Growing Out of Trouble? Corporate Responses to Liability Risk

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This article analyzes corporate responses to the liability risk arising from workers' exposure to newly identified carcinogens. We find that firms, especially those with weak balance sheets, tend to respond to such risks by acquiring large, unrelated businesses with relatively high operating cash flows. The diversifying growth appears to be primarily motivated by managers' *personal* exposure to their firms' risk in that the growth has negative announcement returns and is related to firms' external governance, managerial stockholdings, and institutional ownership. The results suggest that corporate governance is particularly important when firms are exposed to the risk of large, adverse shocks. (*JEL* D21, G32, G34, K13)

Every firm is exposed to business risks, including the possibilities of large, adverse shocks. Potential sources for such shocks abound; examples include new technologies that reduce barriers to entry, disruptive product innovations, the relaxation of international trade barriers, and changes in government regulations. Exposing a firm's managers to these risks is often necessary to induce them to work hard and provides the basis for many principal–agent models of the firm (e.g., Holmström 1979; Grossman and Hart 1983). The risks of bankruptcy and employment loss are understood to provide particularly strong managerial incentives for effort, because these events can lead to severe personal losses, including the loss of private benefits, reputation, and specialized

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human capital (Grossman and Hart 1982; Gilson 1989). Exposing managers to such risks, however, introduces another agency conflict. Managers will have incentives to take actions that reduce the likelihood of bankruptcy, even when these actions do not maximize shareholder value (Jensen and Meckling 1976).[1] For example, managers may make overly conservative investment choices or grow the firm by undertaking diversifying acquisitions (Amihud and Lev 1981; Holmström 1999).[2]

Although theoretical models and calibrations suggest that agency conflicts arising from managers' exposure to risk can significantly affect firms' investment and financing choices (Parrino, Poteshman, and Weisbach 2005), the empirical relevance of these conflicts is less clear. Empirical evidence is sparse in part because of the difficulty of isolating an exogenous increase in firms' business risks that does not also affect other aspects of the firms, such as their current cash flows. Our article overcomes this challenge by exploiting exogenous increases in legal liability that increase firms'—and managers'—exposure to the risk of poor future corporate performance and even bankruptcy. By investigating firms' responses to an increase in liability risk, we shed light on the importance of agency conflicts arising from managers' exposure to risk.

In particular, we focus on the legal liability that is created when a chemical to which a firm's workers are already exposed is newly identified as a carcinogen. Using this approach, we analyze how 2,209 firms in more than 100 Standard Industrial Classification (SIC) industries between 1980 and 2006 responded to the identification of 121 different chemicals as carcinogens. Despite the presence of the workers' compensation system, these exposures can carry significant corporate legal liability (Ringleb and Wiggins 1990). Discovery of a chemical's carcinogenicity increases the likelihood that a firm will need to spend large sums on legal fees, damage payments, and insurance premiums in the future—if and when workers eventually fall ill. This increased potential for large cash outflows increases the likelihood of future poor corporate performance and financial distress, allowing us to cleanly identify an increase in firms' business risks.

The most salient risk for these firms is that a chemical will become the next asbestos. Widespread workplace exposure to asbestos, whose medical dangers were known as early as the 1920s (well before the sample period of this study), has come to be regarded as "the worst occupational health disaster in U.S.

[1] Jensen and Meckling (1976) write, "If under bankruptcy the bond holders have the right to fire the management, the management will have some incentives to avoid taking actions which increase the probability of this event (even if it is in the best interest of the equity holders) if they (the management) are earning rents or if they have human capital specialized to this firm, or if they face large adjustment costs in finding new employment" (p. 340).

[2] A number of other theoretical papers also find that managers' exposure to risk can cause a misalignment between managers and shareholders' risk preferences. For example, see Smith and Stulz (1985), Lambert (1986), Hirshleifer and Suh (1992), Hugonnier and Morellec (2007), and Acharya and Bisin (2009).

history" (White 2004; Cauchon 1999). Litigation related to asbestos exposure has targeted more than 8,400 corporate defendants, has bankrupted at least 85 firms, and is projected to cost defendants $200 billion to $265 billion in total (Carroll et al. 2005; White 2004). Although the expected liability costs of a newly identified carcinogen are unlikely to approach those of asbestos, there is a chance that a firm that has exposed its workers to a carcinogen will be liable for a substantial payout.

The dominant finding of our analysis is that firms tend to undertake a period of aggressive growth via both capital investment and acquisitions after liability risk increases. Although firms that become exposed to the increased legal liability are very similar to other firms before the risk increases (including in size, market-to-book ratio, growth rate, financial leverage, payout rates, and other characteristics), exposed firms grow to become about 10% larger, on average, than unexposed firms within a few years after the risk increases. The exposed firms finance their growth primarily with equity, causing modest decreases in average leverage ratios, and the growth is concentrated among firms that seem to be more vulnerable to the realization of an adverse shock. For example, firms at high risk of bankruptcy (measured by Altman z-score) grow by an average of 38% to 48% more than otherwise similar firms after the increased liability risk is discovered. Firms at low risk of bankruptcy show no average growth. The growth is also associated with other indicators of financial vulnerability, such as high leverage, low operating cash flows, zero dividends, and small overall size.

While some of the growth is achieved by an increase in capital expenditures, at least half stems from an increase in acquisitions. The discovery of a new carcinogen is associated with a 6% increase in the total number of acquisitions completed in exposed industries, and many of these acquisitions diversify the firms' assets away from those causing the liability. In comparison with acquisitions undertaken by similar firms without exposure to the chemical, the targets acquired by the exposed firms can be described as "cash cows": They average 39% larger and have relatively high operating cash flows, recent growth, and total payout rates. The exposed firms also pay a 13.7-percentage-point greater takeover premium, and announcements of the deals are associated with negative abnormal returns on the acquirers' equity. In fact, acquirer announcement returns average 1.3 percentage points lower than for deals undertaken by unexposed firms.

These responses to the increase in liability risk suggest that the firms are attempting to reduce their probability of future financial distress arising from the increased liability risk. Building or acquiring businesses with strong prospects for producing high cash flows provides the firms with deeper pockets from which to pay future liability costs. Deeper pockets may increase the total potential damage claims, but they are also likely to reduce the probability of financial distress. Funding the growth with equity rather than debt further lowers the probability of financial distress. Consistent with this motivation, the growth is concentrated among firms with already weak balance sheets before liability risk increases, leaving them more vulnerable to an adverse cash flow shock.

There are multiple reasons why firms might seek to reduce the probability of financial distress after liability risk increases. First, if financial distress is costly, it may be in the interest of shareholders to grow or even diversify to avoid incurring these costs should the firm end up being liable for substantial damages. In order for the growth to benefit shareholders, the avoided costs of financial distress must be greater than the potential costs of diversification (Berger and Ofek 1995; Lang and Stulz 1994) and any value lost from exposing the assets of the newly acquired businesses to the liability. A second possibility is that the growth is motivated by managers' *personal* exposure to their firms' risk. Managers who earn private benefits from maintaining control have an incentive to direct their firms to take costly investments that ensure the firms' long-run survival with themselves at the helm (Holmström 1999). From a purely financial perspective, a risk-averse manager who has a large fraction of his personal wealth tied to the firm also gains more from reducing idiosyncratic liability risk to the firm's stock price than does a diversified shareholder (Hugonnier and Morellec 2007).

Additional results support the idea that agency motivations play a role in firms' responses to the increase in liability risk. First, the negative average announcement returns associated with the acquisitions suggest that much of the growth is not in the interest of shareholders. Second, we find that firms' responses to the increase in risk are related to various indicators for the degree of risk-related agency conflicts at these firms, specifically the strength of external governance (Jensen and Ruback 1983; Shleifer and Vishny 1989), the size of senior management's ownership stake in the firm (Parrino, Poteshman, and Weisbach 2005), and the degree of institutional equity ownership (Shleifer and Vishny 1986). We find that total assets grow by almost 35% after the risk increases at firms with weak external governance. Firm growth is also larger when senior management holds a larger equity stake in the firm, which increases their exposure to the firm's idiosyncratic risk, and when relatively few equity shares are held by institutional investors, who are thought to be more effective at monitoring managers.

At the same time, firms where risk-related agency conflicts are likely *less* severe—firms with strong external governance, low inside ownership, or high institutional ownership—do not grow after liability risk increases. Instead, these firms increase their payouts to shareholders, suggesting that increasing payouts rather than growth may be shareholders' preferred response to the increased risk. In theory, an increase in payouts might benefit shareholders when the costs of financial distress are not too high. To the extent that the increase in liability risk decreases the expected returns on new investments, shareholders may prefer that the firm reduce investments and increase payouts, all the more so if excess corporate liquidity increases expected damage awards. By paying out capital, investors can redeploy these funds more profitably to other firms that are not exposed to the liability.

Collectively, these results suggest that the risk of large, adverse shocks has the potential to cause large changes in corporate activity and that managers' incentive to reduce their downside risk plays a role in these decisions. In this regard, our analysis complements cross-country comparisons presented by Acharya, Amihud, and Litov (forthcoming), who find that firms are more likely to undertake diversifying acquisitions and less risky investments in countries with stronger creditor rights, particularly rights that increase the likelihood of managers' removal in periods of financial distress. Our evidence is also consistent with Tufano (1996, 1998) and Low (2009), who argue that agency conflicts may be related to firms' risk management choices and stock volatility. In contrast to these articles, our article provides evidence on how agency conflicts can affect firm financing and investment choices and shows for which firms this distortion appears to be more severe.

Our results also offer insight into what motivates managers. Although we find that managers grow their firms after risk increases, the growth being concentrated among financially vulnerable firms suggests that managers' motivations may be more accurately described as "career concerns" than as a preference for empire-building per se. These results complement Bertrand and Mullainathan (2003), who conclude, based on corporate responses to antitakeover legislation, that the average manager does not have a preference for empire building or diversification. Although the average manager may be "reluctant to undertake cognitively difficult activities" (what Bertrand and Mullainathan also call the "quiet life"; p. 1067), our results suggest that many managers are willing to overcome this reluctance when the stakes are sufficiently high. Putting the results together suggests that agency problems can play out quite differently in normal times than when times are tough.

This interaction between managerial agency conflicts and corporate financial vulnerability has implications for a firm's optimal capital structure. Jensen (1986) describes the scope for using debt to reduce managerial agency problems at "firms that have stable business histories and substantial free cash flow" (p. 325). Our evidence reinforces the importance of Jensen's first condition, that the business be stable. If managers' objectives and shareholder interests tend to diverge as a firm approaches financial distress, then a high amount of financial leverage that moderates managerial agency problems in normal times may amplify another managerial agency conflict when the firm encounters an adverse shock. This potential cost of debt financing—and the broader interaction between managerial agency conflicts and financial distress—has received little attention in the literature.

The remainder of the article is organized as follows. Section 1 discusses firms' legal liability for occupational carcinogens. Section 2 describes our empirical strategy and the data sources. Section 3 presents our results, and Section 4 discusses possible explanations. Section 5 concludes.

1. Liability for Occupational Carcinogens

In the United States, diseases—including cancers—that are contracted by workers in the course of employment are covered by a legal institution known as the workers' compensation system. Under this system, employers are required to compensate workers for all job-related injuries irrespective of fault. Upon establishing that employment was at least a contributing factor in causing a disease, workers typically qualify for payment of their complete medical expenses as well as some compensation for lost wages (Peirce and Dworkin 1988). Because these payments accrue irrespective of employer negligence, the firm bears liability even if it had no knowledge of the danger (Schwartz 1985).

Damages related to carcinogenic exposures in the workplace can be significant. Treating cancer is expensive, and if a worker dies of the disease, surviving family members often qualify for death benefits. Furthermore, sick workers and their family members are entitled to sue employers directly for negligence, pain and suffering, and punitive damages if they can prove that their employer had "dual capacity" (for example, if the employer was also the producer of the substance causing the carcinogenic exposure) or committed "willful misconduct" (for example, if the employer took few precautions despite knowing the risks of exposure). Even a few such suits can lead to significant damage awards, and numerous suits can tax the financial assets of even large corporations (Ringleb and Wiggins 1990). As a result, managers cite occupational exposures as a significant risk to their firms' operations.[3]

A calibration confirms that such workplace exposures to carcinogens can significantly increase a firm's risk of future financial distress and bankruptcy.[4] Using historical data on damage awards (Pontiff 2007) and workplace exposures to known carcinogens, the typical potential legal liability faced by firms in our sample (described later) appears to be around 5% of assets. Given firms' historical cash flows, an adverse cash flow shock of this magnitude would increase the median probability of distress among these firms 30-fold (from 0.09% to 3.35%), representing a substantial increase in risk. (Details of the calibration are described in the Appendix.)

