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Corporate Environmental Liabilities and Capital Structure

Xin Chang
(The University of Cambridge and Nanyang Technological University)
Kangkang Fu
(INSEAD)
Tao Li
(Central University of Finance and Economics)
Lewis H.K. Tam
(University of Macau)
George Wong
(The Hong Kong Polytechnic University)

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Xin Chang, Kangkang Fu, Tao Li, Lewis H.K. Tam, George Wong

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Abstract

We investigate the capital structure implications of corporate environmental liabilities, which are captured using the amount of firms' toxic production-related waste. We document that firms with higher environmental liabilities maintain lower financial leverage ratios, suggesting that environmental liabilities work as a substitute for financial liabilities. The substitution effect is more pronounced for larger firms, firms covered by more analysts, firms that have higher sales to principal customers, and firms with greater community concerns. Further analysis shows that less environmentally responsible firms have a lower fraction of bank debt in total debt, all else equal, consistent with the notion that banks are more environmentally sensitive than other lenders. Overall, our findings imply that being environmentally responsible can enhance firms' debt capacity and improve the availability of bank credit.

JEL Classification: G32, L11
Keywords: corporate social responsibility, environmental liability, capital structure, bank debt

* Chang, x.chang@jbs.cam.ac.uk, Cambridge Judge Business School, the University of Cambridge, and changxin@ntu.edu.sg, Nanyang Business School, Nangyang Technological University; Fu, kangkang.fu@insead.edu, INSEAD; Li, econlitao@vip.sina.com, School of Economics, Central University of Finance and Economics; Tam, lewistam@umac.mo, Department of Finance and Business Economics, University of Macau; Wong, george.lb.wong@polyu.edu.hk, School of Accounting and Finance, the Hong Kong Polytechnic University. We are grateful for the valuable comments and suggestions from Jie (Jay) Cao, Yangyang Chen, Jun-koo Kang, Spencer Martin, Naomi Soderstrom, Cameron Truong, and seminar participants at Chinese University of Hong Kong, the Hong Kong Polytechnic University, the University of Melbourne, Monash University, Nanyang Technological University, and SSFII Conference 2015 in Oxford. All errors are our own. Chang acknowledges financial support from Rega Capital Management Limited and Academic Research Fund Tier 1 provided by Ministry of Education (Singapore) under grant numbers SUG FY08, M58010006. An important part of research was done at the Research Institute of Capital Formation of Development Bank of Japan when Chang visited as a Shimomura Fellow in June-July 2016. Wong acknowledges financial support from RGC Fund and Central Research Grant provided by the Hong Kong Polytechnic University under grant numbers A-PJ98 and G-YN61, respectively.

"*Dirty Secrets - Companies may be burying billions more in environmental liabilities than their financial statements show…But few investors understand the true magnitude of the threat that toxic liabilities - environmental liabilities, that is - pose to the financial health of some U.S. businesses.*"

CFO Magazine (2009)

I. Introduction

The U.S. Environmental Protection Agency (EPA hereafter) define environmental liabilities as "*legal obligations* to make *future* expenditures due to the past or ongoing manufacture, use, release, or threaten release of a particular substance, or other activities that adversely affect the environment*"* (EPA 1996). Both anecdotal evidence and empirical studies suggest that environmental liabilities are staggering. For instance, according to a study by the United Nations, the annual global environmental expenses are around US$6 trillion in 2010, which amounts to 11% of the global GDP. Barth and McNichols (1994) estimate firms' environmental liabilities under Superfund and find that the average amount of unrecognized environmental liabilities is roughly 28.6% of the market valuation of equity.[1]

We study whether and how firms' *environmental* liabilities affect the level and structure of their *financial* liabilities. Despite the sheer magnitude of corporate environmental liabilities and the drastically increasing attention that environmental issues have received, the capital structure implications of corporate environmental liabilities remain largely unexplored. In essence we ask: While companies keep most of environmental liabilities as off-balance-sheet liabilities, do they treat environmental liabilities as a substitute for financial on-balance-sheet liabilities?[2] Further, do companies' observed financial leverage ratios and debt structure vary according to their environmental liabilities?

Environmental liabilities are legally binding obligations and share important characteristics of

[1]The United Nations study is described at http://www.environmentalleader.com/2010/10/05/un-estimates-annual-global-environmental-costs-equal-6-trillion/. As additional firm-level evidence, Exxon Mobil spent $5.5 billion on environmental expenditures for pollution controls and made a provision of additional environmental liabilities of $391 million in 2012. The sum of the two expenses accounts for 13% of the net income of $44.8 billion. Clarkson, Li, and Richardson (2004) study the future pollution abatement obligations of firms in the pulp and paper industry and document that the average unbooked liabilities for high-polluting firms are approximately 16.6% of the market capitalization. Carroll et al. (2004) examine the claims for injuries from asbestos litigations and state that the estimated costs range from $200 to $265 billion.

