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On the Continuing Misuse of Event Studies: The Example of Bessen and Meurer

Glynn S. Lunney Jr
Texas A&M University School of Law, glunney@law.tamu.edu

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ON THE CONTINUING MISUSE OF EVENT STUDIES: THE EXAMPLE OF BESSEN AND MEURER

Glynn S. Lannry, Jr.*

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* McGlinchey Stafford Professor of Law, Tulane University School of Law.
I. INTRODUCTION

In their book, *Patent Failure: How Judges, Bureaucrats, and Lawyers Put Innovators at Risk*, James Bessen and Michael Meurer present an empirical assessment of the costs and benefits of patent protection. Their conclusion is startling: For most industries, the availability of patents discourages innovation. According to Bessen and Meurer, patents benefit innovators by providing exclusivity and thereby enabling an innovator to capture more rents or profits from their innovation than they could with lead-time or other market mechanisms alone. While innovators can obtain rents from their own Patents, they also face the threat of infringement litigation from Patents held by others whenever they introduce new products. The availability of patents to others means that innovators also face the threat of patent litigation from others whenever they introduce new products or services. According to Bessen and Meurer, the benefits of patents to innovators remained roughly constant or rose only slightly during the 1990s. The costs of the patent system, in contrast, rose sharply. During the 1990s, the number of patent lawsuits filed in district courts tripled, increasing the risk of innovators being sued for patent infringement. When Bessen and Meurer multiplied this increased risk of being sued by the “true” cost of patent litigation, which they estimated using an event study, they found that, aside from the chemical and pharmaceutical industries, the costs of patents to innovators outweigh the benefits of patents.

While I am generally sympathetic to Bessen and Meurer’s analysis and their recommended reforms, I am deeply troubled by their use of a stock market event study to establish the true cost of patent litigation. Although others have used a similar technique, this approach suffers from a fatal flaw: It treats a loss in market capitalization—a loss to the firm’s shareholders—as if it either is, or measures, a...
loss to the firm itself. Obviously, a loss in market capitalization, which is what an
event study estimates, is not itself a loss to the firm. It is a loss to the firm’s
shareholders. Moreover, while we can construct a theory of share prices under
which a change in market capitalization directly measures a corresponding change
in the discounted present value of the firm’s expected future earnings, this theory
does not survive empirical testing. To the contrary, what empirical testing has
repeatedly shown is that the change in market capitalization associated with
certain kinds of bad news, such as the filing of a lawsuit, exceeds, often by an
order of magnitude, any reasonable estimate of the capitalized loss in the firm’s
expected future earnings associated with the bad news.8

We cannot, therefore, have much confidence in Bessen and Meurer’s ultimate
conclusion that the patent system has become a net disincentive for innovation.
Nonetheless, it is undoubtedly true that the costs of the patent system to
innovators rose during the 1990s. More patent lawsuits were filed, and the legal
costs of defending against a claim of patent infringement rose. Further, as Bessen
and Meurer show, the risk of being sued for patent infringement is not restricted
to copyists, cheats, and thieves, but applies generally to anyone who introduces
innovative goods.9 Due to an inability to sufficiently identify relevant patents—a
phenomena Bessen and Meurer denote a failure of patent “notice”—even
innovative companies may inadvertently find themselves guilty of patent
infringement.10

This is a compelling story, and Bessen and Meurer offer some plausible
solutions for it. Yet, they are trying to offer something more. As the authors
explain, they seek to “move[ ] beyond anecdote to provide the first
comprehensive empirical evaluation of the patent system’s performance.”11
Unfortunately, without the event study to estimate the costs of the patent system,
their attempt to establish empirically the patent system’s problems falls apart.
What’s left is a story—a compelling story from my perspective, to be sure—but
just one more story based upon anecdote. As a result, the criticism with which
they begin their book applies to their work as well: “It is hard to tell who is right,
however, because most evidence offered in support of these positions is anecdote,
if not myth . . . .”12

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8 For a discussion of some of the relevant studies, see infra notes 27–53 and accompanying text.
9 Id. at 127–28.
10 See id. at 8–9 (stating that an overwhelming number of patents must be cleared for basic
business functions, such as advertising or the shipping of goods).
11 Id. at 3–4.
12 Id. at 3.
II. HOW WE GOT HERE: A BRIEF HISTORY OF EVENT STUDIES

To understand how event studies became popular as a method for estimating a change in a firm’s expected future earnings associated with any given event, we begin in the late 1960s. This is when seminal papers established the basic framework for modern event study methodology.\(^1\) To undertake an event study based on this framework, the researcher first defines the event of interest and identifies the date or dates when knowledge of the event became available to the market.\(^2\) Second, the researcher defines the criteria by which companies are included or excluded from the analysis.\(^3\) Third, the researcher estimates normal and abnormal returns for the included companies, individually or as a portfolio, and determines whether the event at issue generated abnormal returns significantly different from zero.\(^4\) Depending on the results obtained, the presence or absence of abnormal returns can either confirm or rebut economic theories that suggest how the event at issue should have affected security prices.\(^5\)

Event study methodology models a company’s abnormal return\(^6\) as:

\[
e_t = \frac{R_t}{E_t} | X_t
\]

where \(e_t\), \(R_t\), and \(E(\cdot)\) are the abnormal, actual, and normal returns for the company in period \(t\), and \(X_t\) is the conditioning event. To help account for movement in the target firm’s security price driven by broader market factors, the practice has been to model the normal returns for companies using a market model.\(^7\) A market model emulates the relationship between the target firm’s stock returns and the market’s return over an estimation window using:

\[
R_{it} = \alpha_i + \beta_i R_{mt} + \epsilon_{it}
\]

\(E[\epsilon_{it}] = 0 \quad Var[\epsilon_{it}] = \sigma^2\)

---


\(^3\) Id.

\(^4\) Id.

\(^5\) Id.

\(^6\) A stock’s daily return is the percent change in the stock’s price from one day to the next.