Large firms often self-insure against these risks, thereby retaining primary liability (LeRoy et al. 1989), and general liability and workers' compensation insurance are likely to provide other firms with only limited protection from these claims. Third-party policies are often limited in scope and do not provide any protection against future premium increases due to changes in the firm's

[3] For example, in their 2008 10-K, Novelis Inc., a producer of aluminum rolled products, noted that the company's use of hazardous materials and chemicals could lead to future litigation pertaining to occupational exposures, and that it "is not possible to predict the ultimate outcome of these claims and lawsuits due to the unpredictable nature of personal injury litigation. If these claims and lawsuits, individually or in the aggregate, were finally resolved against us, our financial position, results of operations and cash flows could be adversely affected."

[4] We thank the editor for suggesting this calibration.

risk exposure, and the premiums can become a significant cost of doing business (Williams 1986; Cummins and Olson 1974).[5] For example, a half-dozen surgeries for carpal tunnel problems and other injuries at a factory of 220 workers can lead to costs representing 2.5% of revenue ($4,900 per worker per year, or $2.50 for every hour that an employee works; Greenhouse 2009).[6]

Using subsidiary corporate structures is also unlikely to shield firms from any major liability emerging from these claims because courts can "pierce the corporate veil" and hold a parent corporation responsible for its subsidiaries' liabilities. While there is no set rule or formula, it is generally understood that liability will be imposed on the parent "when it is necessary to promote justice or to obviate inequitable results" (Lattin 1971, p. 72), or when a subsidiary is set up to avoid paying foreseeable damages (because it is undercapitalized; Thompson 1991). Furthermore, using a subsidiary structure in the occupational injury context may actually increase the firm's total liability, because limitations on lawsuits under the workers' compensation system do not usually transfer to the parent corporation (Treece and Zuckerman 1983). Firms also cannot shield themselves from existing liability by spinning off the troubled assets. Although selling the assets can prevent additional expenses, the firms would still be liable to workers for damages already incurred.

Although the increase in liability risk is bad news about the firm's future, it is unlikely to have much of an effect on its *current* cash flows. Damage awards are unlikely to affect cash flows immediately because claims for past exposure to carcinogens typically take years to litigate. Moreover, damage payments to workers typically accrue only after worker injuries manifest themselves, because damages are usually assessed only for actual—not speculative—damages (Ringleb and Wiggins 1990). Although premiums for third-party workers' compensation insurance are likely to eventually reflect the increased risk of a payout, they are also unlikely to adjust immediately (Williams 1986).[7]

The discovery that a chemical currently being used in a firm's production process—and to which the firm's workers are exposed—is a carcinogen thus

5 Because of concerns about strong adverse selection, surplus liability insurance policies covering large risks were often unavailable during the period of this study, and insurance policies that were issued typically excluded many risks including "tail coverage" (i.e., the policies covered only damages from lawsuits actually filed during the policy period, excluding losses that would not manifest until much later; Winter 1991).

6 Firms also warn about this risk in their financial reporting: "We could be subject to present and future claims with respect to workplace exposure, workers' compensation and other matters. Although we maintain property and casualty insurance of the types and in the amounts that we believe are customary for our industries, we cannot assure you that our insurance coverage will be adequate for liability that may be ultimately incurred or that such coverage will continue to be available to us on commercially reasonable terms. Any claims that result in liability exceeding our insurance coverage could have an adverse effect on our business, financial condition and results of operations." (Northwest Pipe Company 10-Q, September 2006, p. 18)

7 After learning about the increased risk, workers might demand higher wages as a sort of insurance against potential noneconomic harm, such as from pain and suffering. (Economic damages and lost wages would be covered by workers' compensation.) However, using the difference-in-difference framework described below, we do not find any evidence of wages increasing after the increase in liability risk. Similar tests presented below find no immediate change in the ratio of cash flow to assets.

has a distinctive feature: It represents a substantial increase in the risk of future financial distress and bankruptcy but has minimal concomitant effect on cash flows. Because the increase in liability risk has little effect on current cash flows, which might directly influence investment (Fazzari, Hubbard, and Petersen 1988), we are able to isolate an exogenous increase in managers' exposure to their firms' risk. We exploit this unique feature to analyze how firms' financing and investment decisions are affected by their managers' exposure to the firms' risk.

2. Empirical Approach

Identifying workers' exposure to newly identified carcinogens requires the combination of information on (1) scientific discoveries related to chemical carcinogenicity; and (2) which firms use these chemicals. For information about the timing of discoveries, we use the National Toxicology Program's (NTP) *Report on Carcinogens* (*RoC*). This report, which is published regularly by the U.S. Department of Health and Human Services under a 1978 congressional mandate, contains a list of all substances (1) that are known or may reasonably be anticipated to be human carcinogens; and (2) to which a significant number of persons residing in the United States are exposed. Nominations for listing in the report are evaluated by scientists from the NTP, other federal health research and regulatory agencies, and non-government institutions. The first two reports were published in 1980 and 1981, and the report has been updated approximately biannually since.

The addition of an agent to the *RoC* indicates an accumulation of new scientific evidence that the agent may be a carcinogen. In our empirical work, we focus on additions to the *RoC* after 1981 for two reasons. First, the initial report in 1980, which listed only 26 agents, was an incomplete listing of known carcinogens at that time; the second report, released only one year later, in 1981, contained 62 additional agents.[8] Second, our data source (described below) for identifying firms' chemical exposures is based on information collected between 1981 and 1983. To avoid the possibility that firms may have already eliminated exposures to carcinogens identified in the two reports prior to the survey, we rely on additions to the *RoC* beginning in 1983. This leaves 121 unique chemical agents.

While there are a number of potential sources for scientific developments related to possible carcinogens, we use the *RoC* because federal regulations specifically require U.S. firms to monitor the report and treat any substances listed as carcinogens. For example, firms are required to warn employees about

8 In the interest of "expeditiously initiating issuance of the first report," the decision was made to include only a limited number of chemicals that "represent substances historically viewed as associated with cancer in man" (National Toxicology Program 1980, pp. vi, 7). Subsequent reports also included chemicals recently identified as carcinogens, usually through animal studies.

their exposure to substances that are included in the *RoC* [U.S. Government Regulation 29 CFR, parts 1910.1200(b)(1) and (d)(4)]. Because of such regulations, it is likely that firms, and presumably employees, are aware of agents listed in the report, and while it is not required, some firms note relevant changes in the *RoC* in their financial reporting. Nevertheless, the listing of a substance in the *RoC* is not in itself a regulatory action that requires firms to limit exposures or uses of the substance in question, although it may prompt regulatory agencies to consider adopting such rules.[9]

To identify firms in which workers were likely to have been exposed to the newly identified carcinogens, we use the National Occupational Exposure Survey (NOES). This survey was conducted by the National Institute for Occupational Safety and Health using on-site visits to 4,490 U.S. business establishments employing approximately 1.8 million workers between 1981 and 1983. In these visits, surveyors recorded all chemical, physical, and biological agents to which workers were observed to be exposed in each firm and the number of workers being exposed to each agent. The survey is expansive and lists nearly 13,000 different agents, including agents that were not known or thought to be hazardous at the time of the survey. Because the NOES was conducted between 1981 and 1983, it measures worker exposures to possible carcinogens before those chemicals were identified as dangerous by the *RoC*. We obtained a custom extract of these data aggregated by four-digit 1972 SIC code, covering 522 industries.

We determine whether a firm is affected by the listing of a newly classified carcinogen based on the firm's SIC code in Compustat in the year prior to each new listing.[10] We consider a firm affected if it operates in a four-digit SIC code where at least 7.5% of workers were observed to be exposed to the carcinogen in the NOES. The cutoff of 7.5% captures roughly the top quartile of observed exposures at the industry level, corresponding to the discoveries that are most likely to result in an increase in legal liability and risk of future financial distress. Our findings are robust to using alternative measures of exposure, including lowering the exposure threshold. Our data on firms are from Compustat. To ensure a consistent sample of observations across specifications, we exclude observations with missing values for *ln(assets), ln(sales), ln(capital expenditures+1), equity, ln(debt+1),* and *ln(dividends+1).*

[9] Future regulatory changes pose yet another risk for firms. Such regulation can significantly increase a firm's cost of doing business, and firms appear to consider this to be a serious risk when new chemicals are discovered to be carcinogenic. For example, in their 1996 10-K filing, Unifrax Corporation, a company that produces insulation, stated concerns that recent evidence of carcinogenicity in ceramic fibers (which were added to the *RoC* in 1994) might lead to new regulatory limits on occupational exposures: "If the U.S. were to adopt legislative or regulatory standards severely restricting the use of ceramic fiber or severely limiting fiber exposure, a material adverse effect on the Company's business could result."

[10] To accomplish this, we first convert the NOES data, which are reported using the SIC 1972 coding scheme, to the SIC 1987 coding scheme used by Compustat, by applying an employee-weighted concordance table from the Bureau of Labor Statistics (1989). We then determine which firms were affected by an increase in liability risk based on Compustat's measure of a firm's industrial classification.

The use of the NOES likely introduces a degree of measurement error in our ability to identify firms with potential exposures, possibly leading us to underestimate the true effect of liability risk. There are two main measurement issues. First, the NOES provides data on exposures only at the four-digit industry level; firm-level data are not available. Our subsequent analysis implicitly assumes that all firms in the industry are affected and calculates the average effect. If not all firms in the industry are affected, then we are underestimating the true average effect of an increase in liability risk. Second, firms may have stopped using a dangerous chemical after the NOES was completed in 1983 but before the chemical's listing in the *RoC*. The increase in liability risk would be smaller in such cases, though the firms would still be liable for past exposures that occurred while the chemical was still in use.

Despite these measurement concerns, evidence suggests that the NOES indeed captures exposures that later become significant liability risks. For example, one chemical in the NOES is trichloroethylene, which was used in a number of industries, including the semiconductor and related devices industry (SIC 3674). The chemical is often used in semiconductor firms' "clean rooms," and the NOES observed more than 8.5% of employees in this industry being exposed.[11] In 2000, trichloroethylene was added to the *RoC* as a probable carcinogen, indicating that firms operating in the semiconductor industry were at greater risk of liability. Financial filings from the industry confirm that managers perceived their risk to have increased. Between 1994–1999 and 2000–2005, there was a fivefold increase in the number of semiconductor firms mentioning trichloroethylene in a 10-Q or 10-K filing, and while only a quarter of the 10-K and 10-Q filings in this industry mentioned both the words "exposure" and "liability" between 1994 and 1999, nearly two-thirds of filings mentioned these words between 2000 and 2005. More directly, trichloroethylene has been the source of recent litigation pertaining to occupational exposures in the semiconductor industry.[12]

Figure 1 displays the timing of the increases in liability risk and the number of firms affected in each year. Using our measure of workers' exposures, increases occurred in 1983, 1985, 1989, 1991, 2000, and 2004, with more than 100 firms affected by newly identified carcinogens in each of those years. In all, 106 different industries and 2,209 firms, representing 12% of nonfinancial firms covered by Compustat during the sample period, are affected by a newly identified carcinogen.[13] In addition to being robust to using alternative

[11] Clean rooms are designed to protect semiconductors during their manufacturing by recirculating the air in the room, but in doing so workers can be exposed to high concentrations of trichloroethylene.

[12] Examining equity market returns would be another way to test whether these exposures are salient to managers (and the market), but because *RoC* listings are not associated with exact announcement dates (there is a multi-step review process, and information leaks out slowly in the months leading up to a new listing), a standard event study is not feasible. Long-run event studies are feasible, but the results are very noisy.

[13] Compustat covers 18,413 nonfinancial firms between 1982 and 2006, of which 2,209 firms experience an exposure. In an average year, 1.87% of previously unexposed firms suffer a new exposure.

