Environmental Risk and Shareholder Returns: Evidence from the Announcement of the Toxic 100 Index

Kenneth Bettenhausen [a], John Byrd [a], Elizabeth S. Cooperman [a],

a. The Business School, University of Colorado Denver. Colorado

Abstract: This paper examines the stock price response to the announcement that a U.S. company has been named to the Toxic 100 list of the largest air polluters, where rankings are based on data from the Environmental Protection Agency's (EPA) Risk Screening Environmental Indicator (RSEI) project. We find a significant negative average abnormal return (AR) of -1.20% in 2006 and -1.60% in 2008 over the two-day announcement periods for the Toxic 100 announcements, representing an average drop in market value for the average firm in the index of -$235,944,909 in 2006 and -$237,595,885 in 2008. Firms in the top 10 ranking of the index had a significantly, larger negative abnormal return than in the bottom 10 ranking. Firms that were not on the 2006 index, but were added to the 2008 index experienced an average abnormal return of -3.5%. The results are interesting for two reasons. One, they show that investors impound environmental risk into their company valuations, implying that environmental disclosure and reporting is important. Two, the results suggest that although analysts had the RSEI data prior to the release of the Toxic 100 lists, they view the Toxic 100 as a significant event. This suggests limits to the semi-strong form of market efficiency, suggesting that the anticipated payoff from computing their own environmental risk assessment may not justify their time and effort required to do so.

1. Introduction

By early June 2010, British Petroleum's (BP) shares fell by 40 percent following the explosion of BP's Deepwater Horizon rig on April 20, 2010,

reducing BP's market capitalization by about $20 billion, resulting in loses for U.S. Pensions at that time of about $1.4 billion and U.K. pensions by 12 billion pounds.[1] Similarly, the Bhopal disaster of 1984 led to huge liability losses for Union Carbide and a large loss in its market value following the disaster announcement.[2]   These large costs show that investors need to include expected environmental risk in their valuations of companies.

In response to the 1984 Bhopal disaster and others that shortly followed, the U.S. government initiated the Emergency Planning and Community Right to Know Act (DPCRA) in 1986.   Under EPCRA, large companies are required to release a detailed inventory concerning their chemical hazards.   The EPA is required to collect data annually on releases and transfers of certain toxic chemicals from industrial facilities and to make the data available to the public.   The data is made available through several web-based tools on the EPA website (http://www.epa.gov/tri/).   The EPA notes that the goal is "to empower citizens, through information, to hold companies and local governments accountable in terms of how toxic chemicals are managed."   Data was first collected in 1987 and first released to the public in 1989.   Initially, the data was reported in pounds without regard for a chemical's toxicity or the location of the reporting facility.   In 1999 the EPA developed a Risk-Screening Environmental Indicators (RSEI) model. The RSEI is a computer-based screening tool that examines factors that can result in chronic human health risks including the volume of toxic chemical releases, degree of toxicity, and the size of potential population exposure.

While not a perfect measure, the RSEI scores provide a good first approximation of a company's exposure to environmental risk.   The Political Economy Research Institute (PERI) at the University of Massachusetts at Amherst used the EPA's RSEI scores to develop the Toxic 100 Index consisting of the 100 companies with the highest RSEI scores.   The Toxic 100 Index provides investors with information concerning the companies that are most likely to have large liability exposures due to environmental risk.   We investigate whether investors do, in fact, consider potential environmental risk in their valuation of public companies.   Our study is the first financial study that utilizes the EPA RSEI database (via the PERI Toxic 100 list).   We examine the market reaction to two iterations of the Toxic 100 index that have been produced.   The first, released in

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[1] See McNicol (2010); Gardner (2010); and Insurancenewsnet (2010).

[2] On December 3, 1984, methyl isocyanate (MIC) gas leaked from a tank at the Union Carbide facility in Bhopal, India, killing approximately 3,800 people and leaving thousands of others disabled.

2006, included only U.S. companies and was based on toxic release inventory data from 2002. The second version, released in 2008, included both U.S. and non-U.S. companies, and was computed using toxic release data from 2005.

2. Related Literature

Whether investors quickly react to environmental events has been examined using a number of event studies that investigate the stock price reaction to environmental events. For example, Klassen and McLaughlin (1996) and Karpoff, Lott and Wehrly (2005) report significant negative abnormal returns at the announcement of environmental accidents, such as an oil spill, and significant positive abnormal returns on the announcement of environmental awards. More recently, Capelle-Blanchard and Laguna (2010) present evidence of significant negative abnormal returns of about 1.3% over the two trading days immediately following an industrial chemical accident.