\(^7\) Id.
where $R_m$ is the market portfolio return, $u_t$ is the zero mean disturbance term, and $\alpha_i$ and $\beta_i$ are the parameters for the market model.\(^{20}\)

Once the researcher has estimated the market model, she estimates the abnormal return at the time of the event by using the market model to predict what the firm's stock return should have been at the time of the event, and then subtracting that expected or normal return from the firm's actual return on the event date:

$$\hat{AR_t} = R_t - \hat{\alpha} - \hat{\beta}R_m$$

(5)

If we use an event window longer than one day, we calculate the cumulative abnormal return (CAR) over the event window as the sum of the individual abnormal returns.

Event study methodology relies on the assumption that capital markets are efficient for two critical points.\(^{21}\) First, we assume that at any given time, stock prices reflect all publicly available information regarding a company and its prospects.\(^{22}\) Second, we assume that stock prices react very quickly to new information.\(^{23}\) Taken together, these assumptions suggest that firm-specific stock price movements are due to newly available information and allow us to infer a causal role where we can identify an abnormal stock price movement contemporaneous with newly available information, at least in the absence of any other material information becoming available.\(^{24}\)

After the initial work of Fama et al. and Ball and Brown established the basic framework, researchers used event study methodology to examine the underlying assumptions of the efficient capital market hypothesis.\(^{25}\) As the methodology

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\(^{20}\) Id. For our study, we will use an estimation period, $L$, of two hundred days, beginning ten days before the event date, to estimate $\alpha$, $\beta$, and the variance of $u_t$.


\(^{22}\) Id.

\(^{23}\) Id.

\(^{24}\) See Jeffrey R. Lax \\& Matthew D. McCubbins, Positive Political Theory and the Law: Courts, Congress, and Public Policy, Part I: The FDA, the Courts, and the Regulation of Tobacco, 15 J. CONTEMP. L. ISSUES 163, 177 (2006) ("That is, since event studies do not specify causal chains, alternative casualties must be completely ruled out. There must be no confounding events — other (surprising) events that might have affected prices at the same exact time as the event of interest."). If other material information becomes available at the same time, we refer to this as a "confounding event." Id. Such a confounding event substantially limits our ability to infer any causal relationship between the two events and a contemporaneous abnormal return. Id.

became accepted, researchers began using event studies to study a variety of issues. Initially, researchers treated the change in market capitalization for what it was—a gain or loss to the firm’s shareholders. Thus, a number of papers have used event study methodology to examine how various actions, including mergers, tender offers, and antitrust enforcement, affected shareholders.\(^{26}\)

But, in 1981, William Schwert suggested that the methodology could be extended to examine the effects of unanticipated regulatory changes on firms.\(^{27}\) Schwert justified this extension by simply asserting that the loss in a firm’s market capitalization is an unbiased estimate of a corresponding loss in the firm’s expected future earnings.\(^{28}\) Schwert wrote: “The efficient-markets/rational-expectations hypothesis posits that security prices reflect all available information. Hence, unanticipated changes in regulation result in a current change in security prices, and the price change is an unbiased estimate of the value of the change in future cash flows to the firm.”\(^{29}\)

Schwert offered neither proof, nor empirical evidence, for this assertion. Rather, he merely cited Muth’s rational expectation model for asset pricing in a footnote\(^{30}\) and moved on. Presumably, Schwert’s unspoken reasoning went something like this: If Muth was right, then the value of an asset is simply the discounted present value of the asset’s expected future earnings. If we treat a publicly traded corporation as simply another asset, then the value of a corporation is likewise the discounted present value of the corporation’s expected future earnings. If we subtract off the corporation’s debt, then a firm’s stock market capitalization—the value of the corporation to its shareholders—should equal the discounted present value of the firm’s expected future earnings less the present value of the firm’s debt. Given this theoretical or assumed equivalence, Schwert must have reasoned that so long as the firm’s debt remains constant, an observed change in the firm’s stock market capitalization must reflect a corresponding change in the present value of the firm’s expected future earnings, q.e.d.

\(^{26}\) See, e.g., James C. Ellert, Antitrust Law Enforcement and Stockholder Returns, 31 J. Fin. 715 (1976) (examining the risk and return characteristics of large companies whose mergers were challenged by governing antitrust authorities between 1950 and 1972); Michael Gort & Thomas Hogarty, New Evidence on Mergers, 13 J.L. & Econ. 167 (1970) (examining returns to shareholders of acquiring and after-acquired firms before and after merger); James H. Lorie & Paul Halpern, Conglomerates: The Rhetoric and the Evidence, 13 J.L. & Econ. 149 (1970) (same).

\(^{27}\) Schwert, supra note 21, at 121–22.

\(^{28}\) Id.

\(^{29}\) Id.

\(^{30}\) Id. at 121 n.2 (citing John F. Muth, Rational Expectations and the Theory of Price Movements, 29 Econometrica 315, 316–30 (1961)).
In any event, wherever the assumption of equivalence came from, once asserted, the asserted equivalence between a loss in the firm’s market capitalization, as measured by an event study, and a corresponding loss in the discounted present value of the firm’s expected future earnings (the Equivalence Assumption) quickly became accepted as gospel truth among researchers. Almost as quickly, the Equivalence Assumption led to some startling empirical findings.

Applying event study methodology to various stages of the *Pennzoil v. Texaco* litigation and other lawsuits, two separate pairs of researchers found that litigation is not a zero-sum game. Given the transaction costs litigation entails, it is unsurprising that the plaintiff should not receive dollar-for-dollar what the defendant loses. But, when estimated through event studies, the magnitude of the asymmetry was far larger than could reasonably be expected. Using event study methodology and the Equivalence Assumption, Cutler and Summers found that for every dollar Texaco lost, Pennzoil gained only seventeen cents. Similarly, for six specific events studied in the *IBM v. Telex* litigation, beginning with the filing of the suit to Telex’s dropping its final appeal, Engelmann and Cornell found that “the change in the value of IBM [was] between seventy-two and 483 times greater than the change in the value of Telex.”