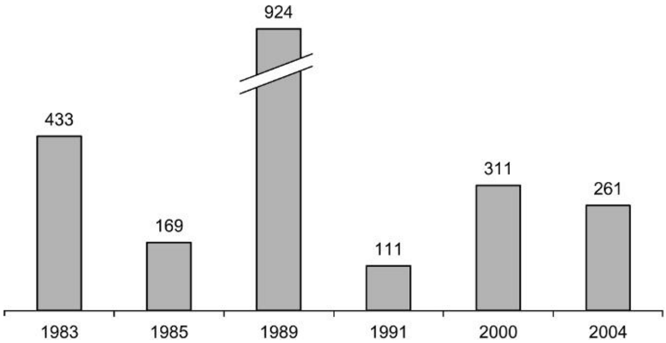

Figure 1
Number of firms facing an increase in liability risk by year
This figure graphs the number of firms newly affected by the liability risk by year. A firm is considered affected if at least 7.5% of employees in its four-digit SIC industry were observed in the 1981–1983 National Occupational Exposure Survey to be exposed to a chemical listed in the *Report on Carcinogens* in that year. A total of 2,209 firms are affected.

measures of workers' exposures, our findings are robust to excluding any chemical or any year in which chemicals were added to the *RoC*, including 1989, when two widely used chemicals (dichloroethylene and tetrachloroethylene) were added to the *RoC*.

For each new chemical's listing in the *RoC*, we construct a comparison group of unaffected firms (firms without observed exposures to any newly listed carcinogens) that were present in Compustat in the year prior to the *RoC* listing and were in the same Fama-French 48 industry classification as one of the affected firms. (Fama-French industries are collections of four-digit SIC industries that are meant to represent broader industry categories.) This yields a comparison sample of 8,373 unexposed firms in 249 industries. Our results are also robust to using all unaffected firms in Compustat as our comparison group or to using two-digit SIC codes instead of Fama and French (1997) industry classifications.

Firms with exposures to the newly identified carcinogens are very similar to our sample of unexposed firms in the year before the listing of a new carcinogen. The ex ante characteristics of firms with exposures are reported in column (i) of Table 1, and the ex ante characteristics of firms without exposures are reported in column (ii). Even though we match firms based only on Fama-French industries, the two groups are similar in size, market-to-book ratio, recent growth, age, leverage, payout policy, capital intensity, and cash balances. We are unable to reject the null hypothesis that firms whose liability risk increases are similar to other firms in all of these dimensions.

There is also no evidence of any relationship between the increase in liability risk and current cash flows. Average cash flows for exposed and unexposed firms in the year before, the year of, and the year after new carcinogen listings are reported in Table 2. In all three years, we are unable to reject the null

Table 1
Ex ante firm characteristics

	Exposed (i)	Unexposed (ii)	p-value of difference (iii)
Ln(Assets)	4.586	4.256	0.261
	(2.607)	(2.360)	
Market-to-book ratio	3.036	3.095	0.929
	(5.614)	(6.081)	
5-year asset CAGR (%)	13.83	13.16	0.622
	(20.61)	(20.22)	
Firm age	13.77	12.78	0.453
	(11.32)	(11.43)	
Leverage	0.285	0.285	0.983
	(0.252)	(0.269)	
Total payout / Assets * 100	1.856	1.813	0.830
	(3.525)	(3.643)	
Capex / Assets	0.086	0.081	0.228
	(0.076)	(0.085)	
Cash / Assets	0.093	0.094	0.981
	(0.148)	(0.151)	
Observations	2,209	8,373	
# of Industries	106	249	

This table reports summary statistics for firm characteristics in the year before a new chemical was added to the *Report on Carcinogens*. The mean and standard deviation (in parentheses) for each variable are reported separately for two samples of firms. Column (i) reports estimates for firms in four-digit SIC industries for which more than 7.5% of employees were observed to be exposed to the chemical in the 1981–1983 National Occupational Exposure Survey. Column (ii) reports estimates for other firms in the same Fama-French 48 industry classification. Column (iii) reports the p-value from a t-test for the difference between exposed and unexposed firms, where the standard errors are clustered at the four-digit SIC industry level. *Firm age* is the number of years since the firm's first information in Compustat. The sample is restricted to firms with nonmissing observations for *ln(assets), ln(sales), ln(capital expenditures+1), equity, ln(debt+1)*, and *ln(dividends+1)*.

Table 2
Cash flows around the time liability risk increases

Year relative to increase in liability risk	Exposed (i)	Unexposed (ii)	p-value of difference (iii)
$t = -1$	0.048	0.048	0.981
	(0.258)	(0.255)	
$t = 0$	0.042	0.025	0.530
	(0.273)	(0.293)	
$t = 1$	0.049	0.037	0.649
	(0.273)	(0.287)	

This table reports summary statistics for cash flows/assets in the years around a new chemical being added to the *Report on Carcinogens*. The mean and standard deviation (in parentheses) for cash flows in the years $t = -1$, $t = 0$, and $t = 1$ are reported separately for two samples of firms. Column (i) reports estimates for firms in four-digit SIC industries for which more than 7.5% of employees were observed to be exposed to the chemical in the 1981–1983 National Occupational Exposure Survey. Column (ii) reports estimates for other firms in the same Fama-French 48 industry classification. Column (iii) reports the p-value from a t-test for the difference between exposed and unexposed firms, where the standard errors are clustered at the four-digit SIC industry level. The sample is restricted to firms with nonmissing observations for *ln(assets), ln(sales), ln(capital expenditures + 1), equity, ln(debt + 1), and ln(dividends + 1)*.

hypothesis that there is no difference in average cash flows between affected and unaffected firms. This evidence supports the interpretation that the effects of the increase in liability risk are caused by changes in the risk of a large adverse shock, rather than changes in current cash flows.

To estimate firms' responses to the increase in liability risk, we compare changes in the exposed and unexposed firms' behavior around the time of each new carcinogen listing in the *RoC*. For each year that new carcinogens are listed in the *RoC*, we construct a cohort of exposed and unexposed firms using firm-year observations for the ten years before and the ten years after the listing. Firms are not required to be in the sample for the full twenty years around the event, and we obtain similar findings if we instead compare the five years before with the five years after each listing. We then pool the data across cohorts (i.e., across all new carcinogens listings) and estimate the average treatment effect. Specifically, we estimate the following firm-panel regression:

$$y_{ijct} = \beta_0 + \beta_1 Exposure_{jct} + \gamma_{ic} + \omega_{tc} + \varepsilon_{ijct}, \tag{1}$$

where y is one of several dependent variables of interest for firm i and year t, and *Exposure* is an indicator that equals 1 if at least 7.5% of employees in cohort c and industry j were observed to be exposed in the NOES to a known *RoC* carcinogen as of year t. For an exposed firm, this indicator changes from 0 to 1 when the chemical is identified in the *RoC* as a carcinogen. We also include firm-cohort fixed effects, γ_{ic}, to ensure that we estimate the impact of exposure after controlling for any fixed differences between firms, and we include year-cohort fixed effects, ω_{tc}, as a nonparametric control for any secular time trends. We allow the firm and year fixed effects to vary by cohort, because this approach is more conservative than including simple fixed effects. (Similar results are obtained in both specifications.) We deliberately do not control for any time-varying accounting variables in these regressions because these variables are likely affected by the increase in liability risk, and including them would confound estimates of β_1.[14] In any event, including the standard controls does not qualitatively affect the results. To account for potential covariance among firm outcomes within the same four-digit SIC code and over time, we cluster the standard errors at the industry level.

[14] Our identification assumption is that the incidence of the increase in liability risk is as good as randomly assigned within our industry-matched sample—i.e., which firms' chemicals are discovered to be carcinogenic is uncorrelated with other determinants of the dependent variables after controlling for firm and year fixed effects. The results presented in Table 1 support this assumption. In this framework, β_1 in Equation (1) measures the increase in the dependent variable caused by the increased liability risk. If we include endogenous controls, then β_1 would instead measure only the portion of the increase in the dependent variable caused by the liability risk that is not also correlated with the causal impact of the liability risk on the other variables. For example, suppose the liability risk leads firms to double in size by increasing capital expenditures by the same amount; then a regression of firm size on the exposure indicator and capital expenditures would yield a coefficient on the exposure indicator that is close to zero—even though exposure caused substantial growth.

3. Results

3.1 Firm size, investment, and payout policy

We begin analyzing how firms respond to the increase in liability risk by examining the impact on overall firm growth. In response to increased business risks, diversifying growth is one way managers can reduce the likelihood of financial distress (Amihud and Lev 1981). Estimates of the effects on log assets, log sales, and log capital expenditures are reported in Table 3.

We find that, on average, firms grow after liability risk increases. The estimates for log assets, reported in column (i), indicate that, after the increase in liability risk, exposed firms grow total assets by an average of 10.3 percentage points more than unexposed firms.[15] One possibility is that this increase in assets reflects firms making investments in order to protect their workers from exposure to the newly identified carcinogens. However, we find that sales at these firms increase by a similar margin [column (ii)], suggesting that these firms are increasing their overall size and not strictly making capital investments to protect workers. The estimates are robust to including controls for cash flows and the market-to-book ratio. These results are also not caused by survivorship bias, where the increase in liability risk causes weaker, exposed firms to exit the sample at a greater rate than unexposed firms. Such differential exit rates could bias upward estimates of growth among exposed firms. In further analyses, however, we find that firms affected by the increase in liability are not more likely to drop out of the sample within three, five, or ten years after liability risk increases.

Table 3
Effect of liability exposure on firm size and investment

	Ln(Assets)	Ln(Sales)	Ln(Capex + 1)
Dependent Variable =	(i)	(ii)	(iii)
Exposure	0.098*	0.105**	0.054
	(0.056)	(0.049)	(0.045)
Observations	144,650	144,650	144,650
# of Firms	10,582	10,582	10,582
R^2	0.32	0.27	0.15
Fixed effects:			
Firm-cohort	X	X	X
Year-cohort	X	X	X

This table reports coefficients from firm-panel regressions of firm size and investment on an indicator for liability exposure, firm-by-cohort fixed effects, and year-by-cohort fixed effects. The liability exposure indicator equals 1 if more than 7.5% of employees in the firm's four-digit SIC industry were observed to be exposed in the 1981–1983 National Occupational Exposure Survey to a chemical listed in the most recent edition of the *Report on Carcinogens (RoC)*. The dependent variables are *ln(assets), ln(sales), and ln(capex + 1)*. The data include firm-year observations in the ten years before and ten years after each new chemical listing in the *RoC*. Standard errors, clustered at the industry level, are reported in parentheses. * significant at 10% level, ** significant at 5% level.

[15] The increase in log assets of 0.098 log points corresponds to an increase in assets of $e^{0.098} - 1 = 10.3$ percentage points. We use this method throughout the article to interpret estimates from regressions with log-dependent variables.

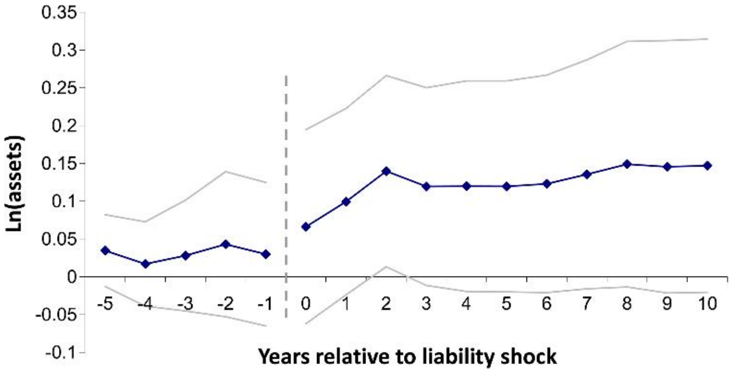

Figure 2
Effect of liability risk increasing on growth by year
This figure reports the point estimates from a firm-panel regression of log assets on an indicator for liability exposure, firm-by-cohort fixed effects, and year-by-cohort fixed effects. The specification is the same as that reported in Table 3 except that the effect of liability exposure is allowed to vary by year for each year from five years before the risk increases through ten years after. Ninety-five-percent confidence intervals, adjusted for clustering at the industry level, are also plotted.

The timing of the increase in size coincides with the increase in legal liability. Figure 2 plots the point estimates from a modified version of Equation (1), where we allow the effect of *Exposure* to vary by year from five years before risk increases through ten years after.[16] There is no indication of a difference in growth prior to the increase in liability risk; exposed firms do not appear to be more or less likely to grow or shrink relative to other firms before risk increases. But afterward, firms with exposure to a newly identified carcinogen tend to grow their assets more than other firms. This growth begins the same year risk increases and continues for about two to three years. The precise timing of the growth suggests that it is in fact *caused* by the increase in liability risk, rather than by any omitted firm or industry characteristic. The timing of the growth also confirms that our findings are robust to the choice of a specific window of analysis and that firms did not anticipate the chemical's being added to the *RoC*.[17]

The growth's magnitude is also related to the degree of firms' liability exposure. If the growth is indeed caused by the newfound legal liability, then it should be greater among firms where more employees are exposed to carcinogens. We verify this relation using data from the NOES on the fraction of employees exposed to each chemical. Figure 3 plots estimates from a modified

[16] The plotted coefficients measure the change in log assets (from its level six to ten years before the increase in liability risk) for affected firms relative to other firms. The confidence intervals shown have much less power than estimates from Equation (1) because they compare each year separately against the reference period.