Closer to the spirit of the present paper, several studies look at the announcement date stock price response to the release of the EPA's Toxic Release Inventory (TRI) data.

The Toxics Release Inventory was created in the Emergency Planning and Community Right to Know Act (EPCRA) of 1986.[3] As the Act's name suggests the TRI was designed to serve two purposes: one, help authorities plan for emergencies; and two, provide better information for citizens regarding chemical releases in their communities.

The first year of data under TRI was collected in 1987 and included information on the release and transport of 332 chemicals from about 19,000 facilities in the United States.

Submissions are required but self-reported, with TRI data first released to the public in 1989. In 1994 the EPA included about 300 additional chemicals to the original set of 332. In the most recent reporting year with available data from 2007, the EPA received over 80,000 reports from nearly 22,000 facilities for the almost 650 toxic chemicals.

Early studies looked at the stock price reaction to the early releases of TRI information to the public beginning in 1989. Hamilton (1995) published the first

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[3] The Toxics Release Inventory program, including access to the database, can be found at: http://epa.gov/tri/index.htm

study examining the stock price reaction to the first 1989 release.   He finds about three-fourths of TRI pollution releases reported by journalists at this time originated from large publicly traded firms.   Empirical results show significant negative abnormal returns for his sample, with an average loss of about $4.1 million in market value on the TRI release day.   Konar and Cohen (1997) also examined the stock market reaction to the first public release of TRI data and find firms with the most media exposure to have the largest significant negative abnormal returns.   Consistent with the premise that firms with the largest losses will attempt to turn themselves around, the 40 companies with the largest negative abnormal returns surrounding the TRI announcement showed significantly lower toxic emissions over the next three years.

Other studies examined the market reaction to later TRI releases in the 1990's including Khanna, Quimo, and Bojilova (1998) for 1989 through 1994.   They find a statistically significant negative abnormal return for the day following the release dates of TRI data for 1990 through 1994.   They also find that firms with larger stock valuation losses had a decline in later on-site toxic releases, but also a rise in wastes transferred off-sight, resulting in a negligible change in total toxic wastes generated.

For more recent TRI releases, Connors and Silva-Gao (2008) find that the announcement date abnormal returns are less negative when companies report decreased levels of toxic releases (and vice versa), but these results vary according to industry, leverage, and Tobin's Q.   Their sample includes companies from the electric utility, chemicals, and pulp and paper industries, with data drawn from the years 2000 to 2005.   Although they do not report the abnormal returns in their working paper, in a private communication they confirm that the abnormal returns for their sample are not significantly different from zero.   In fact, they note no published studies report abnormal returns for recent TRI distribution dates over the last five years (2005 through 2009).   Connors and Silva-Gao suggest this is because recent announcements do not produce significant market reactions by investors who are already aware of this information, perhaps because much of the information content of the toxic emissions may have already been impounded into stock prices after the first few years of public dissemination of the TRI data.

Freedman and Patten (2004) theorize that corporations offset poor TRI data or other negative information on their actions by using largely voluntary financial report environmental disclosures to mitigate them, suggesting that voluntary

environmental disclosure may be inadequate as a corporate control mechanism. To test this premise

the authors examine market reactions for a sample of 112 firms to the unexpected proposal in June 1989 for revisions in the Clear Air Act. Their results showed more negative market reactions for firms that were the worst polluters based on TRI data. However, among these firms, those with the least extensive environmental disclosures in 10-K reports had more negative stock market reactions.

Bui and Mayer (2003) also argue that TRI releases may be ineffective in reducing information asymmetries between polluters and the public, because of assessment difficulties and transaction costs. They perform an event study examining house price changes in hazardous areas before and after the release of negative TRI data for communities, and find no significant changes, supporting their premise.