Moving beyond the study of individual lawsuits, researchers have also used event study methodology to examine the impact of lawsuit filings more generally. For example, in their 1994 article, Bhagat et al., examined the stock price response to interfirm lawsuit filings and settlement announcements for all firms with lawsuit filings or settlements announced in the *Wall Street Journal* from 1981 to 1983. For their sample, they found that defendants experienced an average CAR of negative 0.92% over a two-day event window beginning the day before

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34 Cutler & Summers, *supra* note 31, at 160 (“Pennzoil gained only 17% of what Texaco lost.”).


the lawsuit filing was announced in the Wall Street Journal.38 Somewhat surprisingly, plaintiffs also experienced a negative, but not statistically significant, CAR at the time of the lawsuit filings.39 In short, in response to the filing of a lawsuit, the defendant lost, on average, $20.91 million in market capitalization, while the plaintiff gained nothing.40 Koku, Qureshi, and Akhigbe extended Bhagat et al.'s work to a larger sample, examining the effects of news regarding the filing of corporate lawsuits reported in the Wall Street Journal between 1990 and 1994, and found the same result: Significant losses for defendants without any corresponding gain for plaintiffs.41 Rather than question the assumptions that led to this seemingly anomalous, lose-no gain result, researchers have accepted the Equivalence Assumption as truth from the outset.42 Where it led to startling numbers, they proffered various

38 Id. at 228.
39 Id. at 245 (“When a suit is filed, the common stock for the typical defendant declines by about 1%, whereas the average plaintiff experiences no significant gains. For the average pair of firms, the combined drop in equity value upon initial announcement of the filing is $20.91 million (median = $9.55 million).”).
40 Id.
41 Koku, Qureshi & Akhigbe, supra note 31, at 54 (“[The results] also show that while the financial markets, on the average, react negatively (significantly) to corporate defendants when news on a lawsuit first becomes public, they react positively, albeit, insignificantly (statistically) to corporate plaintiffs.”).
42 To be fair, Cutler and Summers acknowledge the possibility of market inefficiency as a potential cause of their anomalous results. See Cutler & Summers, supra note 31, at 169 (“A final explanation for the large fluctuations is that the market inefficiently valued the claims of the two companies, perhaps because many investors were unwilling to hold stock in a potentially or actually bankrupt company like Texaco, and other investors did not step in to fill the gap . . . . The hypothesis of market error in valuing Texaco and Pennzoil is attractive, given our inability to locate large costs of the ongoing struggle.”). Under the traditional scientific method, one forms a hypothesis, and then tests it to see if the hypothesis matches reality. If there is no match, one rejects the hypothesis. Economists seem prone to a slightly different approach. They form a hypothesis, here that the change in market capitalization from an event study measures a corresponding change in the present value of the firm’s expected future earnings, and test it. But when the predictions fail to match reality, economists pretend that reality, rather than the hypothesis, must be wrong. That is an exaggeration, of course. A more sympathetic observer might suggest that before we reject the hypothesis because of a difference between predicted and observed outcomes, we should be sure that our observation of reality is complete. After all, that is how Neptune was discovered. There was a difference between Uranus’s observed orbit and its orbit as predicted by gravitational theory. Theo Koupelis & Karl F. Kuhn, IN QUEST OF THE UNIVERSE 289 (2007). Rather than reject gravitational theory, Urbain Le Verrier calculated where another planet should be in order for Uranus’s orbit to match gravitational theory, and thus Neptune was discovered. Id. Yet, this type of excuse only carries us so far, and should generally only be used when the theory (or hypothesis) is otherwise well-established, and only when we have reason to believe that there is something that we are not seeing. Neither applies to the use of an event study to generate an estimate of how the event changes the present value of a firm’s expected future earnings.
stories in an attempt to rationalize their results and find the missing millions.43 Some of these theories, such as direct legal costs, the risk of bankruptcy, the threat of follow-on lawsuits, and others, undoubtedly account for some of the gap.44 Yet, no one has yet shown that these theories can fully account for the strikingly large gap between what event studies, together with the Equivalence Assumption, suggest a corporate defendant loses and a corporate plaintiff gains when a lawsuit is filed.

Other studies, while still refusing to question the Equivalence Assumption, have examined the issue more directly and found significant differences between the loss in market capitalization, estimated using an event study, and the direct costs (or lost earnings) that could plausibly be associated with the event at issue, estimated using more traditional techniques.45 For example, Jarrell and Peltzman used event study methodology to examine the loss in market capitalization associated with product recalls in the drug and automotive industry.46 For the drug recalls, Jarrell and Peltzman also estimated the costs of the recall to the firms at issue directly.47 They found that, most commonly, the loss in market capitalization associated with a recall far exceeded the recall’s direct cost.48 As they explained:

Perhaps the most striking result [of our analysis] is the magnitude of the capital losses due to recalls. In particular, they are much larger than our generous estimate of direct costs. The mean

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43 See Cutler & Summers, supra note 31, at 166–69 (explaining that the excessive loss suggested by event studies of litigation could reflect expected legal fees, the risk of bankruptcy or other forms of financial distress, the possibility of a corporate take-over, and the possibility of stock market inefficiency); see also Engelmann & Cornell, supra note 31, at 379–83 (explaining that the excessive loss suggested by event studies in response to lawsuit filings could reflect the attorneys’ fees involved in litigation, the risk of follow-on litigation, the potential risk of judicially-imposed constraints on a firm’s behavior, such as an injunction, the risk of bankruptcy, and the increased cost to the firm of entering into explicit or implicit contracts because of potential damage to a firm’s reputation of trustworthiness that may arise from being sued).

44 See supra note 43 and accompanying text.


46 Jarrell & Peltzman, supra note 45.

47 Id. at 518–19 (estimating direct costs of a drug recall as the number of units recalled multiplied by the product’s wholesale price or, where available, using reported direct costs from news reports or corporate filings).