[17] Even if firms anticipated the chemicals' dangers, this would only work against us finding an effect. We classify firms as learning about the potential liability when the chemical is added to the *RoC*. If some firms knew earlier, then our misclassification would attenuate the estimates and cause us to underestimate the extent to which firms respond to the increase in liability risk.

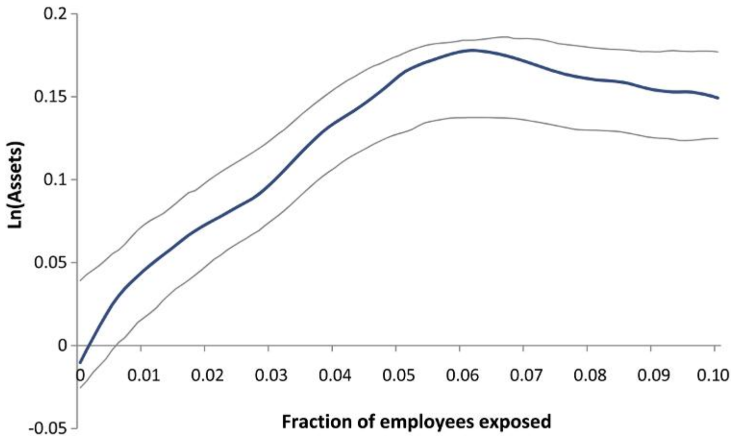

Figure 3
Effect of liability risk increasing on growth by the fraction of employees exposed
This figure plots estimates from a firm-panel semi-parametric regression of log assets on the percentage of employees exposed, firm-by-cohort fixed effects, and year-by-cohort fixed effects. The specification is the same as that reported in Table 3 except that the effect of liability exposure is allowed to vary nonparametrically with the fraction of employees exposed using a Gaussian kernel with a bandwidth of 0.01. Ninety-five-percent confidence intervals, estimated using bootstrapping, are also plotted.

version of Equation (1), where we allow the effect of *Exposure* to vary nonparametrically with the fraction of employees exposed. We find that the increase in growth is positively related to the degree of firms' exposure to potential liability, suggesting that the growth is indeed caused by the increase in liability risk. The estimates indicate that the average growth in log assets after liability risk increases rises initially with the fraction of employees with observed exposures, and then levels off with greater amounts of exposure. These patterns also confirm that our industry-level measure of exposure is indeed picking up meaningful increases in liability risk.

To shed some light on how firms fund this aggressive growth, we examine the effect of the increase in liability risk on log book equity, log debt, and the ratio of debt to assets. These results are reported in columns (i)–(iii) of Table 4. We find that exposed firms are more likely to fund their growth with equity than with debt. Similar to the firm's assets and sales, the overall equity of the firm increases by 11% on average after the increase in liability risk, and this increase is statistically significant at the 5% level. Total debt, however, does not exhibit a statistically significant increase, leaving firms with lower average ratios of debts to assets after liability risk increases.

The increase in liability risk also affects payouts to shareholders, where payouts is defined as the sum of dividends and repurchases per hundred dollars of total assets. The estimates, reported in column (iv) of Table 4, find an average increase in overall payouts to shareholders. Total payouts increase by 30 percentage points—or roughly 16% relative to the sample mean reported in

Table 4
Effect of liability exposure on corporate financing decisions

	Ln(Equity + 1)	Ln(Debt + 1)	Debt / Assets	Total payout / Assets * 100
Dependent Variable =	(i)	(ii)	(iii)	(iv)
Exposure	0.100**	0.035	−0.017*	0.301***
	(0.050)	(0.045)	(0.010)	(0.104)
Observations	137,538	144,650	144,650	144,650
# of Firms	10,539	10,582	10,582	10,582
R^2	0.26	0.14	0.01	0.01
Fixed effects:				
Firm-cohort	X	X	X	X
Year-cohort	X	X	X	X

This table reports coefficients from firm-panel regressions of firm financial choices regarding debt, equity, and payout policy on an indicator for liability exposure, firm-by-cohort fixed effects, and year-by-cohort fixed effects. The specifications are the same as those reported in Table 3, but for different dependent variables: *ln(equity + 1), ln(debt + 1), debt / assets*, and *total payout / assets * 100*, where total payout is the sum of dividends and share repurchases. Standard errors, clustered at the industry level, are reported in parentheses. * significant at 10% level, ** significant at 5% level, *** significant at 1% level.

Table 1. Both the leverage and payout results are robust to including typical controls, including the proportion of fixed assets, log sales, modified Altman z-score, and return on assets (ROA).

At first examination, it may seem odd that firms respond to the increase in liability risk by both issuing equity and increasing payouts to shareholders. Further analysis presented below illustrates that these average responses actually obscure substantial heterogeneity: We find that some firms grow while others are more likely to pay out capital. Furthermore, we will show that the increase in liability risk leads firms to acquire high-cash-flow businesses. Rather than these firms necessarily increasing their payouts from their existing lines of business, much of any increased payout may be coming from these newly acquired business units.

3.2 Connection with financial vulnerability

We next examine whether firms' responses to the increase in liability risk are related to their ability to survive an adverse shock to future cash flows. In particular, we examine whether firms that are potentially more exposed to an adverse shock, as measured by a greater bankruptcy risk, respond differently to the increase in liability risk. The calibration (described in Section 1 and in the Appendix) indicates that such firms would experience a substantially larger increase in their risk of financial distress; an adverse cash flow shock equal to 5% of assets would increase the median probability of distress from 27.5% to 48.5% among these firms. To analyze the response of high-risk firms, we calculate each firm's modified Altman z-score in the year prior to each new listing in the *RoC* and then compare the response of exposed firms in the lowest quartile (highest bankruptcy risk) with that of unexposed firms in the same

Table 5
Bankruptcy risk and the effects of liability exposure

	Ln(Assets)	Ln(Sales)	Ln(Capex+1)
Dependent Variable =	(i)	(ii)	(iii)
A. High bankruptcy risk: z-score in bottom quartile at $t = -1$ *[2,561 firms; 29,311 observations]*			
Exposure	0.321***	0.390***	0.118**
	(0.073)	(0.086)	(0.058)
R^2	0.12	0.13	0.07
B. Low bankruptcy risk: z-score in top quartile at $t = -1$ *[2,561 firms; 37,984 observations]*			
Exposure	0.029	0.010	0.029
	(0.088)	(0.061)	(0.063)
R^2	0.51	0.46	0.27
Fixed effects:			
Firm-cohort	X	X	X
Year-cohort	X	X	X

This table reports coefficients from firm-panel regressions of firm size and investment on an indicator for liability exposure, firm-by-cohort fixed effects, and year-by-cohort fixed effects. The specifications are the same as those reported in Table 3, but Panel A restricts the sample to only firms with modified Altman z-scores in the bottom quartile, while Panel B restricts the sample to only firms with modified Altman z-scores in the top quartile. The dependent variables are *ln(assets)*, *ln(sales)*, and *ln(capex + 1)*. Standard errors, clustered at the industry level, are reported in parentheses. ** significant at 5% level, *** significant at 1% level.

quartile.[18] We then perform the same comparison for firms in the highest quartile (lowest bankruptcy risk). These results are reported in Table 5.

We find that firms with a high risk of bankruptcy tend to respond to the increase in liability risk by growing assets sharply, whereas firms with relatively little bankruptcy risk do not. As reported in Panel A of Table 5, column (i), exposed firms with the greatest bankruptcy risk grow total assets by 38% and sales by 48%, on average, after liability risk increases relative to unexposed firms with similar bankruptcy risk. Firms with low bankruptcy risk, as reported in Panel B, do not exhibit any increase in growth, and the difference in growth between high- and low-risk firms is statistically significant at the 1% level for both assets and sales. The estimates also suggest that capital expenditures increase more for high-risk firms: There is an average increase of 13% for affected high-risk firms and no significant increase for low-risk firms.

Similar to the timing among the full sample, the timing of the growth among firms with a high risk of bankruptcy largely coincides with the publication of a new carcinogen in the *RoC* and does not seem to reflect a preexisting trend. Figure 4A plots the point estimates from the model where the effect of exposure is allowed to vary by year for high-bankruptcy-risk firms. There is

18 Following MacKie-Mason (1990), we calculate a modified-Altman z-score as 3.3*(EBIT/assets) + 1.0*(sales/assets) + 1.4*(retained earnings/assets) + 1.2*(working capital/assets). Including the ratio of market equity to book debt decreases our sample size by about 20%. Instead, we examine the effect of leverage separately in Table 6.

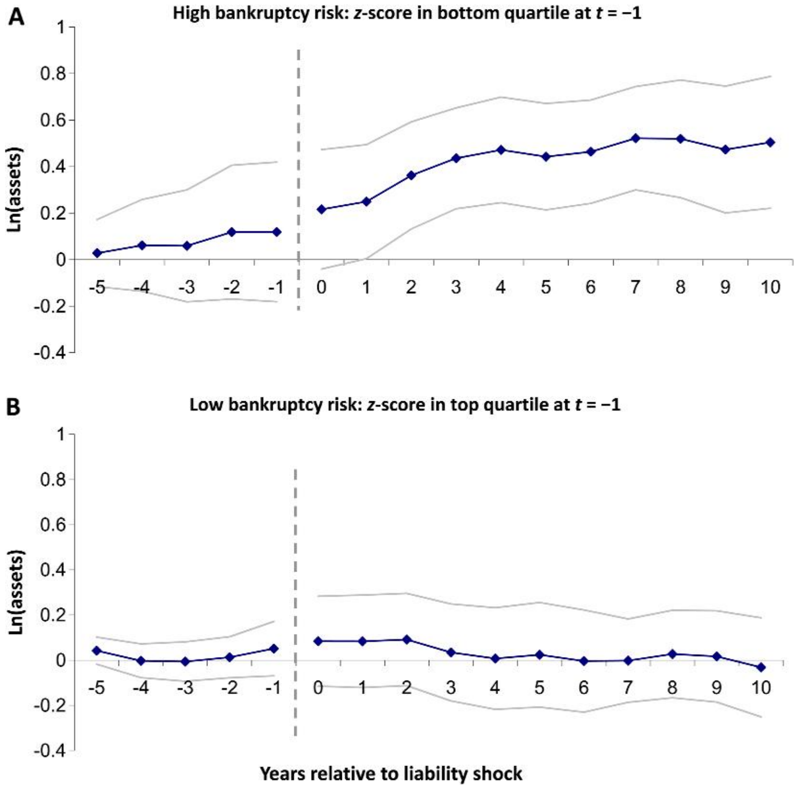

Figure 4
Effect of liability risk increasing on growth by year and bankruptcy risk
This figure reports the point estimates from a firm-panel regression of log assets on an indicator for liability exposure, firm-by-cohort fixed effects, and year-by-cohort fixed effects. The specification is the same as that reported in Table 5 except that the effect of liability exposure is allowed to vary by year for each year from five years before risk increases through ten years after. Panel A restricts the sample to firms with modified Altman *z*-scores in the bottom quartile, while Panel B restricts the sample to firms with modified Altman *z*-scores in the top quartile. Ninety-five-percent confidence intervals, adjusted for clustering at the industry level, are also plotted.

no preexisting trend; before risk increases, exposed firms are no more likely to grow or shrink than other firms. But in the first three to four years after the increase in liability risk, total assets for affected high-risk firms grow more than total assets for unaffected firms. The precise timing again suggests that it is the increase in liability risk causing the firms to grow. Figure 4B plots estimates from a similar model but for low-bankruptcy-risk firms. There is little change in the relative growth of these firms after the chemical is added to the *RoC*.

To further test whether a firm's financial vulnerability affects its response, we divide the sample based on other measures of financial constraints. Following Kaplan and Zingales (1997), we use the following proxies: high leverage, low cash flows, zero dividends, and small size. Similar to before, we match firms within cohorts to compare the differential responses of firms in the top and bottom quartiles for each variable, except for dividends, for which we compare those firms that paid dividends with those firms that did not. In all cases we measure the variable in the year prior to the increase in liability risk. Estimates of the effect on exposed firms' average log assets are reported in Table 6.