The motivation underlying most of the studies cited above is to address the question of whether investors react to news concerning a firm's environmental risk as reflected in changes in a firm's market value. Changes in total TRI releases are a good measure of improvement or deterioration in a company's environmental performance. However, changes in aggregate TRI releases are not a very good measure of the potential environmental risks a company faces. The first limitation of the TRI data is that while it is labeled toxic release data it includes the quantities of chemicals recycled, transferred to off-site disposal facilities, treated on-site as well as uncontrolled releases that could cause harm. Additionally, the TRI data is reported in pounds with all chemical releases and disposals presented in the same way without any consideration for the toxicity of a particular chemical. For example, in terms of toxicity, one pound of asbestos is equivalent to 27 million pounds of the refrigerant HCFC-22.[4] This huge variation in toxicity means that comparing chemicals by weight alone does not accurately capture the potential harm the chemical can do. Nor does the TRI data consider how long a chemical persists (i.e., whether it quickly decomposes in sunlight or otherwise biodegrades) or whether it tends to bio-accumulate in the food chain, or how releases might be transported and the proximity of human populations within those emission pathways.

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[4] EPA toxicity spreadsheet.

Responding to these criticisms of the TRI information, in 1999 the EPA developed the Risk-Screening Environmental Indicators (RSEI) to estimate relative risk factors for reporting facilities. The RSEI tool uses TRI data supplemented by other Federal data to create a risk measure that takes into account:

- The amount of chemical released, transferred or recycled.

- The location of the release (e.g., facility location and smokestack height).[5]

- The toxicity of the chemical.[6]

- Number of people who could potentially be affected.[7]

Thus, the RSEI score for a facility provides a rough estimate of the potential environmental risk of that facility. We say 'rough' estimate because facilities with identical RSEI scores could vary enormously in terms of the likelihood that a serious environmental accident will occur. Facility age, design, maintenance, operation at or near capacity, and employee training and staffing patterns, could all affect the probability of an uncontrolled release occurring. Nonetheless, the RSEI score should provide investors with information beyond that included in the basic TRI data.

3. Data

We examine whether investors respond to the release of RSEI data by computing the abnormal stock return at the announcement of the Toxic 100 Index prepared by the Political Economy Research Institute of the University of Massachusetts at Amherst.[8] The Toxic 100 Index ranks companies according to their RSEI score for air releases and transfers for incineration. The first Toxic 100 Index was released to the public on May 11, 2006. The rankings were based on TRI data for 2002. The second list was distributed to the public on April 10, 2008, using data from 2005. The first list included only U.S. companies, but foreign companies were included in the second list.

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[5] The RSEI model makes various assumptions about smokestack height when exact facility information is not available.

[6] Chemical toxicity weights are based on a chemical's most adverse chronic human health effect using a standard EPA methodology. These weights range from 0.01 to 1,000,000.

[7] The exposed population is determined by combining information about the transport route of emissions from a facility and the population within each 1 square kilometer cell in a 101x101 kilometer grid surrounding the facility. Generally people living upwind and further from a facility will have less exposure.

[8] The first Toxic 100 list can be accessed at: http://www.peri.umass.edu/archive_table/ The second list can be accessed at: http://www.peri.umass.edu/toxic100_index/

Table 1

Sample Summary Statistics

The data presented is for the fiscal year end prior to the announcement of the Toxic 100 list in 2006 and 2008.   Total Assets and Total Revenues are in millions. Debt ratio is debt-to-Equity. Age of Assets is the ratio of Net Plant, Property and Equipment to the Un-depreciated PP&E.

	Total Assets 2005	Total Revenues 2005	Debt Ratio 2005	Age of Assets 2005
Mean	43,559	31,706	0.69	0.61
Median	19,550	12,540	0.66	0.56
Maximum	673,321	370,680	1.93	0.88
Minimum	2,537	1,068	0.34	0.04
Number	74	74	74	74

	Total Assets 2007	Total Revenues 2007	Debt Ratio 2007	Age of Assets 2007
Mean	61,241	41,762	0.65	0.61
Median	26,338	16,593	0.64	0.54
Maximum	795,683	404,552	1.44	0.84
Minimum	1,057	2,019	0.13	0.25
Number	51	51	50	51

Stock price data was collected for all companies on the Toxic 100 lists for 270 days beginning 260 days before the announcement date.   This criterion eliminated some firms from the sample.   For the announcement of the first Toxic 100 Index we have a sample of 74 firms.   Twenty-six firms were lost because there were not sufficient stock return data to compute the market model and the abnormal returns. For the second announcement, out of the 100 firms, 13 firms were excluded as non-U.S. firms with stock return data unavailable, and another 36 firms did not have sufficient data, resulting in a final sample size of 51 firms.