48 Id. at 521.
[cumulative abnormal return] is -6.13 percent, which is fully 12 times the mean relative direct cost of 0.53 percent (and over 50 times the median). We never fully succeed in explaining this enormous gap.\footnote{Id.}

Similarly, Mark Mitchell used event study methodology to estimate the loss in market capitalization associated with the 1982 Tylenol poisonings and then used traditional techniques to estimate the direct costs of the poisonings to Johnson & Johnson.\footnote{Mitchell, supra note 45.} Like Jarrell and Peltzman, Mitchell found that his estimated loss in market capitalization of $1.44 billion far exceeded his estimated out-of-pocket costs of approximately $200 million.\footnote{Id. at 611.} (It also far exceeded the $100 million in direct costs reported by Johnson & Johnson for the Tylenol recall.\footnote{Jarrell & Peltzman, supra note 45, at 518-19.})

These studies reveal a surprisingly consistent theme: Compared to the change in market capitalization we should expect based upon the change in the discounted present value of the firm’s expected future earnings as a result of these various events, the stock market overreacts, often by an order of magnitude.\footnote{See also Marcus, Swidler & Zivney, supra note 45, at 295 (“Several recent studies have found that product recalls in the drug industry and a variety of other industries result in negative cumulative excess stock returns by approximately twelve times the estimated costs brought about through litigation, or product replacement and repair.”).}

The next section presents an example of a similar overreaction when the event at issue is patent litigation.

### III. PATENT LITIGATION AND EVENT STUDIES: THE PROZAC EXAMPLE

To illustrate the tendency of event studies to “overreact” to bad news in patent litigation, consider the case of the Prozac patents. According to Eli Lilly’s 10Q filed August 14, 2000, U.S. Prozac sales for the second quarter of 2000 and for the first six months of 2000 in the United States generated $539.8 million and $1.05 billion in revenue, respectively.\footnote{Eli Lilly & Co., Quarterly Report (Form 10-Q), at 9 (Aug. 14, 2000), available at http://sec.edgar-online.com/2000/08/14/11/0000950131-00-004887/Section7.asp.} Just five days earlier, however, on August 9, 2000, a panel of the Federal Circuit held that one of two Eli Lilly patents protecting Prozac from competition was invalid for obviousness-type double patenting.\footnote{Eli Lilly & Co. v. Barr Labs., Inc., 222 F.3d 973 (Fed. Cir. 2000), result aff’d on rehearing, 251 F.3d 955 (Fed. Cir. 2001).} As a result, rather than expire in December 2003, Eli Lilly’s
patent protection was limited to the term of its first patent, which at the time of the panel’s decision was scheduled to expire in February 2001. We can value how much this loss of thirty-four months of patent protection cost Eli Lilly in two ways. First, we can use traditional finance and accounting techniques to estimate the value. Second, we can use event study methodology.

A. VALUING THE PROZAC PATENT: TRADITIONAL TECHNIQUES

The traditional method for valuing the Prozac patent would entail comparing Eli Lilly’s Prozac earnings with patent protection to its earnings without such protection. Fortunately, the necessary data is readily available. During the period Prozac was covered by patent protection, Eli Lilly’s 10Qs reflect average Prozac sales in the United States of $1.06 billion over the first six months of 1998, 1999, 2000, and 2001. After the Prozac patents expired in August 2001, Eli Lilly’s revenues from Prozac and other fluoxetine products fell to an average of $202.77 million over the first six months of 2002, 2003, and 2004. In other words, with the loss of patent protection, Eli Lilly’s revenues from Prozac fell by an average of just over $800 million for a six month period, for a monthly average loss in revenue of $142.67 million. If we take this average loss in revenue, convert sales revenue to income using Eli Lilly’s reported gross margin of 77.7%, and


59 This approach implicitly assumes that Eli Lilly’s overhead or other operating costs remain fixed.

60 Eli Lilly & Co., Annual Report (Form 10-Q), at 17 (Aug. 5, 2004) (reporting gross margin of 77.7% of net sales for the first half of 2004), available at http://www.sec.gov/Archives/edgar/data/59478/000095013704006279/c87101e10q.htm. Even with a 100% profit margin, the net present value of $142.67 million in monthly revenue for thirty-four months at a discount rate of ten percent is $4.2 billion.
apply a discount rate of ten percent, then the net present value of the thirty-four months of patent protection Eli Lilly lost was $3.27 billion.\textsuperscript{61}

B. VALUING THE PROZAC PATENT: EVENT STUDY METHODOLOGY

As an alternative to this traditional approach, we can also use an event study to estimate Eli Lilly's loss in market capitalization and pretend that the loss represents an unbiased estimate of the change in the present value of the firm's expected future earnings. However, because the market should incorporate new information as it becomes available, we must consider the whole scenario leading up to, and following, the August 9th panel decision.

1. Background Facts. In December 1995, Barr Laboratories, Inc. filed an Abbreviated New Drug Application (ANDA) under the Hatch-Waxman Act\textsuperscript{62} seeking approval from the Food and Drug Administration (FDA) to market a generic version of Eli Lilly's antidepressant drug Prozac.\textsuperscript{63} In February 1996, the FDA notified Barr Laboratories that it had accepted Barr's ANDA, and Barr in turn notified Eli Lilly.\textsuperscript{64} On April 10, 1996, Eli Lilly responded by suing Barr Laboratories for a declaration that Barr Laboratories' challenges to Eli Lilly's patents were without merit.\textsuperscript{65} The district court denied Barr Laboratories' motions seeking to establish the invalidity of Eli Lilly's two patents as a matter of law.\textsuperscript{66} On appeal, a panel of the Federal Circuit on August 9, 2000 upheld the Eli Lilly patent on its Prozac compound, which at the time of the panel's decision was scheduled to expire in February 2001.\textsuperscript{67} But the panel held a second patent on Prozac's method of use invalid for double-patenting style non-obviousness.\textsuperscript{68} Because the second patent would not otherwise have expired until

\textsuperscript{61} Eli Lilly received a six-month extension on its first Eli Lilly Prozac patent, and thus effectively lost only twenty-eight months in patent protection as a result of the Federal Circuit's decision. \textit{See supra note 56 and accompanying text (Prozac patent extension).}


\textsuperscript{63} Prior to approval, the FDA treats the existence of, and information about, an ANDA as confidential information. 21 C.F.R. § 314.430(b), (d) (2008). Thus, the filing of an ANDA is not public information for purposes of an event study.