Similar to our analysis of bankruptcy risk, we find that firms that are more financially vulnerable to an adverse shock and thereby less able to bear liability risk tend to respond to the increase in risk by growing, whereas less vulnerable firms do not. As reported in Table 6, firms with high leverage, low cash flows, zero dividends, or small size in the year before liability risk increases exhibit an average increase in growth of about 19% to 23%. These increases are all statistically significant at the 5% level. In contrast, firms with low leverage, high cash flows, positive dividends, and more assets do not exhibit a statistically significant increase in average growth.[19]

Table 6
Financial vulnerability and the effects of liability exposure

Dependent Variable = Ln(Assets)

	(i)	(ii)	(iii)	(iv)
	High leverage	Low cash flow	Zero dividends	Small firms
Exposure	0.198***	0.173**	0.184**	0.211***
	(0.075)	(0.073)	(0.072)	(0.076)
Observations	34,431	27,193	78,840	29,489
# of Firms	2,648	2,303	6,636	2,648
R^2	0.23	0.17	0.23	0.14
	Low leverage	High cash flow	Positive dividends	Large firms
Exposure	0.068	0.043	0.013	0.089
	(0.085)	(0.102)	(0.053)	(0.069)
Observations	34,074	35,285	65,810	43,862
# of Firms	2,648	2,303	3946	2,648
R^2	0.36	0.44	0.55	0.49
Fixed effects:				
Firm-cohort	X	X	X	X
Year-cohort	X	X	X	X

This table reports coefficients from firm-panel regressions of *log assets* on an indicator for liability exposure, firm-by-cohort fixed effects, and year-by-cohort fixed effects. The specifications are the same as those reported in Table 3, but estimates are obtained for different subsamples of firms: firms with debt / assets in the top and bottom quartiles [column (i)], firms with operating cash flows / assets in the top and bottom quartiles [column (ii)], firms with zero or positive dividends [column (iii)], and firms with assets in the bottom and top quartiles [column (iv)]. Standard errors, clustered at the industry level, are reported in parentheses. ** significant at 5% level, *** significant at 1% level.

[19] Differences in ex ante firm size alone cannot explain the bankruptcy risk results. Double-sorting the data based on *z*-score and firm size, we find evidence of increased growth even among large firms with low *z*-scores (high bankruptcy risk).

3.3 Acquisitions

We next examine the extent and nature of acquisition activity undertaken by exposed firms after the increase in liability risk. The magnitude and quickness of the growth of financially vulnerable firms after the increase in liability risk, shown in Figure 4A, suggest that acquisitions may play an important role in this growth. The availability of detailed data on corporate acquisitions also enables us to analyze whether the increase in liability risk affects the types of investments undertaken by exposed firms and whether these investments tend to diversify firms' operations. Such diversification might suggest that managers are trying to reduce the likelihood of future financial distress (Amihud and Lev 1981).

To analyze the effect of the increase in liability risk on acquisitions, we obtain the sample of all acquisitions of U.S. firms or subsidiaries that are recorded in the Securities Data Company's (SDC) U.S. Mergers and Acquisitions Database. The sample includes all acquisitions announced between 1980 and 2006. Following previous research, we exclude acquisitions meeting any of the following criteria: (1) the ratio of the deal size to market value of the acquirer's assets is less than 1%; (2) the acquiring firm controlled more than 50% of the target prior to the announcement date or less than 100% after the acquisition was completed; (3) the ultimate parent of the acquirer and the target are the same (i.e., consolidations within holding companies); (4) either the acquirer or the target is a financial firm; or (5) the deal was not completed within 1,000 days of the announcement date.

To test for a change in total acquisition activity after liability risk increases, we run the following industry-panel regression:

$$Ln(deals{+}1)_{jt} = b_0 + b_1 Exposure_{jt} + \alpha_j + \delta_t + e_{jt}, \qquad (2)$$

where *Ln(deals+1)* is the natural log of one plus the total number of deals completed in year t by firms whose primary line of business is industry j. We find similar results if we use the aggregate dollar volume of completed deals rather than the total number. *Exposure* is defined as in Equation (1). Industry-level fixed effects, α_j, control for base differences in the level of acquisitions across industries, and year fixed effects, δ_t, control for any secular time trends and changes in the macroeconomy. As in the analysis reported above, we limit the sample to Fama-French industries that experience an exposure during the sample period. This restriction increases the comparability of exposed and unexposed industries in the sample, but it does not qualitatively affect the results. The standard errors are clustered at the industry level.

We find that industries in which workers were exposed to the newly identified carcinogens undertake more acquisitions after the chemical is listed in the *RoC*. These results are reported in Table 7. Exposed industries complete about 6.6% more deals on average, relative to industries without an exposure. Because the specification includes both industry and year fixed effects, the

Table 7
Effect of liability exposure on acquisition activity

Dependent Variable = Ln(Number of Acquisitions + 1)
[842 Industries; 22,734 Observations]

	Type of Acquistions			
	All (i)	Main line (ii)	Side line (iii)	No Match (iv)
Exposure	0.064*	0.037	0.035*	0.054**
	(0.034)	(0.031)	(0.020)	(0.025)
R^2	0.22	0.15	0.07	0.14
Fixed effects:				
Industry	X	X	X	X
Year	X	X	X	X

This table reports coefficients from industry-panel regressions of *ln(acquisitions+1)* on an indicator for liability exposure, industry fixed effects, and year fixed effects. The liability exposure indicator equals 1 if more than 7.5% of employees in the firm's four-digit SIC industry were observed to be exposed in the 1981–1983 National Occupational Exposure Survey to a chemical listed in the most recent edition of the *Report on Carcinogens (RoC)*. We further classify acquisitions into three types: "main line" if the primary SIC industry for the acquiring firm coincides with any SIC code of the target; "side line" if the acquirer's primary SIC code does not match any SIC code listed for the target, but an SIC code listed as a side-line business does; and "no match" if none of the target's or acquirer's primary or side lines of business coincide. The sample includes all acquisitions announced between 1980 and 2006 that were recorded in SDC's Mergers and Acquisitions Database, but it excludes acquisitions meeting any of the following criteria: (1) the ratio of the deal size to market value of the acquirer's assets is less than 1%; (2) the acquiring firm controlled more than 50% of the target prior to the announcement date or less than 100% after the acquisition was completed; (3) the ultimate parent of the acquirer and the target are the same (i.e., consolidations within holding companies); (4) either the acquirer or the target is a financial firm; or (5) the deal was not completed within 1,000 days of the announcement date. We also exclude Fama-French (1997) industries where none of the included four-digit SIC codes experience an exposure during the sample period. Standard errors, clustered at the industry level, are reported in parentheses. * significant at 10% level, ** significant at 5% level.

positive coefficient for b_1 indicates that the increase in the overall number of acquisitions after liability risk increases, relative to both the typical number of completed deals in these industries before risk increases and the concomitant growth in acquisition activity in unaffected industries.

The timing of the increase in acquisitions largely coincides with the publication of a new carcinogen in the *RoC* and does not seem to reflect a preexisting trend. Figure 5 plots the point estimates from a modified version of Equation (2) where the effect of exposure is allowed to vary by year. While the annual point estimates are noisy, they show no preexisting trend; in the three years before the increase in liability risk, exposed industries are no more likely to do acquisitions than other industries. The point estimates indicate that acquisition activity rises in the year that liability risk increases and remains elevated for the next three years.

The increase in acquisitions appears to account for a significant proportion of the growth in overall assets reported in Table 3. The average aggregate value of acquisitions undertaken by firms with exposures in the ten years after a carcinogen is newly identified is \$643 million greater than that of unexposed firms, whereas the average aggregate increase in overall assets is \$1.36 billion greater. The ratio of these two values suggests that at least 47%

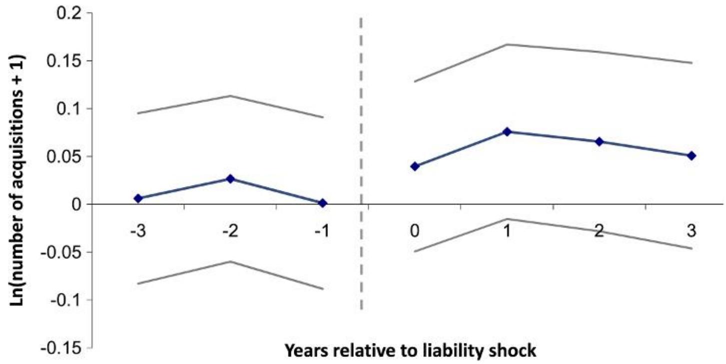

Figure 5
Effect of liability risk increasing on acquisitions by year
This figure reports the point estimates from an industry-panel regression of log number of acquisitions on an indicator for liability exposure, industry fixed effects, and year fixed effects. The specification is the same as that reported in Table 7, column (i), except that the effect of liability exposure is allowed to vary by year for each year from three years before risk increases through three years after. Ninety-five-percent confidence intervals, adjusted for clustering at the industry level, are also plotted.

of the asset growth observed in Table 3 is attributable to acquisitions. The overall contribution of acquisitions toward growth may be greater because the subsequent growth of an acquired firm is not captured by this estimate.

To examine whether these acquisitions are consolidating or diversifying in nature, we classify acquisitions based on the SIC codes of the acquirer and target firms. In addition to a firm's primary line of business, SDC lists up to nine other four-digit SIC codes that represent "any small side lines the company is involved in" (Thomson Financial 1999). Using this information, we classify an acquisition into three distinct types: (1) "main line" if the primary SIC industry for the acquiring firm coincides with any SIC code of the target; (2) "side line" if an SIC code listed as a side-line business for the acquirer matches any SIC code listed for the target, but the acquirer's primary SIC code does not match; and (3) "no match" if none of the target or acquirer's primary or side lines of business coincide. We then calculate the number of acquisitions at the industry-year-type level and reestimate Equation (2) for each type of acquisition. The results are reported in columns (ii)–(iv) of Table 7.

The results suggest that the exposed firms are both expanding existing side lines of business and expanding into completely new lines of business. As reported in column (iii), there is a statistically significant increase in side-line acquisitions after liability risk increases, consistent with firms using acquisitions to expand side lines of business. At the same time, there is also a 5.5% increase in acquisitions for which there is no apparent overlap between the target and acquirer's businesses, again measured relative to industries that do not have such exposures [column (iv)].

How does the increase in risk affect the type of firms being acquired, other than the increase in diversification? To shed some light on this question, we examine the subsample of acquisitions for which financial data are available in Compustat for the target firm.[20] We examine characteristics of the target firms based on their most recent financial data available in Compustat before the acquisition announcement using the following regression:

$$y_{ijt} = B_0 + B_1\ Exposure_{jt} + \alpha_j + \delta_t + \eta_{ijt}, \tag{3}$$

where y is an ex ante characteristic of target firm i, in industry j, for an acquisition announced in year t. We examine the following target characteristics as dependent variables: log total assets, five-year compounded annual growth rate for assets, the ratio of debt to assets, the ratio of cash flow to assets, and the ratio of the total payout to assets.[21] *Exposure* is defined as in Equation (1). We include both industry and year fixed effects, and we cluster the standard errors at the industry level.

Liability exposure seems to affect the type of firms being acquired. As reported in Panel A of Table 8, the acquired firms are larger, have greater historical growth rates, and have less debt. In terms of total assets, targets acquired by exposed firms are 39% larger, on average, than targets acquired by unexposed firms [column (i)]. Their growth rate in the five years before being acquired is 10.1 percentage points greater on average than for targets acquired by unexposed firms [column (ii)]. The targets in these deals also average 6.3 percentage points lower ratios of debt to total assets [column (iii)], which may indicate lower takeover gains for the acquirer (Israel 1991).

Exposed firms also tend to acquire targets that generate and pay out greater cash flows per dollar of total assets. Compared with targets acquired by unexposed firms, targets acquired by exposed firms average 8.3 percentage points greater ratios of operating cash flows to assets [column (iv)], and 3.4 percentage points greater ratios of total payouts to assets [column (v)]. These findings suggest that exposed firms may be seeking to acquire so-called cash cows after liability risk increases. These results may also explain some or all of the increase in the average ratio of total payout to assets for firms that grow after liability risk increases. Rather than these firms necessarily increasing the payout ratio from their existing lines of business, it is possible that much of the increased payout is coming from the newly acquired high-cash-flow business units.