Table 1 provides summary statistics on total assets, total revenues, total debt to equity, and the age of assets calculated at the ratio of net plant, property and equipment to un-depreciated PPE for the two samples. The average asset size is $43.56 billion.

Average total revenues are $31.706 billion with an average debt to equity ratio of 69 percent, and the average age ratio is 0.61 in 2006, indicating large, well established

companies on average.   Similar means appear in 2008, but with a larger average total asset size of $61.241 billion and mean revenues of $41.762 billion. Firms in the Toxic 100 include very large publicly-traded firms including firms in

the top 10 in 2006 as DuPont, U.S. Steel Corporation, Conoco Phillips, GE, Eastman Kodak, Exxon Mobil, Ford Motor Company, Tyson Foods, Alcoa, and Archer Daniels Midland Company, all firms in industries with large environmental risk by the nature of their operations.

4. Methodology

We estimate the abnormal returns associated with the public release of each Toxic 100 Index using a standard event study methodology with a two-day event window consisting of the event date plus one day before and one day after its occurrence.   Abnormal returns (AR_{it}) are computed as:

$$AR_{it} = R_{it} - (\alpha_i + \beta_i R_{mt}) \tag{1}$$

where R_{it} is the change in the stock price of firm i on day t; α_i is the intercept oefficient for firm i, R_{mt} is the change in the S&P 500 index for day t; β_i is the beta coefficient for firm i, estimated using 250 daily returns beginning 260 days before the announcement date.

Thus, the abnormal return is the actual return for day t minus the expected return from the market model.   The two-day event window includes the announcement date and the day following, days 0 and +1.   The cumulative abnormal return is the sum of the abnormal returns for these two days.   We test the significance of the cumulative abnormal return by computing a Z-statistic with the standard error based on the variance of the abnormal returns.

To compare our results with previous results for TRI data public releases, in addition we perform a second event study examining abnormal returns surrounding the announcement of the TRI data releases in 2006 and 2008, and a third event study examining the reaction surrounding the EPA's RSEI data release dates. Previous studies in recent years have found insignificant returns surrounding the TRI data releases, suggesting that a rational market already considered this information.   Studies have not examined market reactions to the EPA's RSEI data. Since the Toxic 100 list is based on data previously released to the public,[9] and analysts could have used this data to create their own rankings using this data,

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[9] The Toxic 100 released in 2006 is based on TRI data for 2002 that was released to the public on June 24, 2004. The Toxic 100 released in 2008 is based on TRI data for 2005 that was released to the public on March 22, 2007.

under a semi-strong market efficiency argument, there should be no significant market reaction.   However, if the majority of market analysts anticipated that the payoff from computing these numbers and rankings did not justify the time required to do so, this could explain the previous insignificant market reactions to TRI releases.   From this perspective, investors may consider the announcement of the Toxic 100 as "new information" on a firm's environmental risk in terms of the worst offenders being listed that could provide relative information of a firm's environmental risk.   Under such a discerning investor hypothesis, the market would be expected to have a differential reaction for different firms in the index based on whether they are included in the index each year or not, and whether they are among the worst offenders.

To examine this premise, we also examine the differential market reaction for firms that were included in the Toxic 100 index in 2006, but not included in 2008, and firms that were added to the Toxic 100 index in 2008.   We also examine for differences in abnormal returns for the top 10 and bottom 10 offenders for the Toxic 100 index each year.

5. Empirical Results

5.1 Event Study Results of the Toxic 100 Announcements

The data in table 2 document that sample firms differ dramatically in terms of debt, dividends, and ownership structure.   If, as suggested above, sample firms are prone to agency problems and if financial and ownership characteristics mitigate agency problems, then firm market values will vary systematically with these characteristics, *ceteris paribus*.   However, the *ceteris paribus* condition is unlikely to hold.   For example, the quality, tax treatment, time of extraction, and extraction costs of petroleum reserves may vary across firms.

Table 2 presents the results for the tests for abnormal returns surrounding the First Toxic 100 index in 2006 and the Second Toxic Index in 2008.