\textsuperscript{64} Barr Pharmaceuticals Inc. Annual Report (Form 1--K), at 9 (June 30, 1996).

\textsuperscript{65} Eli Lilly & Co. v. Barr Labs, 222 F.3d 973, 975--76 (Fed. Cir. 2000).


\textsuperscript{67} Eli Lilly & Co. v. Barr Labs., 222 F.3d 973, 984 (Fed. Cir. 2000), \textit{aff'd on reh'g}, 251 F.3d 955 (Fed. Cir. 2001).

\textsuperscript{68} \textit{Id.} at 987.
December 2003, the panel's decision effectively cut thirty-four months off Eli Lilly's patent protection for Prozac in the United States.\textsuperscript{69}

Following the panel's decision, Eli Lilly petitioned the Federal Circuit to rehear the case en banc.\textsuperscript{70} Although such petitions are rarely granted, the Federal Circuit granted the petition on May 30, 2001, vacated the original panel opinion, and remanded the case to the original panel, which (on the same day) reaffirmed its decision to invalidate the second Eli Lilly patent (albeit on slightly different grounds).\textsuperscript{71} Still dissatisfied, Eli Lilly petitioned the Supreme Court to review the Federal Circuit's en banc decision, but as expected, the Court denied the petition and refused to review the decision.\textsuperscript{72} While these two petitions for review of the panel's decision generated the result expected—that the August 9, 2000 panel ruling was final—they should not reduce the significance of the stock price reaction to the August 9th decision, nor generate significant stock price reactions themselves.

2. Abnormal and Cumulative Abnormal Returns. Table 1 reports the abnormal returns for the event date, the day before and the day after the event, cumulative abnormal returns for a trading week before, and for a trading week after the following event dates: (1) April 10, 1996; (2) January 12, 1999; (3) August 9, 2000; (4) May 30, 2001; and (5) January 14, 2002, along with the relevant $p$ statistics in parentheses.

<table>
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<tr>
<th>Event</th>
<th>$[t]$</th>
<th>$[t-1]$</th>
<th>$[t+1]$</th>
<th>$[t+1][t+1, t+5]$</th>
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<td>-2.02%</td>
<td>0.12%</td>
<td>-0.85%</td>
<td>-9.66%</td>
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<tr>
<td></td>
<td>(0.212)</td>
<td>(0.938)</td>
<td>(0.594)</td>
<td>(0.0074)</td>
</tr>
</tbody>
</table>

\textsuperscript{69} See supra note 56 and accompanying text. As things turned out, Eli Lilly lost twenty-eight months of patent protection.

\textsuperscript{70} Eli Lilly & Co. v. Barr Labs., Inc., 251 F.3d 955 (Fed. Cir. 2001).

\textsuperscript{71} Id.

\textsuperscript{72} Eli Lilly & Co. v. Barr Labs., Inc., 534 U.S. 1109 (2002).

\textsuperscript{73} Returns and prices for Eli Lilly's common stock and for the market model indices were obtained from the Center for Research on Security Prices (CRSP). For the market model, I tested four broad based stock indices: the S&P 500, the S&P Composite, the CRSP Equal-Weighted Index, and the CRSP Value-Weighted Index. The S&P Composite had the highest adjusted R-squared and was used as the market model. I tested, but did not use a sector-specific index as the market model because of spill-over effects from the Eli Lilly decision on other pharmaceutical companies' security returns.
Trial court upholds Prozac patent

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<td>(0.287)</td>
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<td>(0.0042)</td>
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Federal Circuit strikes down Prozac patent

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<th>p-Value</th>
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<td>-0.461%</td>
<td>0.60%</td>
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</tr>
<tr>
<td>(&lt;0.0001)</td>
<td>(0.579)</td>
<td>(0.871)</td>
<td>(0.941)</td>
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Federal Circuit refuses to revisit decision

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<th>t-Statistic</th>
<th>p-Value</th>
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<td>2.69%</td>
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<td>(0.678)</td>
<td>(0.401)</td>
<td>(0.990)</td>
<td>(0.673)</td>
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Supreme Court refuses to review decision

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3. Preliminary Analysis. As expected, neither the Federal Circuit’s en banc decision nor the Supreme Court’s denial of certiorari generated statistically-significant abnormal returns. However, we find statistically significant abnormal returns for the filing of the lawsuit over the event window [t+1, t+5], the district court’s decision over the event windows [t+1] and [t+1, t+5], and the Federal Circuit’s panel decision over the event window [t] at the one-percent two-tailed level of statistical significance. In terms of market efficiency, the results reflect that the market processed the new information reflected in the two decisions concerning the validity of Eli Lilly’s patents quickly. The market appears to have responded to the Federal Circuit decision on the date of the decision rather than on the date of the subsequent Wall Street Journal report. Nighty-eight percent of the CAR over [t, t+5] occurred on August 9th. In contrast, the market response to the district court’s decision appears to be spread over the date of the decision and t+1, with seventy-four percent of the CAR over [t, t+5] coming on t+1. The delay in the response to the district court’s decision suggests that the market relies more heavily on news accounts for information regarding district court decisions. Given the opposite or fluctuating signs for the abnormal returns on the day before and the CARs for the week before the panel and district court decisions, information regarding the decisions does not appear to have leaked to the market before each decision was formally issued.