[20] We match the firms in SDC Platinum to Compustat using their CUSIPs. Unfortunately, historical CUSIPs are not available in Compustat, so we determine a firm's historical CUSIP by matching observations to CRSP using the CRSP/Compustat Merged Database, and then using the historical CUSIP reported by CRSP. When the historical CUSIP is missing, we use the CUSIP recorded in Compustat's header file.

[21] Except for the regression of log total assets, the regressions are estimated by weighted least squares, using the target firms' total assets as weights. Given the magnitude of the size differences between deals, weighting gives the estimates a more meaningful interpretation: The estimated coefficients represent the effect of liability exposure on characteristics associated with the average dollar of transaction value (rather than the average deal). For example, the regression of the ratio of cash flows to assets examines whether the ratio of the total cash flows across all acquired targets to the total assets acquired increases after liability risk increases.

Table 8
Effect of liability exposure on the characteristics of acquisitions

	A. Target characteristics					B. Acquisition characteristics		
Dependent	Ln(Assets)	5-year Assets CAGR	Debt / Assets	Cash flow / Assets	Payout / Assets * 100	Takeover premium	Percent Stock	Acquirer CAR [−1,1]
Variable =	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Exposure	0.331*	0.101**	−0.063***	0.083***	3.425***	0.137**	8.034*	−0.013*
	(0.178)	(0.045)	(0.020)	(0.030)	(1.307)	(0.067)	(4.389)	(0.008)
R^2	0.38	0.38	0.48	0.44	0.50	0.07	0.41	0.21
Fixed effects:								
Industry	X	X	X	X	X	X	X	X
Year	X	X	X	X	X	X	X	X

This table reports coefficients from firm-panel regressions of acquisition and ex ante target firm characteristics on an indicator for liability exposure, industry fixed effects, and year fixed effects. The liability exposure indicator equals 1 if more than 7.5% of employees in the firm's four-digit SIC industry were observed exposed in the 1981–1983 National Occupational Exposure Survey to a chemical listed in the most recent edition of the *Report on Carcinogens (RoC)*. In Panel A, the dependent variables are ex ante target characteristics: log total assets, five-year compounded annual growth rate *(CAGR)* for assets, the ratio of debts to assets, the ratio of cash flow to assets, and the ratio of the total payout to assets. In Panel B, the dependent variables are other characteristics of the acquisition: takeover premium, percentage of consideration paid in stock, and acquirer cumulative abnormal return over a three-day announcement window (*CAR*[−1,1]). The sample of acquisitions is the same as that used in Table 7, but it is further restricted to mergers with non-missing observations for premium, *CAR*, and log target assets, leaving 2,253 firms. Fewer observations are available for growth rate (1,526), cash flow (2,164), and percent stock (2,142). Target characteristics are from Compustat, and abnormal returns are computed using a market model and CRSP equally weighted index returns, estimated over the [−300,−46] day interval. Estimates for growth rate, leverage, cash flow, and total payout are weighted by target firm size. Standard errors, clustered at the industry level, are reported in parentheses. * significant at 10% level, ** significant at 5% level, *** significant at 1% level.

Exposed firms also pay more, on average, to complete these acquisitions and are more likely to finance the deals with stock. We calculate the takeover premium paid over the target firm's market value in each acquisition and estimate how it changes after liability exposure using Equation (3). The results are reported in Panel B of Table 8. We find that these acquisitions are associated with nearly 14-percentage-point greater takeover premiums, on average, than the premiums paid on acquisitions by unexposed firms [column (vi)]. The share of financing using stock increases by 8 percentage points [column (vii)]. In sum, the liability exposure seems to lead firms to pay relatively high prices to undertake diversifying, stock-financed acquisitions of large, high-cash-flow-generating firms.

Investors also appear to perceive the announcements of these mergers as bad news for the firms' shareholders. Of the acquisitions analyzed in Table 8, the average abnormal return over a three-day window [−1, +1] for acquisitions by exposed firms is −1.35% (standard error is 0.31).[22] Further analysis suggests

[22] To estimate abnormal returns, we use standard event study methods (see MacKinlay 1997) and compute market model abnormal returns using CRSP equally weighted index returns. The parameters for the market model are estimated over the [−300, −46] day interval. The results are not sensitive to estimating the parameters for the market model over other conventional periods or to defining abnormal returns using net-of-market returns or using the value-weighted CRSP market return in the estimation of the market model.

that the negative abnormal return is attributable to the increase in liability risk, rather than an industry or year characteristic. We estimate the effect of liability exposure on abnormal returns using Equation (3). The estimate, reported in column (viii), suggests that acquisitions undertaken by exposed firms are associated with abnormal returns that are 1.3 percentage points lower. This decline in returns also holds after controlling for how the acquisitions are financed.

4. Interpretation

When facing an increased risk of a large future adverse shock to cash flows, firms appear to undertake costly actions to reduce these risks. Foremost, at-risk firms grow their businesses. The growth is funded primarily with equity and appears largely driven by an increase in diversifying acquisitions of large cash cows. Their goal appears to be two fold: first, to diversify the firm away from the exposed line of business; and second, to shore up the firm's balance sheet to protect it from the future shock.[23]

The most natural explanation for why firms might reduce their risk exposure is to avoid costly financial distress (Froot, Scharfstein, and Stein 1993; Fluck and Lynch 1999), including the loss of organizational capital—productive capacity embedded in a firm's organization and its "people relationships" (Prescott and Visscher 1980; Tomer 1987). By providing firms with deeper pockets to pay future liability costs, the growth reduces the probability of distress, which can preserve shareholder value. Redirecting operations to a new industry after liability risk increases may also preserve shareholder value (Maksimovic and Phillips 2002). Costs of financial distress can explain many of our results: why the growth is stronger among firms for which external finance would be more costly, why it is funded with equity rather than debt, and why the acquisitions target firms with high cash flows.

A calibration confirms that such growth can substantially offset the increased risk of future financial distress caused by the legal liability. Using estimates of the increase in cash and interest expenses caused by average exposed firms' growth, the calibration suggests that the observed growth reduces the future likelihood of default from 3.35% to 0.78%, a 77% drop. Likewise, the average growth observed among high-risk firms largely offsets the increase in default risk caused by the liability for these firms, reducing it from 48.53% to 30.32% and returning it close to its pre-liability level of 27.47%. (Details of this calibration are described in the Appendix.)

There are a number of reasons, however, why the growth, despite its impact on the likelihood of distress, may not improve shareholder value. First is the nature of the increase in liability risk. Because acquired firms are considered

[23] While deep pockets may increase a firm's chance of being sued, evidence suggests that they reduce the risk of financial distress. Pontiff (2007) finds that expected litigation losses are a concave function of pocket depth, indicating that deeper pockets do not increase expected liabilities as fast as the assets available to pay them.

assets of the parent company after a takeover, legal liability extends to the target firm. If the potential damage payments are high enough, then extending the legal liability reduces the value of the target's assets. Second, the increased acquisitions are associated with negative announcement returns, suggesting that some of the growth is not in shareholders' interest. If the observed growth were improving shareholder value, we would instead expect to find positive announcement returns associated with the acquisitions.[24]

Because distress can be *personally* costly for managers, the growth may be driven, in part, by managers trying to reduce the likelihood of financial distress (even if doing so were not in shareholders' interest). Negative corporate outcomes often adversely affect managers' career prospects, even if poor corporate performance is caused by factors beyond their control (Gilson 1989; Jenter and Kanaan 2008). Consequently, managers may prioritize the value of their own human capital and the firm's long-run survival above shareholder value and take actions that will reduce the increased risk of a large adverse shock. For example, managers may alter corporate investment (Holmström 1999) or diversify into new lines of business (Amihud and Lev 1981). Similarly, managers may overpay for acquisitions (relative to their value for shareholders) to also avoid the personal costs of financial distress.

In the presence of these managerial agency conflicts, the growth after liability risk increases may actually reduce shareholder value, which could explain the negative abnormal returns associated with the acquisitions. Indeed, the agency model is consistent with all of the corporate responses to the increased liability risk documented above. Managers' interest in insuring their career and personal wealth against a negative shock can explain why firms grow through acquisitions and why the growth is concentrated among firms with weak balance sheets, funded using equity, targeted at cash cows holding less leverage, and purchased at a premium. Diversification, lower leverage, and the acquisition of cash cows increase the likelihood that the firm (and the CEO's job) survives a potential future barrage of liability costs.[25]

4.1 Additional evidence of managerial agency conflicts

To further explore the plausibility of the agency interpretation, we first examine the relation between the growth of liability-exposed firms, their corporate governance, and their ownership structures. Agency problems are likely to be particularly severe for entrenched managers (Jensen and Ruback 1983; Shleifer

[24] Moreover, Taillard (2010) finds that some firms distressed by asbestos liability can reorganize without destroying firm value. This suggests that the diversifying growth we observe reflects managers' interest in reducing the likelihood of distress rather than shareholders'; if liability-induced distress does not adversely affect shareholders, then actions taken to avoid it are also unlikely to benefit shareholders.

[25] To increase the firm's likelihood of survival, a manager could also direct the firm to issue equity and retain the proceeds as cash. Our evidence suggests that this is not a common response to increased liability risk. One potential explanation is that accumulating cash would arouse suspicion from investors and is linked empirically to proxy fights and executive turnover (Faleye 2004).

and Vishny 1989) and for risk-averse managers who have much of their wealth tied to the value of the firm's assets (Holmström 1999; Parrino, Poteshman, and Weisbach 2005; Hugonnier and Morellec 2007). Although high managerial ownership may help reduce other agency conflicts by inducing a manager to work hard, it exacerbates the agency problem that we focus on, by increasing a manager's personal exposure to the firm's risk and giving the manager a greater incentive to reduce that risk. Differences in the degree to which managers are monitored by large, institutional shareholders provide a third test of whether the diversifying growth is in shareholders' interest. Institutions are more likely than individuals to hold substantial blocks of shares and thereby to have a financial incentive to monitor management (Shleifer and Vishny 1986). If the increase in growth results from an agency conflict, then we might expect to find the growth concentrated among firms with few institutional shareholders.

To analyze the importance of governance and ownership for how firms respond to an increased risk of a large adverse shock, we return to our original Compustat sample and estimate Equation (1) separately for firms with different corporate governance, different shares of managerial ownership, and different shares of institutional ownership before liability risk increases. In all cases, we classify firms based on their governance and ownership in the year prior to the chemicals' listings in the *RoC*.

To sort firms based on external governance, we use the Gompers, Ishii, and Metrick (GIM) governance index and compare the responses of firms with "weak" corporate governance, as measured by a GIM index greater than or equal to 11, and firms with "strong" governance, as measured by a GIM index less than or equal to 5.[26] Because the GIM index is available only from 1990, we use firms' corporate governance in 1990 as a proxy for their governance in 1988, the year before the 1989 *RoC* report, to increase the number of carcinogenic discoveries that contribute to identification.[27] Our analysis here is limited to the 18% of firms for which we observe the GIM index; these firms are relatively large, accounting for 43% of total assets in the full sample.

To sort firms based on inside ownership, we use the reported shares held by a firm's senior management as a fraction of the firm's total shares outstanding, as recorded by TFN Insider Filing Data.[28] We compare the responses of firms

[26] Our results are robust to using alternative cutoffs, including limiting the weak governance sample to firms with a GIM index ≥ 14 (Gompers, Ishii, and Metrick 2003). Our results are also similar if we divide our sample based on the entrenchment index constructed by Bebchuk, Cohen, and Ferrell (2009).

[27] We do not backfill governance any earlier than 1989 because governance in 1990 is likely to be less correlated with governance in even earlier years.

[28] Although we would ideally measure the value of the insiders' shares relative to their personal total wealth, this information is not available, and their share of firm ownership is a useful proxy. The share of ownership is calculated using the filings derived from Forms 3, 4, and 5 over the period 1986–2005. These filings originate from trades by firm insiders that must be reported to the SEC. The measure of managerial ownership reflects the average total holdings of the CEO, CFO, CIO, and COO in the year, adjusted for stock splits. More details on the construction of these data as well as the data on institutional ownership (discussed below) are described in Panousi and Papanikolaou (2008).

with high inside ownership, as measured by senior managerial stock ownership in the top quartile, and firms with low inside ownership, as measured by senior managerial stock ownership in the bottom quartile. Although the ownership data are available beginning in 1986, there are very few observations before 1996, limiting our sample to only 23% of firms in our full sample, corresponding to 39% of total assets.