For announcements of both versions of the Toxic 100 Index (in 2006 and 2008) we find statistically significant negative abnormal returns over the 2-day event window at a .01 significance level.   In response to the First Toxic 100 announcement on May 11, 2006, the sample of 74 firms in the index experienced a -1.12 mean abnormal return.   Similarly, in response to the Second Toxic 100 announcement on April 10, 2008, the 51 firms in the sample experiences a -1.16 percent abnormal return.   Given the large average size of the firms in the sample,

this represents a large decline in the market valuation for these firms.   Similarly, a sign test of the proportion of negative abnormal returns is significantly different from 50% (a random distribution) at the 1% significance level in both event periods. Hence, the release of the index appeared to provide valuable information to investors, and investors appeared to punish firms that appeared on the index for their greater environmental risk.[10]

Table 2

Event Study Results for the announcement of the Toxic 100 Index in 2006 and 2008.

	First Toxic 100 announcement - May 11, 2006	Second Toxic 100 announcement - April 10, 2008
Average 2-day abnormal return	-0.012	-0.016
Standard Deviation of abnormal returns	0.027	0.030
Sample size	74	51
Z-statistic (Ho: Average abnormal return equals zero)	-3.94	-3.74
Minimum 2-day abnormal return	-0.098	-0.132
Maximum 2-day abnormal return	0.045	0.084
# of negative 2-day abnormal returns	50	39
% negative 2-day abnormal returns	68%	76%
Z-statistic of Sign test (Ho: % negative abnormal return equals 50%)	3.02	3.78

Table 3 below presents the results in terms of the average market capitalization change for the sample firms during the event window.

As shown in the first column of Table 3, the average market capitalization for the firms in the Toxic 100 sample was $32.628 billion in 2006 and $44.925 billion in 2008, with the Toxic 100 representing very large, publicly traded firms.   For the Toxic 2006 sample, market capitalization ranged from $60.327 million to $352.895 billion (Exxon Mobil).   The range for the Toxic 2008 sample was $535 million to $442.390 billion (again Exxon Mobil).   On average the fall in market value in a two-day window surrounding the announcement date of the Toxic 100 in 2006 was about ($235.994 million).   The average market value loss for 2008 was

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[10]A search for conflicting news announcements for sample companies over the three days around the announcement (one day before, the day of the announcement and day after) in the Eastern Edition of the *Wall Street Journal* showed three possible conflicting news items in 2006 and 6 in 2008.   Eliminating the sample companies that were the subject of those articles produced results nearly identical to those reported in Table 2.   The average abnormal return for the 2006 sample was -1.24% with a Z-statistic of -3.85, and the average abnormal return for the 2008 sample was -1.75% with a Z-statistic of 3.67.

similar, ($237.596 million).   The maximum change in market value in 2006 was a loss of $3.788 billion for one firm in the sample and the minimum change was a rise in value of $3.058 billion for one firm in the sample.   Similarly in 2008, the maximum change was a loss in market value of $2.939 billion and a minimum change was a rise in value of $3.296 billion.   Hence, there were differential reactions for individual firms in the Toxic 100.

Table 3
Market Capitalization before and after the Toxic 100 Announcements.
The market capitalization is shown five trading days prior to the announcement in the first column, and in the second column the change in market value based on the two-day announcement event period based on the abnormal returns.   The number of shares for each firm is based on the prior fiscal year-end to calculate the market capitalization equal to the number of shares times the stock market price at that time.

	Market Capitalization Five Trading Days Before the Announcement	Announcement date Change in Market Value
Toxic 100 2006 Sample, N = 74		
Average	$32,627,511.68	($235,994,909)
Minimum Capitalization and Change	$60,326,781	($3,788,344,384)
Maximum Capitalization and Change	$352,894,500,000	$3,058,454,268
Toxic 100 2008 Sample, N = 51		
Average	$44,925,038,004	($237,595,885)
Minimum Capitalization and Change	$535,660,160	($2,939,184,246)
Maximum Capitalization and Change	$442,390,180,000	$3,296,531,234

The results support the hypothesis that investors respond negatively to the announcement that a company has been included in the Toxic 100 Index based on the company's relatively higher RSEI score.   Moreover, these results show that the RSEI score provides new information beyond that included in the TRI quantity data.   The results are also interesting because the information used to create the Toxic 100 Index was available to investors and financial analysts long before the announcement of the Toxic 100 lists. Presumably, investors could have made the same computations much earlier, so the announcement of the Toxic 100 indices would have been old news.   This suggests that the TRI data may not provide data that is accessible to all analysts. While some analysts and investors are certainly aware of TRI and RSEI data, there must not be a sufficient number to move stock prices to a new equilibrium.   Therefore, the release of the Toxic 100 Indices may have provided new information to other market participants and in particular better indications of a firm's relative risk compared to other offenders.