4. Magnitude of the Loss. Although the market therefore appears relatively efficient in terms of the speed and direction of the security price response to the panel decision, the magnitude of the August 9th abnormal return appears substantially larger than the net present value of the reduction in Eli Lilly’s expected future earnings attributable to the decision. The 9.16% abnormal return Eli Lilly experienced on August 9th reflects a one-day loss in market capitalization of $35.754 billion.
C. WHAT A DIFFERENCE THE DIFFERENCE MAKES

If taken as a direct measure of the reduction in Eli Lilly's discounted expected future earnings as a result of the loss of thirty-four months of Prozac patent protection, this loss in market capitalization exceeds by a factor of ten, our direct estimate of the net present value of the lost earnings associated with the loss of thirty-four months of patent protection. The excess nature of the event study estimate becomes even more apparent given that the market should have reduced Eli Lilly's stock price to reflect the risk of an appellate loss when the appeal was filed (or given the expectation that an appeal would occur when the district court order was entered). This huge gap in valuations places Bessen and Meurer in something of a quandary.

On the one hand, let's assume that the event study is right. By incorporating a broader consideration of the Prozac patent's value to Eli Lilly, including such things as diverted management attention, heightened borrowing costs to Eli Lilly, and a correspondingly higher risk of bankruptcy, perhaps $36 billion comes closer to the true value for thirty-four months of Prozac patent protection to Eli Lilly than a direct measure of lost earnings. Perhaps. However, if that is the more accurate measure, then Bessen and Meurer have substantially understated the values of patents generally. If thirty-four months out of the seventeen-year life of a single patent is really worth $36 billion, then $4.4 billion cannot possibly be a good estimate of the total value of all patents issued in 1991.  

74 Under Rule 4 of the Federal Rules of Appellate Procedure, the notice of appeal must be filed “within 30 days after the judgment or order appealed from is entered.” FED. R. App. P. 4. However, the denial of summary judgment is usually a non-final ruling, and therefore not subject to appeal. Parker Bros. v. Tuxedo Monopoly, Inc., 757 F.2d 254, 255 (Fed. Cir. 1985). In the Eli Lilly case, Eli Lilly agreed to pay $4 million to the defendants on January 25, 1999 in return for dismissal of their final two challenges to Eli Lilly patents. Eli Lilly & Co., Annual Report (Form 10-Q), at 10 (Mar. 30, 2000), available at http://www.sec.gov/Archives/edgar/data/59478/0000950131-00-00201-d1.html. When the district court entered a dismissal of the final two challenges, then the district court’s decision would become final and subject to appeal. In any event, the notice of appeal was likely filed more than a year before the August 9, 2000 panel decision. In 1998, of the eighty-five cases appealed to the Federal Circuit identified through the search “core-terms(patent and infringe!)” of the LEXIS Federal Circuit database involving patent infringement claims, the Federal Circuit reversed or vacated the district court’s decision (either in whole or in part) in thirty-five cases, or roughly 45.5%. Federal statistics state that the Federal Circuit reversed in nineteen percent of the appeals taken from district courts in the twelve months prior to September 30, 1998, though it is not clear how the statistics treat cases in which the Federal Circuit vacate or reverse in part. Table B-8: U.S. Court of Appeals for the Federal Circuit - Appeals Filed, Terminated, and Pending During the Twelve-Month Period Ended September 30, 1998, http://www.uscourts.gov/dirrpt98/608sep98. pdf (last visited Sept. 7, 2008).

75 BESSEN & MEURER, supra note 1, at 112 (“Using our upper-bound mean estimate of $78,000, the aggregate value of United States patents granted to private United States parties in 1991 was
On the other hand, if the event study estimate represents a wildly inflated overreaction here, just as it has elsewhere, then Bessen and Meurer have radically overstated the costs of the patent system. Like other work that relies on event studies to estimate litigation costs, the grain of truth is still there: Measuring the loss to Eli Lilly by focusing solely on the direct loss in earnings attributable to the loss of the Prozac patent likely omits some real costs to Eli Lilly. Among others, an earnings-lost measure does not include direct litigation expenses, diverted employee attention, or any costs associated with having to turn to external rather than internal funding to replace the lost Prozac cash flow. Yet, even if we throw exceedingly generous estimates at each of these, such as $100 million for direct litigation costs, $500 million for diverted employee attention, and an added $350 million in borrowing costs, that would bring our estimate of the costs of the Prozac litigation up to just over $4 billion—a high number to be sure, but nowhere close to the $36 billion estimated using an event study.

IV. EXPLAINING THE OVERREACTION: WHAT DO EVENT STUDIES TELL Us?

For patent litigation, just as for other types of litigation, drug recalls, and the Tylenol poisoning incident, event studies overreact if the change in market capitalization is taken as an estimate of the change in the firm's expected future earnings. Even though this overreaction is readily apparent, event studies remain a surprisingly popular method of measuring an event's impact on a firm. In part, they are popular because traditional measures of these events' costs on a firm are not all-inclusive. Reputational losses, the risk of repeat litigation, the threat of bankruptcy, and other hard-to-observe costs undoubtedly arise in some

about $4.4 billion in 1992 dollars . . . "

76 See supra notes 45–53 and accompanying text.
77 See supra note 31 and accompanying text.
78 Bessen & Meurer, supra note 1, at 131–32 (noting that "[i]n extreme cases, legal costs can mount to tens of millions . . . ").
79 This number would represent 200 employees working full-time for five years on the Prozac litigation with total average compensation from Eli Lilly of $250,000 per employee and assuming that Eli Lilly would otherwise have earned a 100% return on these employees if they had been working on something other than the Prozac litigation.
80 This assumes that Eli Lilly would have to pay a ten percent higher net interest rate on the $3.5 billion in lost Prozac earnings if it borrowed that money, rather than relying on the Prozac earnings to fund operations.
81 See Bessen & Meurer, supra note 1, at 133 (discussing use of event studies to estimate the costs of litigation).
82 Id. at 134.
of these cases, and they can be surprisingly difficult to measure using traditional tools.\textsuperscript{83} The grain of truth that serves as an excuse for the continued use of event studies in this way is that event studies promise a trivially easy and all-inclusive method of calculating an event's expected cost to a firm, whether the costs are otherwise readily observable or not.\textsuperscript{84}