To sort firms based on institutional ownership, we use the fraction of a firm's equity that is owned by institutional investors, based on 13(f) filings recorded in the TFN Institutional Holdings database. A 1978 amendment to the Securities and Exchange Act of 1934 requires all institutions with more than $100 million of securities under discretionary management to report their holdings to the SEC through 13(f) filings. We compare the responses of firms with limited institutional monitoring, as measured by institutional ownership in the bottom quartile, and firms with high institutional monitoring, as measured by institutional ownership in the top quartile.

Estimates of how firms' growth response varies based on governance and ownership structures are reported in Table 9. We find that the growth is concentrated among firms with weak corporate governance, high inside ownership, and low institutional ownership. As seen in column (i) of Table 9, firms with weak governance increase their average size dramatically following the

Table 9
Governance, ownership, and growth

	Dependent Variable = Ln(Assets)		
	(i)	(ii)	(iii)
	Weak governance	High inside ownership	Low institutional ownership
Exposure	0.295***	0.523**	0.318***
	(0.109)	(0.258)	(0.092)
Observations	5,515	2,131	20,116
# of Firms	311	165	1,618
R^2	0.59	0.49	0.21
	Strong governance	Low inside ownerhip	High institutional ownership
Exposure	−0.037	0.195	0.077
	(0.189)	(0.128)	(0.083)
Observations	2,202	2,248	26,893
# of Firms	140	165	1,618
R^2	0.47	0.50	0.54
Fixed effects:			
Firm-cohort	X	X	X
Year-cohort	X	X	X

This table reports coefficients from firm-panel regressions of *log assets* on an indicator for liability exposure, firm-by-cohort fixed effects, and year-by-cohort fixed effects. The specifications are the same as those reported in Table 3, but estimates are obtained for different subsamples of firms based on firm-level characteristics at time $t-1$: firms with weak and strong external governence (GIM $\geq$ 11 and GIM $\leq$ 5, respectively) [column (i)], firms with managerial ownership in the top and bottom quartiles [column (ii)], and firms with institutional ownership in the top and bottom quartiles [column (iii)]. Standard errors, clustered at the industry level, are reported in parentheses. ** significant at 5% level, *** significant at 1% level.

increase in legal liability, relative to other weakly governed firms. Average total assets increase by about 34%, whereas strong governance firms do not grow on average after liability risk increases, and they may even shrink.[29] We also find evidence of a sharp increase in growth among firms with high inside ownership or low institutional ownership [columns (ii)–(iii)], whereas exposed firms with low inside ownership or high institutional ownership exhibit a much smaller, nonsignificant increase.[30]

These governance and ownership results, combined with the negative returns after acquisition announcements, suggest that the growth of liability-exposed firms may be driven by managerial incentives rather than shareholders' interests. In fact, if the growth has negative NPV, then this growth may be one concrete example of how shareholder rights can affect corporate performance and firm value (as suggested by the correlations presented by Gompers, Ishii, and Metrick 2003 and others).

If the diversifying growth we observe is indeed driven by managerial private interests, then the growth should benefit managers. One way managers may benefit from the growth is greater job security. We examine this hypothesis in our setting by analyzing whether rapid growth after liability risk increases is indeed associated with lower CEO separation rates and a reduced likelihood of firms exiting Compustat.[31] Specifically, we construct an indicator, *Firm exit*, that equals one if a firm is no longer covered in Compustat five years after liability risk increases, and an indicator, *CEO exit*, that equals one if a firm is still covered in Compustat five years after risk increases but the CEO has changed.[32] We determine whether a CEO exit has occurred using data on CEO tenure and age provided in the Disclosure database used by Linck, Netter, and Yang (2008). Using firms' asset growth from the year before to the year after

29 This finding is striking given that the GIM index data is mostly available only for the largest Compustat firms. While we do not see an average response of growth among large firms (see Table 6), there does appear to be significant growth among larger firms with weak governance.

30 Differences in ex ante firm size do not appear to explain these results. The average log assets for weak governance firms is 7.22 before the increase in liability risk, whereas it is 6.44 for strong governance firms. This suggests that the stronger growth among weak governance firms is not driven by them being smaller on average. In the case of ownership, the average sizes of firms with low institutional ownership and high inside ownership are significantly smaller than those of firms with high institutional ownership and low inside ownership, respectively. However, after double-sorting the data based on firm size and institutional ownership, we find that firm size and shareholder monitoring appear to be both independently related to firms' responses to the increase in liability risk. A similar analysis suggests that firm size and inside ownership are independently related to firms' responses.

31 While there are a number of possible reasons why a firm may exit Compustat, most of them, such as bankruptcy or takeover, are often associated with managerial turnover. And while a reduced likelihood of firm exit is also likely to benefit shareholders, our earlier evidence on announcement returns, corporate governance, and ownership suggests that, on average, the potential costs to shareholders of this diversifying growth exceed the expected benefits.

32 Longer windows are harder to interpret because of high baseline exit rates. For example, ten years after liability risk increases, about two-thirds of CEOs at both exposed and unexposed firms will have turned over naturally. A test of whether CEO exit rates are different at this horizon is less informative than looking at a shorter window when a significant share of original CEOs are still present. Consistent with this, longer windows show smaller differences between exposed and unexposed firms' exit rates.

Table 10
Growth and exit rates for exposed firms and their CEOs

Dependent Variable =	Firm exit by t = 5 (i)	CEO exit by t = 5 (ii)	CEO or firm exit by t = 5 (iii)
High Growth [t−1,t+1]	−0.147***	−0.069**	−0.160***
	(0.026)	(0.030)	(0.031)
Observations	912	674	912
R^2	0.04	0.06	0.06
Cohort fixed effects	X	X	X

This table reports coefficients from firm-level regressions of firm and CEO exit rates on an indicator for whether a firm is in the top quartile of growth in the years after liability risk increases. Only firms experiencing a liability exposure between 1983 and 2000 that exhibit growth either in the top or bottom quartile are included in the regression. Liability exposure is determined as in Table 3, and a firm's growth response to the liability risk is measured using the percent change in assets between years $t = -1$ and $t = 1$. The dependent variable, *firm exit by* $t = 5$, is an indicator equal to one if a firm is no longer found within Compustat five years after liability risk increases, and zero otherwise. *Firm or CEO exit by* $t = 5$ is an indicator equal to one if either a firm exits or the CEO changes in the five years after the liability risk increases. *CEO exit occurs by* $t = 5$ is an indicator equal to 1 if a change in the CEO occurs during the five-year period after liability risk increases for firms that did not exit within five years after risk increases. All estimates include cohort fixed effects, and standard errors, clustered at the industry level, are reported in parentheses. ** significant at 5% level, *** significant at 1% level.

liability risk increases, we restrict our sample to exposed firms that were in either the top or bottom quartiles of growth and regress the two exit measures onto an indicator for being in the top quartile of growth. The estimates are reported in Table 10.

Exposed firms that grow significantly after the increase in liability risk are much less likely to exit Compustat or replace their CEO. Exposed firms in the top quartile of growth were nearly 15 percentage points less likely to exit Compustat within five years after risk increases relative to exposed firms in the bottom quartile of growth [Table 10, column (i)]. Among firms still covered by Compustat five years after liability risk increases, the average CEO exit rate was also 6.9 percentage points lower [column (ii)]. Combining the two exit measures, exposed firms with significant growth after liability risk increases have an average rate of CEO or firm exit that is 16 percentage points lower [column (iii)].

Finally, we analyze whether governance and ownership structures are related to the observed increases in payouts shown in Table 4. If shareholders' costs of financial distress are not too high, then such an increase in payouts might benefit shareholders. To the extent that the increase in liability risk decreases the returns on new investments, increasing payouts would allow investors to redeploy these funds more profitably to other firms that are not exposed to the liability. If the increase in payouts to shareholders after liability risk increases is concentrated among firms with strong external governance, low inside ownership, and large institutional shareholders, then we might conclude that shareholders typically prefer that the manager pay out capital than grow the firm. The estimates for these regressions are reported in Table 11.

Table 11
Governance, ownership, and payout policy

Dependent Variable = Total payouts / Assets * 100

	(i)	(ii)	(iii)
	Weak governance	High inside ownership	Low institutional ownership
Exposure	0.690	0.58	0.055
	(0.426)	(0.527)	(0.134)
Observations	5,515	2,131	20,116
# of Firms	311	165	1,618
R^2	0.07	0.05	0.01
	Strong governance	Low inside ownerhip	High institutional ownership
Exposure	1.165**	1.797*	0.470*
	(0.486)	(0.932)	(0.266)
Observations	2,202	2,248	26,893
# of Firms	140	165	1,618
R^2	0.04	0.07	0.04
Fixed effects:			
Firm-cohort	X	X	X
Year-cohort	X	X	X

This table reports coefficients from firm-panel regressions of *the ratio of total payouts to assets* on an indicator for liability exposure, firm-by-cohort fixed effects, and year-by-cohort fixed effects. The specifications are the same as those reported in Table 3, but estimates are obtained for different subsamples of firms based on firm-level characteristics at time $t-1$: firms with weak and strong external governence (GIM $\geq$ 11 and GIM $\leq$ 5, respectively) [column (i)], firms with managerial ownership in the top and bottom quartiles [column (ii)], and firms with institutional ownership in the top and bottom quartiles [column (iii)]. Standard errors, clustered at the industry level, are reported in parentheses. * significant at 10% level, ** significant at 5% level.

While strong governance, low inside ownership, and high institutional ownership firms do not grow after liability risk increases, they do significantly increase their average total payouts to shareholders. Strong governance firms increase their total payout ratio by 45.9% relative to a sample mean of 2.54 for strong governance firms before risk increases, and the increase is statistically significant at the 5% level [Table 11, column (i)]. Low inside ownership and high institutional ownership firms exhibit similar increases in payouts [columns (ii)–(iii)]. Weak governance firms, high inside ownership, and low institutional ownership firms, in contrast, do not exhibit statistically significant increases in their payouts, and the point estimates are smaller.[33]

Overall, the corporate governance, managerial ownership, institutional monitoring, and CEO exit results show that managerial private interest can play a

33 Differences in ex ante financial vulnerability do not appear to explain these results or the growth results. The average modified z-score for weak governance firms before liability risk increases is 1.94, whereas the average modified z-score for strong governance firms is 2.06. The difference of 0.12 is only one-tenth of a standard deviation, and the p-value of the difference is 0.406. Firms with higher inside ownership also exhibit a lower average bankruptcy risk than firms with low inside ownership. Only in the case of institutional ownership do we find a possible concern in that average bankruptcy risk of firms with low institutional ownership is significantly lower than that of firms with high institutional ownership. However, after double-sorting the data based on bankruptcy risk and institutional ownership, we find that greater bankruptcy risk and less monitoring appear to be both independently related to firms' responses to the increase in liability risk.

significant role in corporate responses to the risk of an adverse shock. Average growth is large when agency problems are more severe—when firms have weaker external governance, when senior management holds a larger equity stake in the firm, and when relatively few equity shares are held by institutional investors. Firms that grow also exhibit fewer CEO turnovers, suggesting that managers benefit from this growth. At the same time, firms where agency problems are milder—firms with strong external governance, low inside ownership, and high institutional ownership—do not grow; instead, they greatly increase their payouts to shareholders. These results suggest that much of the diversifying growth is not in shareholders' interest, and that the average shareholder might prefer managers to pay out the excess cash instead.

4.2 Alternative interpretations

Two additional explanations for firms' financing and investment responses to the increase in liability risk also merit careful consideration: asymmetric information and managerial effort.

Asymmetric information If investors do not have as much information about the potential legal liability as the firms' managers, then the managers may be making money for existing shareholders by exploiting this asymmetric information to issue overvalued equity—through both secondary equity issues and stock acquisitions. While firms are required by law to warn employees about their exposure to substances that are included in the *RoC*, it is possible that the financial market does not pick up on these risks or systematically underestimates the firm's exposure to them. Huberman and Regev (2001) lend some plausibility to this hypothesis by documenting a case in which the market did not price public scientific information (previously published in the journal *Nature* and various popular newspapers) until it appeared in a prominent article in the Sunday *New York Times*.