5.2 Event study of the TRI public release for 2006 and 2008

In the section above we present evidence that investors respond to the announcement that a company is included in the PERI Toxic 100 list, which is consistent with the RSEI data containing new information. In this section we examine whether investors also responded to the public release of the TRI data for 2006 and 2008. For both of these years the public release of the TRI data preceded the announcement of the Toxic 100 Index by several months, but since the Toxic 100 reflects Toxic 100 data included in RSEI data for the previous two years, the TRI data announcements reflect updates of their data base, the TRI releases provide different information from the Toxic 100 index, which compiles the worst offenders in terms of toxic chemical releases.

These releases of the TRI data are the seventeenth and nineteenth versions of the data to be released. As noted above, no published studies have reported significant stock price reactions to the public release of the TRI data since about 1999. In this section we test whether the public release of the TRI data in 2006 (April 12, 2006) and 2008 (February 21, 2008) using the same samples and methodology used in section 1.

Table 4

Results from the event study of the public release of the Toxic Release Inventory data in 2006 and 2008 using the sample from the Toxic 100 Index.

	2006 Toxic Release Inventory announcement - April 12, 2006	2008 Toxic Release Inventory announcement - February 21, 2008
Average 2-day abnormal return	0.001	-0.003
Standard Deviation of abnormal returns	0.016	0.014
Sample size	74	51
Z-statistic (Ho: Average abnormal return equals zero)	0.698	-1.668
Minimum 2-day abnormal return	-0.064	-0.035
Maximum 2-day abnormal return	0.043	0.028
# of negative 2-day abnormal returns	36	29
% negative 2-day abnormal returns	47%	57%
Z-statistic of Sign test (Ho: % negative abnormal return equals 50%)	0.232	0.98

Table 4 shows the event study results. There are no significant results for the 2006 TRI public release and mixed results for the 2008 TRI public Release. Thus, the announcement of the Toxic 100 Index a few months after the TRI data is publicly released does provide investors with information beyond that provided by the TRI data itself. This result is consistent with earlier studies and suggests that either this type of information was already compounded in stock prices and/or investors perceive that the TRI data by itself is not a good indicator of a company's environmental risk. This contrasts to what seems to be newer information from the standpoint of a larger announcement that a firm is included among the 100 most offensive polluters as revealed in the Toxic 100 Index announcements.

5.3 Event Study for Release Dates for the RSEI Data

Since the RSEI Data provides greater information for use by analysts than the Toxic Release Inventory, we also did an event study surrounding the RSEI release dates.

The results are shown in Table 5 below.

Table 5
Results from the event study of the public release of the Risk-Screening Environmental Indicator (RSEI) data in 2004 and 2008.
We examine the market reaction of the firms in the Toxic 100 Index (based on RSEI score rankings). The Toxic 100 for 2006 (released April 12, 2006) is based on RSEI data released September 22, 2004. The Toxic 100 for 2008 (released February 21, 2008) is based on RSEI data released January 30, 2008. The EPA supplied the RSEI event dates.

	2004 RSEI release announcement - September 22, 2004	2008 RSEI release announcement - January 30, 2008
Average 2-day abnormal return	0.0016	-0.0034
Standard Deviation of abnormal returns	0.015	0.029
Sample size	73	51
Z-statistic (Ho: Average abnormal return equals zero)	0.876	-0.828
Minimum 2-day abnormal return	-0.0251	-0.116
Maximum 2-day abnormal return	0.0536	0.083
# of negative 2-day abnormal returns	43	27
% negative 2-day abnormal returns	58.9%	53%
Z-statistic of Sign test (Ho: % negative abnormal return equals 50%)	1.52	0.42

The Toxic 100 lists are compiled using the EPA's Risk-Screening Environmental Indicator database.   As Table 5 shows at the release of this data there is not a significant average abnormal stock return in either 2004 or 2008.   Since this is publicly available information it suggests that there is a limit to semi-strong market efficiency.   This public information was not quickly impounded into stock prices. When the same information is announced later in the Toxic 100 lists then the information affects stock prices.

5.4 Companies on the 2006 TOXIC 100 Index that were not on the 2008 Index

Sixty companies from the 2006 Toxic 100 Index continued to be included in the 2008 Toxic 100 Index.   Forty companies from 2006 were no longer included in the 2006 Index.   Twenty-five U.S. and 15 non-US companies were added to the 2008 Index.   Of the 40 companies removed from the Index we found stock price data for 30.   Table 6 shows the abnormal returns for these companies over the announcement period of the release of the 2008 Toxic 100 Index.

