leak out in between the two dates. (Some calculations of intermediate prices in the program would change, but not the final number.) What is essential is that the leakage of information does not change the information set at date $-k$ or date 0.

Constructing the tables in the paper required calculations of computing average awards. This could be done by Monte Carlo simulation, but instead our simulation computes the averages more directly using an option pricing or dynamic programming approach. The expected performance measure in all the cases depends on the stock price path only through current stock price, running-average stock price, and time, and these are chosen as the state variables of the problem. The approach to computing the means is to compute the performance measure for all possible values of the state variables at the end, and then use the definition of one-period expectations to step back in time. In the program,[10] it is simpler to work with integer versions of these state variables to summarize where we are in the price tree.

The two state variables x and y are defined by

$$(8) \quad x_i \equiv \sum_{-k<j\leq i} q_j$$

and

$$(9) \quad y_i \equiv \sum_{0\leq j\leq i} x_j.$$

By convention, we take an empty sum to be zero, so $x_{-k} = 0$ and $y_i = 0$ when $i \leq 0$. The state variable x determines the stock price through the formula

$$(10) \quad S_i = 100 + 100\sigma\sqrt{1.5\Delta t}(x_i - i - k) - D_i,$$

where D_i is the cumulative sum of d_i:

$$(11) \quad D_i = \begin{cases} \Gamma & \text{for } i \geq 0 \\ 0 & \text{for } i < 0 \end{cases}.$$

The state variable y determines the running-average price for computing damages starting at time 0. For $i \geq 0$, we have that the running average is

$$\overline{S}_i = 100 + 100\sigma\sqrt{1.5\Delta t}\frac{1}{i+1}\left(y_i - \frac{(2k+i)(i+1)}{2}\right) - \Gamma.$$

[10] Literally speaking, our program works with one plus the variables described, so they can be used as array indices with FORTRAN's default base of one.

In this expression, $(2k+i)(i+1)/2$ is the value of y_i corresponding to all middle price moves, and the factor $1/(i+1)$ is there because we are averaging the $i+1$ price observations for dates 0, 1, ... , i.

For a sale at date i, the damage amount is the larger of 0 and the purchase price S_{-k} less the average price $\overline{S}(y,i)$, and at the terminal date we have

$$(12) \quad v(x,y,n) = \max(0, S_{-k} - \overline{S}(y,n)),$$

where $v(x,y,i)$ is the expected value of the damage payment given $x_i = x$ and $y_i = y$. The maximum is required because the plaintive will not choose to sue when measured damages are negative. The computation starts by computing damages at maturity, $v(x,y,n)$, for all possible x and y. To obtain values for earlier dates, we just use the law of iterated expectations to step one date earlier. We have several cases to consider. Since accumulation of x into y starts at date 0, the formula for the expectation changes when $i \geq 0$. Also, the formula for the expectation is different if there is an option to sell to lock in the damages. Consider first the case without the option to sell. For $i < 0$, y must be 0 (by convention), and the expectation can be computed as

$$(13) \quad v(x,0,i-1) = \pi_u v(x+2,0,i) + \pi_m v(x+1,0,i) + \pi_d v(x,0,i).$$

For $i \geq 0$ (still without the option to sell), y changes to reflect the new value of x, and we have that

$$(14) \quad v(x,y,i-1) = \pi_u v(x+2, y+x+2, i) + \pi_m v(x+1, y+x+1, i) + \pi_d v(x, y+x, i).$$

In the case with an option to sell to lock in damages, the investor will choose, at each node at or after the corrective announcement date $i = 0$, whether to sell (to lock in the damages) or wait. The choice will depend on which is larger, the current damage measure or the continuation value, and because the investor chooses the alternative with higher value, the appropriate value is the larger of the two. Since sale to lock in the gain is unavailable before the corrective announcement date, the formula for the expectation is the same for $i < 0$, and is given by (13). For $i \geq 0$, with the option to sell, we have that

$$(15) \quad v(x, y, i-1) = \max(S_{-k} - \overline{S}(y, i), \pi_u v(x+2, y+x+2, i) + \pi_m v(x+1, y+x+1, i) + \pi_d v(x, y+x, i)),$$

where the first argument of the maximum is the value of selling now and the second argument is the value of waiting. In all the cases, we step backwards in time, computing the values at date n, then at date $n-1$, etc., backwards until date $-k$. The unconditional expectation used in the table is $v(0, 0, -k)$.