Asymmetric information, however, cannot easily explain all of our results. It is unclear why information asymmetry would cause a shift toward acquisitions of firms with higher cash flows. Furthermore, if investors are unaware of the increase in liability risk and managers are acting on their own, there is little reason to expect the growth to be concentrated among firms with weak external governance or high inside ownership. One possibility is that weak governance is correlated with superior CEO ability (e.g., Hermalin and Weisbach 1998), and that higher-ability CEOs are more likely to exploit overvalued equity using stock acquisitions. However, even this explanation cannot explain why the growth is also concentrated among firms with low institutional ownership.

Managerial effort Agency models of the firm provide another possible explanation for some of our results. As noted by Grossman and Hart (1983), fear of bankruptcy and employment loss can provide strong incentives for managers to exert effort. Because large future cash outflows pose a threat to a manager's employment, particularly for financially vulnerable firms, it is possible that the increase in liability risk induces managers to exert greater effort to improve overall firm value and efficiency, which may in turn increase the likelihood of survival should litigation occur. In this scenario, the growth might be driven by a *general* increase in managerial effort that benefits shareholders, rather than just an increase in managerial effort to avoid the personal costs of financial distress. If true, we would expect to find other improvements besides higher growth, such as cost cutting and improved profitability.

There is little evidence, however, that the increase in liability risk affects measures of firm performance that might indicate greater overall managerial effort. There is no evidence that firms' return on assets (ROA) or asset turnover (sales/assets) improve after liability risk increases. There is also no evidence that wages or other costs decline significantly. Increased managerial effort also cannot explain a number of our other results. It does not explain why the growth would tend to diversify firms' operations or be targeted at acquiring cash cows. The negative announcement returns associated with these acquisitions are also not consistent with this growth being in shareholders' interest.

5. Conclusion

This article examines how firms respond to exogenous increases in legal liability risk resulting from employees' exposure to carcinogens. Like many other business risks, the increase in liability risk represents an increased probability of large adverse shocks in the company's future. We find that firms tend to grow aggressively using both capital investment and acquisitions after the risk increases, and this growth is concentrated among firms that are more financially vulnerable to the realization of an adverse shock and funded primarily with equity. The acquisitions appear to diversify firms' assets and to target large firms with relatively high operating cash flows, recent growth, and total payouts.

Firms' responses to the increases in liability risk seem to be aimed at reducing the firms' exposure to the newfound risks. These actions can create value for shareholders if they are not too expensive and reduce the probability of costly financial distress. There is a concern, however, that managers will overreact, because they also benefit personally from reducing the liability risks, which can threaten the managers' private benefits, reputation, and future income even if the risks are caused by factors beyond their control (Gilson 1989; Jenter and Kanaan 2008).

Empirically, managers' personal incentives appear to play a role. The growth seems to help managers secure their jobs, but at a high cost for shareholders: The additional acquisitions are associated with relatively high takeover premiums and negative abnormal returns. Further, we find that firms with weak external governance grow after liability risk increases, whereas firms with strong external governance do not grow. Firm growth is larger both when senior management holds larger equity stakes in the firm (magnifying their sensitivity to firm risk and amplifying the potential agency conflict) and when relatively few equity shares are held by institutional investors (who are thought to monitor managers). Instead of growing, firms likely to have few agency conflicts increase total payouts to shareholders, suggesting that shareholders of the *average* liability-exposed firm might prefer that managers pay out the excess cash rather than grow the firm.

The observed growth is similar to diversification programs of tobacco firms in the 1960s and 1980s, which Jensen (1986) points to as prominent examples of managers making investments that are contrary to shareholders' interests. Both diversification waves followed increases in liability risk. The U.S. Surgeon General (1964) released its first report on the health consequences of smoking in 1964. Almost immediately, major American cigarette companies began expanding into nontobacco businesses, such as consumer packaged goods, dog food, whiskey, corn-oil refining, and domestic crude oil and natural gas exploration. The industry experienced another round of diversification two decades later after the first academic medical study documenting the harmful effects of secondhand smoke was published in 1981 (Hirayama 1981), opening cigarettes to new regulation. Within a few years, R. J. Reynolds bought Nabisco and Philip Morris bought General Foods and eventually Kraft.

Our results have broad implications beyond the effects of liability risk. The increases in liability risk we study have characteristics similar to many other business risks that firms face in that they reduce firms' expected future cash flows but have a limited effect on firms' *current* resources. Roughly speaking, these characteristics are similar to a development, such as a technological innovation, that increases the probability of future competitive entry into a firm's product market. If entry eventually occurs, the firm's cash flows will be reduced; this is similar to the reduction in cash flow that is likely to be realized if liability damages are eventually incurred. Additional parallels can be drawn to any number of other business risks that involve a decrease in expected future cash flows—for example, the risk that tariffs will be eliminated or that new regulations will greatly increase a firm's marginal costs of production. Case studies of industries facing the risk of decline also document corporate behavior similar to that in our findings. Examples include the steel industry in the late 1970s (Hall 1997), the oil industry in the 1980s (Jensen 1986), and the defense industry near the end of the Cold War (Dial and Murphy 1995). While we cannot be sure how managers might respond to these other risks, the results presented in this article suggest that the responses may not always coincide with shareholders' interests.

Our results imply that there is an interaction between managerial agency conflicts and corporate financial vulnerability. This interaction suggests that agency problems play out differently in normal times than when times are tough. Although managers may pursue the "quiet life" in normal times

(Bertrand and Mullainathan 2003), they appear willing to take aggressive, potentially value-destroying actions when their firms' survival is at risk. Such considerations can affect a firm's optimal capital structure. If managers' objectives and shareholder interests diverge as a firm approaches financial distress, then a high amount of financial leverage that moderates managerial agency problems in normal times may amplify this other managerial agency conflict when the firm encounters an adverse shock. This interaction between agency conflicts and financial distress presents an interesting area for future research.

Appendix: Calibrated impact of observed growth on the probability of default

To estimate the potential impact of the legal liability and firms' subsequent growth on the likelihood of financial distress, we calibrate the probability of default (i.e., when a firm does not have a sufficient amount of cash on hand to cover both interest expenses and any legal liabilities) for exposed firms in our sample under three different scenarios: (1) no liability; (2) with liability; and (3) with liability and growth. To perform this calibration, we construct a distribution for each firm's liquid resources in future years, based on the firm's historical cash flows. We deflate each firm's operating cash flows using the U.S. Consumer Price Index and calculate the mean (μ_{OCF}) and standard deviation (σ_{OCF}) of operating cash flows in the ten years prior to the increase in liability risk. We assume that the distribution of the cash that a firm has on hand to meet its future liabilities is given by $cash_t \sim Normal(cash_{t-1} + \mu_{OCF}, \sigma_{OCF})$, where $cash_{t-1}$ is the firm's cash balance in the year prior to the increase in liability risk. The probability of default is given by $Prob(int_t > cash_t)$, where we use the firm's average, inflation-adjusted interest expenses over the previous ten years as an estimate of int_t. The results of this calibration are reported in Appendix Table A-1.

(1) No liability

Median default probabilities calculated using this approach are reported in column (i) of Appendix Table A-1. The median default probability in our sample of exposed firms is 0.09%. This matches well with historical default rates. The median firm in our sample has a long-term S&P credit rating of BBB, and historically, firms with a BBB rating have an average annual default rate of 0.15% (Moody's Investor Service 2002). Our estimates of the likelihood of default also match for high-bankruptcy-risk firms: Among exposed firms with a credit rating of CCC in our sample, our calibration suggests an average annual probability of default of 19.5%, whereas the historical average default rate for firms with a CCC+ to C rating is 24.7%.

(2) With liability

To estimate the probability of default when liability risk increases, we use the same framework and calculate the probability that the firm does not have enough cash available to cover both interest expenses and the legal liability. In column (ii) of Appendix Table A-1, we report the probability of default when firms face a legal liability equal to 5% of assets. Historical data on lawsuits show that 5% of assets appears to be a reasonable proxy for how large the liability would be if it were realized. According to Pontiff (2007), average damages awarded in corporate lawsuits related to cancer, lung damage, death, and other factors is about \$3 million per lawsuit. Using this estimate for the potential liability faced by firms, along with the fraction of workers with observed exposures in each firm's industry, we estimate the potential liability of exposed firms in our sample. Assuming that the firm will be liable for 10% of exposed workers, we find that the average potential liability for firms in our sample is 7.1% of assets in place at the time of the increase in liability risk (the median is 3.4%). Note that for a small firm with \$100 million

Table A-1
Calibrated impact of observed growth on probability of default

	No liability (i)	With liability (ii)	With liability & average observed growth (iii)	With liability & average high-risk growth (iv)
Median probability of default				
All firms	0.09%	3.35%	0.78%	0.28%
High-risk firms	27.47%	48.53%	35.52%	30.32%
Low-risk firms	0.00%	0.07%	0.00%	0.00%

This table reports calibrated probabilities of default (i.e., when a firm does not have a sufficient amount of cash on hand to cover both interest expenses and any legal liabilities) for exposed firms in our sample under three different scenarios: (1) no liability; (2) with liability; and (3) with liability and growth. To estimate the probability of default, we construct a distribution for the firm's liquid resources in future years, based on the firm's historical cash flows. We deflate each firm's operating cash flows using the U.S. Consumer Price Index and calculate the mean (μ_{OCF}) and standard deviation (σ_{OCF}) of operating cash flows in the ten years prior to the increase in liability risk. We assume that the distribution of the cash that a firm has on hand to meet its future liabilities is given by $cash_t \sim Normal(cash_{t-1} + \mu_{OCF}, \sigma_{OCF})$, where $cash_{t-1}$ is the firm's cash balance in the year prior to the increase in liability risk. The probability of default is then given by $Prob(int_t > cash_t)$, where we use the firm's average, inflation-adjusted interest expenses over the previous ten years as an estimate of int_t. In column (i), we report the estimated probability of default absent any legal liability, and in column (ii), we report the probability of default when firms face a legal liability equal to 5% of assets. The probability of default is reported separately for all firms, high-bankruptcy-risk firms (modified Altman z-score in bottom quartile), and low-bankruptcy-risk firms (modified Altman z-score in upper quartile). In column (iii), we report the probability of default when firms face the same legal liability but assume that the firm has grown their available cash by 16% and interest expenses by 5%, which are the average observed responses of exposed firms in our sample (relative to unexposed firms) following an increase in liability risk. In column (iv), we report the probability of default when firms face the legal liability but the firm has grown their available cash by 26% and interest expenses by 15%, which are the average observed responses of exposed, high-bankruptcy-risk firms in our sample (relative to unexposed, high-bankruptcy-risk firms) following an increase in liability risk.

in assets, even just one or two lawsuits could represent 5% of assets (and indeed, Table 6 of the article shows that we find stronger effects for smaller firms).

The legal liability has a significant impact on the likelihood of default. The legal liability increases the median default probability from 0.09% to 3.35%. This represents a more than 30-fold increase in the probability of distress. The increase in default risk is even larger among firms that were already at high risk of bankruptcy before the increase in liability risk. The median default probability for high-risk firms increases from 27.5% to 48.5%. The liability, however, has minimal impact on the likelihood of default for firms with low ex ante bankruptcy risk. The median default probability is still only 0.07% after the increase in liability risk. The difference between how the increase in liability risk affects the likelihood of distress for high- and low-bankruptcy risk firms is consistent with our finding that only the high-risk firms respond, on average, to the increase in liability risk.

(3) With liability and growth

Finally, we estimate how growing would reduce the firm's probability of default. We find that exposed firms, on average, grow their assets by 10%, driven largely by equity-financed acquisitions of cash-rich firms. To assess the impact on the firm's ability to avoid default, we estimate the average increase in cash and interest expenses for exposed firms following the increase in liability risk. Relative to comparable unexposed firms, the average exposed firm grows its cash balance by 16%, and high-risk exposed firms grow their cash balance by 26%. Interest expenses increase by 5% and 16%, respectively. The smaller increase in interest expenses, relative to the increase in overall assets and cash, is consistent with our finding that exposed firms tend to finance the growth with equity. Based on these changes in cash balances and interest expenses, we recalculate these firms' probability of default.

We find that, for the average firm, the observed growth substantially mitigates the legal liability's impact on the firm's likelihood of default. Column (iii) of Appendix Table A-1 reports default probabilities for firms that undertake the average growth patterns displayed by exposed firms. For the average firm, such growth significantly offsets the increase in the likelihood of default caused by the legal liability, decreasing it from 3.35% to 0.78%, a 77% drop. Likewise, the average growth observed among high-risk firms [column (iv)] largely offsets the increase in default risk caused by the liability for these firms, reducing it from 48.53% to 30.32% and returning it close to its pre-liability level of 27.5%.

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