Table 6
Results from the event study of the public release of the Toxic 100 Index on April 10, 2008, for 30 companies that were on the 2006 Index but not on the 2008 Index.

	Toxic 100 Index announcement - April 10, 2008
Average 2-day abnormal return	-0.002
Standard Deviation of abnormal returns	0.019
Sample size	30
Z-statistic (Ho: Average abnormal return equals zero)	-0.58
Minimum 2-day abnormal return	-0.035
Maximum 2-day abnormal return	0.049
# of negative 2-day abnormal returns	20
% negative 2-day abnormal returns	67%
Z-statistic of Sign test (Ho: % negative abnormal return equals 50%)	1.83

The average 2-day abnormal return is -0.2% and is not statistically different from zero.   Two-thirds of the announcement date returns are negative, and the proportion of negative abnormal returns is significantly different than 50% at the 5% level.   Comparing the abnormal returns of this group to companies that were in the Toxic 100 Index in 2008 (-1.6%) we find a difference in the 2-day abnormal return of 1.4% that is statistically different from zero at the 1% level (Z-statistic of

2.58).   The stock market response to the two groups (those that left the Index and those that remain) is very different.   This suggests that firms that were removed from the index benefited, avoiding the large drop in stock prices that firms that appeared received surrounding the announcement that they were included in the 2008 Toxic index.   Firms that were removed from the index appeared to be no longer censored by investors.   In contrast, new firms that were added to the index in 2008 suffered punishment from investors in terms of an average -3.5% decline in their average stock price in response to the announcement.

Table 7
Comparison of the Top 10 and Bottom 10 Toxic 100 Firms in 2006

Top 10 v Bottom 10

Top 10 Offenders	2-Day AR	Rank
E. I. Du Pont de Nemours & Co.	0.00071	1
United States Steel Corp.	-0.04137	2
ConocoPhillips	-0.03863	3
General Electric Co.	0.00921	4
Eastman Kodak Co.	-0.00095	5
Exxon Mobil Corp.	-0.01112	6
Ford Motor Co.	0.01281	7
Tyson Foods	0.01674	8
Alcoa Inc.	-0.06184	9
Archer Daniels Midland Co. (ADM)	-0.04019	10
Top 10		
Average AR		**-0.015463**
Stdev AR		**0.027700731**
Bottom 10 Offenders	**2-Day AR**	**Rank**
Pfizer Inc.	0.01175	89
Brunswick Corp.	-0.00717	90
Ameren Corp.	0.00494	91
Altria Group Inc.	0.00738	93
The Stanley Works	-0.00786	95
Kimberly-Clark Corp.	0.02274	96
Harley-Davidson Inc.	0.02615	97
Mohawk Industries Inc.	-0.00630	98
Plum Creek Timber Co. L.P.	0.02201	99
Illinois Tool Works Inc.	-0.02223	100
Bottom 10		
Average AR		**0.005141924**
Stdev AR		**0.015935043**
Comparison of Means		
	Average Difference	**-0.020605**
	Pooled Std. Deviation	**0.0101057**
t-statistic		**-2.039**

Hence, firms appear to have a rational goal not to be listed among the worst 100 offenders, with a status below the 100 providing a significant reward in terms of not being punished, with the announcement of the new top 100 offenders.

As a final test to examine if the market discriminates between the worst and least offenders in the Toxic 100, we compare the abnormal returns for the top 10 offenders to the bottom 10 offenders for each announcement year, and test for a significant difference.

As shown in Table 7, we find a significant difference in the average abnormal return for the top 10 offenders in 2006 with an average AR of -1.55% compared to the bottom 10 offenders, with an average AR of + 0.51%, an average difference of -2.06% for the worst 10 offenders versus the least 10 offenders. This suggests that investors are sophisticated in their evaluation of the worst vs. the less worse firms in terms of environmental risk for the 2006 Toxic 100 ranking. For 2008, however, we find an insignificant difference between the worst and least offenders for that sample.