Yet, this cannot be the whole reason for event studies' enduring popularity. Researchers, such as Jarrell and Peltzman,\textsuperscript{85} rely on them even where the researchers frankly admit that the gap between the event study estimate and a traditional measure of the event's costs is far too large to reflect even a generous estimate of real, but otherwise hard-to-observe, costs.\textsuperscript{86} Sometimes I wonder if it is not the overreaction itself that makes event studies so popular. Because event studies overreact, they reliably generate the sort of absurdly large numbers that grab headlines and make careers. You do not have to be a complete cynic to realize that a book saying that patent litigation costs increased somewhat in the 1990s is going to garner far less attention than a book that purports to prove that the patent litigation costs have increased so much that patents now discourage innovation.

In any event, it is critically important to keep in mind that the loss that an event study measures is a real loss. It is not just a loss to the firm, nor is it an unbiased measure of the event's impact on the firm's expected future earnings. Rather, event studies measure the loss that the firm's shareholders experienced over the event window.\textsuperscript{87} Instead of continuing to pretend that these absurdly large numbers are telling us something about an event's otherwise unobservable

\textsuperscript{83} Bessen and Meurer add some of their own stories about these indirect costs. \textit{Id.} at 132-35.

\textsuperscript{84} \textit{See id.} at 133 ("Given the varied and complicated nature of these costs, it might seem impossible to estimate them. This is not so, however. A number of researchers have used stock market 'event studies' to estimate the costs of litigation . . . . The advantage of this approach is that it captures investors' evaluations of all the different costs and all the possible outcomes."); \textit{see also id.} at 135 ("Note that these losses reflect investors' calculations of all aspects of the lawsuit that might affect future profits.").

\textsuperscript{85} \textit{See supra} note 46 and accompanying text.

\textsuperscript{86} \textit{See supra} note 45 and accompanying text.

\textsuperscript{87} Bessen and Meurer's use of an event study would thus be appropriate if the loss to the shareholders from the filing of litigation was the key issue. That might be case if, for example, patentable research was funded through an initial public offering of stock directly, or if officers were so heavily invested in the firm's stock that they responded directly to stock price movements, rather than the firm's underlying fundamentals. But Bessen and Meurer make clear that they are using the change in market capitalization as a proxy for the costs of the litigation to the firm. \textit{Bessen \& Meurer, supra} note 1, at 137-39. Thus, the "Change in Firm Value" (i.e., change in stock market capitalization) in Table 6.2 becomes the basis for "Aggregated U.S. litigation costs" in Figure 6.5. \textit{Id.}
costs to the firms at issue, it is well past time that we recognize that these numbers are telling us something about the nature of stock markets.

Treating stock prices as no more than the rational expectations of discounted future earnings ignores the cooperative nature of stock prices. Recent developments in asymmetric information and game theory models suggest a need to revisit the simplistic assumptions reflected in the rational expectations model. The efficient capital markets hypothesis assumes that all investors are aware of all publicly available information. But what if, as seems more likely, the stock market contains a mixture of more perfectly informed and less perfectly informed investors? In such a market, less perfectly informed investors may take a stock price's movement itself as relevant information. Not knowing what is driving the stock price movement, these less perfectly informed investors may nonetheless sell or buy simply because more perfectly informed investors have just done so. This would lead to "rational" panics, where stock prices overreact to unexpected news.

Even within the context of Muth's rational expectations model, losses to shareholders do not necessarily reflect losses to the firm. When an event changes a firm's expected future earnings, this can affect the firm's stock price, even within Muth's model, in two ways. First, an event can change the firm's expected future earnings directly. Second, and on top of that, the event may also lead to increased variability in the firm's expected future earnings. To compensate for the increased risk associated with this increased variability, investors would apply a higher discount rate to the firm's earnings stream. As a result, an event may cause the stock price to fall if it increases the systematic risk associated with holding the stock, even if the firm's expected future earnings, discounted at some constant discount rate before and after the event, remain unchanged.

In addition, Bessen and Meurer expressly concede that bubbles can form in the stock market. Yet, the existence of a stock market bubble is fundamentally

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89 For a model suggesting the possibility of "rational" panics in such a market, see id.
90 See Marcus, Swidler & Zivney, supra note 45, at 295–96 (discussing effect of drug recall on loss of shareholder wealth).
91 For example, before an event, a firm expects to earn, with 100% certainty, $1 million each year. After the event, a firm expects to earn either $2 million or nothing each year, with each possibility equally likely. Although the discounted present values of these two streams of expected future earnings are the same if the same discount rate is applied, the firm's stock price will fall in response to such an event, because the increased risk will lead investors to apply a higher discount rate to the firm's expected future earnings after the event than they did before the event. See id.
92 BESSEN & MEURER, supra note 1, at 138 ("Note that these estimates, based as they are on the common stock prices of firms, have been corrected to remove any effects of the stock market
incompatible with the assumptions necessary for event study methodology to apply. Behavioral finance, with its theories of groupthink and herd behavior, can accept and explain bubbles in stock price, but the efficient capital markets hypothesis cannot.

Consider a simple model. An investor holds one share of stock in period 1. He can either sell the share at the end of period 1 for a price, $p_1$, or he can hold the stock until the end of period 2, in which case he receives a dividend, $d$, and a price, $p_2$. If we assume that the investor discounts returns from period 2 by the factor, $\delta$, then the investor should sell the share in period 1 if and only if $p_1 \geq E1[\delta(d + p_2)]$. In other words, whether to sell in period 1 turns on the investor's expectation, based upon the information available in period 1, as to the price and dividend that he will receive should he hold the stock into period 2. But the price of the stock in period 2 will necessarily depend upon the decision of other investors either to buy or sell the stock in question. The price of a company's stock at any given time is thus the result of a simultaneous game among potential investors in which each investor: (i) forms an expectation as to the stock's future price; and (ii) buys, sells, or holds accordingly.