6. Summary and Conclusion

Whether investors anticipate and punish firms for their environmental risk is an interesting empirical question. Recent empirical studies have found insignificant reactions to the EPA's announcements of the release of TRI data on the chemical pollution of firms. In this study we examine market reactions to the announcements of the Toxic 100, whereby the worst polluters are ranked based on the EPA's Risk-Screening Environmental Indicators (RSEI) model, which considers the toxicity of releases and the population close to chemical facilities.. We examine the market reaction to announcements for the first index in 2006 and the second index in 2008. Our results indicate that while investors do not react to new TRI data or the releases of the EPA's RSEI data, they respond with large significant abnormal returns on average to announcements that a firm is included in the Toxic 100 index for each year, despite the fact that the indexes are based on previous RSEI data that was released that would allow analysts to compute their own rankings. These results are consistent with new environmental risk information affecting corporate valuations and with there being limits of the semi-strong form of market efficiency, suggesting that analysts may not have anticipated a payoff from the time and effort required to perform their own prior analysis. The market also provides a differentiated response, no longer penalizing

a firm when it is removed from the index in a later year, and for the initial index announcement in 2006, penalizing more harshly the top 10 polluting firms significantly more than the bottom 10 polluting firms in the index.

References

Financial Accounting Standards Board, Accounting Standards Statements of Financial Accounting Concepts, McGraw Hill, New York, 1985, 1-5.

Binder, John, 1985. Measuring the effects of regulation with stock price data, The RAND Journal of Economics, 16(2), 167-183.

Bui, Linda T. M. and Christopher Mayer, 2003. Regulation and capitalization of envirionmental amenties: evidence from the toxic release inventory in Massachusetts, The Review of Economics and Statistics, 85(3), 693-708.

Capelle-Blancard, Gunther and Marie-Aude Laguna, 2010. How does the stock market respond to chemical disasters? Journal of Environmental Economics and Management, 59(2), 192-205.

Connors, Elizabeth, Lucia Silva-Gao, 2008. The value of toxic release inventory as a measure of corporate environmental performance. University of Massachusetts at Boston Working Paper.

EPA Website, assessed on June 22, 2010 at http://www.epa.gov/tri/triprogram/

EPA's Risk-Screening Environmental Indicators (RSEI) Methodology RSEI Version 2.2.0 (February 2009) at: http://www.epa.gov/opptintr/rsei/pubs/RSEI%20Methodology%20V2.2.0.pdf

Freedman, Martin and Dennis Patten, 2004. Evidence on the pernicious effect of financial report environmental disclosure, Accounting Forum, 28(1), 27-41.

Gardner, David, 2010. BP market plunge wipes billions off UK pension funds as shares in oil giant suffer fresh falls, MailOnline, June 2, 1-9 accessed at http://www.dailymail.co.uk/news/worldnews/article-1282870/BP-shares-plunge-15-oil-giant-admits-oil-spill-August.html

Hamilton, James T., 1995. Pollution as news: Media and stock market reactions to the toxics release inventory data, Journal of Environmental Economics and Management, 28, 98-113.

Insurancenewssnet, 2010. "BP stock price drop hits state investment holdings: Pension systems, BWC portfolio have lot millions," Insurancenewnet.com, July 5, 2010, 1-3, accessed on October 2, 2010, at http://insurance newsnet.com/article.aspx?id=204901&type=newswires

Karpoff, Jonathan, John R. Lott, Jr., and Eric Wehrly, 2005. The reputational penalties for environmental violations: empirical evidence, Journal of Law and Economics, 68, 653-675.

Khanna, Madhu, Wilma Rose H. Quimio, and Dora Bojilova, 1998. "Toxics release information: A policy tool of environmental protection," Journal of Environmental Economics and Management, 36: 243-266.

Klassen, Robert and McLaughlin, Curtis, 1996. The impact of environmental management on firm performance, Management Science, 42(8), 1199-1214.

Konar, Shameek, Mark A. Cohen, 1997. "Information as regulation: The effect of community right to know laws on toxic emissions," Journal of Environmental Economics and Management, 32: 109-124.

McNichol, Dunstan, 2010. "BP Oil Spill Costs U.S. State Pensions $1.4 Billion," Bloomberg Businessweek, October 2, 1-2, accessed on Oct. 2, 2010 at: http://www.businessweek.com/news/2010-06-28/bp-oil-spill-costs-u-s-state-pensions-1-4-billion.html.

Wruck, K.,1989. Equity ownership concentration and firm value: Evidence from private equity financings, Journal of Financial Economics, 23 (June), 3-28.