In a market that corresponds to the efficient capital market hypothesis, every investor forms an expectation of the stock's future price based solely upon that investor's estimate of the present value of the firm's expected future earnings, which incorporates all publicly available information. In such a market, bubbles do not form. If bubbles do form, as Bessen and Meurer concede, then at least some investors must be basing their expectations regarding the firm's future stock price, not on the firm's underlying fundamentals, but on their expectations as to what other investors will do. If these investors assume that other investors believe that the stock price will rise, then they will buy or hold accordingly. If they assume that others believe that the stock price will fall, then they will sell accordingly. As a result, a firm's stock price may rise or fall based solely on changes in investors' expectations regarding the likely behavior of other investors (which can then become self-fulfilling) even in the absence of any change in the firm's underlying fundamentals.
Presumably, something like this explains the existence of bubbles. Bessen and Meurer do not address this theory. Rather, looking back with the benefit of hindsight, they state that such a bubble existed in the 1990s because stock prices subsequently fell to what they consider to be the long-term equilibrium. But whatever the mechanism or reason for a bubble, if stock prices can rise and persist for years at a level above their long-term equilibrium, presumably they can just as easily fall and persist below their long-term equilibrium. And if we do not know why the bubbles form or how they pop, we cannot rule out the possibility that unexpected good or bad news is one way in which a bubble (or its opposite) begins. Accepting the existence of bubbles in stock prices thus fatally undermines the assumptions necessary to rely on event study methodology as an estimate of how an event changes the present value of a firm’s expected future earnings.

In the end, though, it does not matter for our purposes here why event studies, if taken as a measure of the event’s effects on a firm’s expected future earnings, so consistently overreact to certain kinds of unexpected bad news. That they do so is enough to fatally undermine Bessen and Meurer’s ultimate conclusion that patents have become a net disincentive for most industries.

V. WITHOUT THE EVENT STUDY, WHAT’S LEFT?

If we take away the “patents are a net disincentive” headline, what is left of Bessen and Meurer’s analysis? Even when we take away the event study, an undeniable surge in patent litigation during the 1990s remains.

But, as Bessen and Meurer themselves note, an increase in patent litigation is not necessarily an indication that the patent system is failing. As they explain, “Patent litigation becomes a problem when it imposes social or private costs that are large in comparison to the benefits patents provides.”

Unfortunately, because Bessen and Meurer rely on the event study to establish the costs of patent litigation, without it they have no means for establishing the social or private costs of patent litigation. The increase in patent lawsuit filings alone or the differences in probability that a patent will become the basis for a lawsuit “lack[ ] clear economic significance.”

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97 Bessen & Meurer, supra note 1, at 135, 279 n.14.
98 Id. at 128–29.
99 Id. at 128.
100 Id. In this section of the book, Bessen and Meurer criticize Nathan Myhrvold’s statement that “the likelihood of a patent issued today being involved in litigation is smaller today than at any point since 1995.” Id. at 128–29. They criticize it for both being untrue and even if true “lack[ing] clear economic significance” because it does not consider the social or private costs of patents relative to
Surely, though, Bessen and Meurer might counter, even if the failings of the event study mean that we must ignore the absolute level of patent litigation costs that they have calculated and presented in Figure 6.5, the time trend alone, which shows a clear increase in litigation costs in the 1990s, provides empirical evidence to support their failure of patent notice story. The problem, though, is that the time trend does not support Bessen and Meurer’s story.

If Bessen and Meurer’s story about patent notice were true, then we should expect litigation costs to increase disproportionately for firms in industries where the failure of patent notice is more severe, in other words for firms other than chemical and pharmaceutical firms. Yet, that is not the case. If we ignore the absolute levels of the litigation costs presented in Figure 6.5 and focus instead on how much litigation costs have increased over the time period presented, aggregate United States litigation costs for the chemical and pharmaceutical industries have increased by a factor of six to eight, from the 1980s to 1999. Over the same period, aggregate United States litigation costs for firms in other industries have also increased by a factor of six. This identical increase is fundamentally inconsistent with the story that patent notice problems, particularly acute outside the chemical and pharmaceutical industries, were driving the escalation in litigation costs.

Despite these flaws, I have little doubt that the patent notice problems that Bessen and Meurer have identified are a part of the problem with the patent system today. For me, their story is persuasive and the anecdotes they offer in support of it are both colorful and amusing. Yet, I am not persuaded that they have identified the problem with the system, or that their proposed solutions will reverse the increasing incidence and costs of patent litigation that we have seen over the last twenty years. Nevertheless, by the ordinary standards of academic scholarship, their book represents both an important and insightful contribution.

Unfortunately, the standard Bessen and Meurer set for themselves is somewhat higher: “[T]o provide the first comprehensive empirical evaluation of the patent system’s performance.” While Bessen and Meurer accept that

the value of patents for innovators. Id. Their statistics in Table 7.2 regarding the probability that a patent will be involved in a lawsuit presumably suffers from the same lack.  

101 Id. at 139.  

102 The figure is not scaled precisely, but from my examination, litigation costs appear to hover around $500–$600 million annually on average from 1985 through 1989 and then increase to just over $4 billion in 1999. BESEN & MEURER, supra note 1, at 139.  

103 Again, the figure is not scaled precisely, but litigation costs for firms other than chemical and pharmaceutical firms appear to average about $2 billion in the 1980s and then increase to just under $12 billion in 1999. Id.  

104 Id. at 3.
bubbles exist, they do not attempt to explain how or why they arise. When we take away the event study and its associated estimate of litigation costs, Bessen and Meurer have given us only half the cost-benefit equation. Lacking the promised empirical evaluation of the patent system’s performance, all we are left with is a plausible story of a failure of patent notice with anecdotes to support it. As I said, this is an important contribution, but not at all what Bessen and Meurer promised.