[2] We discuss the accounting treatment of environmental liabilities in Section II.B.

financial debt. Firms with substantial environmental liabilities make regular and legally mandated outlays to achieve and maintain compliance with environmental laws and regulations. Similar to interest expense on financial debt, environment-related expenses and investments are tax-deductible. Failure to demonstrate compliance may lead to substantial non-compliance induced environmental liabilities and can even trigger bankruptcy.[3] Based on these debt-like features and building on the trade-off theory of capital structure, we expect environmental liabilities to be negatively related to the use of financial debt for four reasons.

First, environmental outlays reduce taxable income, thereby lowering firms' marginal tax rates, which are defined as the present value of the tax obligation from earning an extra dollar today. DeAngelo and Masulis (1980) argue that each firm has an optimal amount of total tax deductions and that non-debt tax shields (NDTS) substitute for interest tax deductions. Thus, to the extent that environment-related outlays are an important source of tax savings, firms with higher environmental liabilities should have weaker tax incentives to use financial debt, all else equal. Second, environmental outlays reduce the amount of cash flows available to service financial debt obligations, thus lower firms' capacity for financial debt.

Third, environmental liabilities increase firms' business risk. Environmental liabilities imposed through violations are unpredictable, substantial, and highly impactful (Barth and McNichols 1994; White 2002; Clarkson et al. 2011; Schneider 2011; Li, Simunic, and Ye 2014). Clarkson et al. (2011) and Flammer (2013) show that poor environmental performance contributes significantly to firms' future operational risk and poor financial performance. Facing increasingly more stringent environmental regulations, firms with high environmental liabilities are inevitably subject to more uncertainties arising from market demand due to damaged reputation, operating costs associated with

[3] For example, asbestos liability, a typical non-compliance induced environmental liability, is treated as a special type of debt in the sense that it is a fixed non-equity claim on the firm's assets with bankruptcy priority (Hadlock and Sonti 2011). Eighty-five firms have filed for bankruptcy due to asbestos liabilities at the end of 2002 (White 2002). Solutia Inc. and Tronox Inc. filed for bankruptcy in 2003 and 2009, respectively, due to significant unbooked environmental liabilities.

waste management and future compliance, future litigation and enforcement activities, and the cost of external financing (e.g., Gormley and Matsa 2011; Chava 2014; Li, Simunic, and Ye 2014), all of which would increase firms' likelihood of financial distress and bankruptcy, thereby reducing their use of financial debt.

Finally, supply side factors may also play a role. Environmentally sensitive lending has increased markedly over the last two decades. A large number of banks, which account for about 80% of the global lending volume, have adopted the Equator Principles (http://www.equator-principles.com/) and agreed to consider social and environmental issues in their lending decisions (Chava 2014).[4] Chava (2014) also argues that when lending to firms with environmental concerns, lenders face multiple risks, which include borrowers' credit risk caused by environmental regulations and compliance, litigation risk under lender liability laws, and reputation risk arising from association with polluting firms.[5] Accordingly, he documents that lenders charge a significantly higher interest rate on the bank loans issued to firms with higher environmental liabilities and avoid lending to firms with severe environmental concerns. We thus expect that firms' environmental liabilities hamper credit supply, especially that from large and highly visible banks. In sum, the preceding four arguments all suggest that firms with higher environmental liabilities should have lower debt ratios, all other things being equal.

We quantify environmental liabilities using non-financial measures provided by the EPA's Toxic Release Inventory (TRI) program, which collects data on release and management of over 650 toxic chemicals by thousands of facilities in the United States. The database is by far the most comprehensive database about waste production and releases by operating facilities in the United States.

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[4] Cogan (2008) reports that many large and publicly traded banks around the globe use reducing greenhouse gas emissions as a target and emphasize clean and renewable energy in their lending portfolios.

[5] Chava (2014) points out that lenders are potentially liable for environmental damage caused by borrowers under the terms of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and its Superfund Amendments, the Resource Conservation and Recovery Act, the Clean Water Act, the Clean Air Act, and the Toxic Substance Control Act, among others. He also gives several examples illustrating that lenders' reputation can be adversely affected by the bad publicity and social attitudes of polluting borrowers.

We compute a firm's total waste produced (in pounds) in all facilities. To account for the differences in toxicity across chemicals, in calculating the total waste produced, the amounts of individual chemicals produced are weighted by their respective toxicity defined by the EPA. Our main proxy for environmental liabilities is then defined at the firm-year level as the natural log of toxicity weighted production waste scaled by total sales.

Using a large panel of US firms that are covered by both the Compustat database and the TRI program over the period of 1992-2013, we find that firms with higher environmental liabilities maintain lower financial leverage ratios. A one-standard deviation increase (0.175) in environmental liabilities decreases the leverage ratio by 7.5% from its mean value (0.255). This economic impact on the leverage ratio is similar to that of the market-to-book ratio, which has been shown by previous studies (e.g., Rajan and Zingales 1995) as one of the most important determinants of capital structure.

The negative relation between environmental liabilities and financial leverage is robust to alternative model specifications and different variable definitions. Furthermore, we perform several tests to mitigate endogeneity concerns caused by omitted variables and reverse causality. Among these tests, we employ an instrumental variable approach using two instrumental variables, i.e., (1) the weighted-average physical distance between EPA regional office and the firm's facility, and (2) the weighted average unemployment rate of the state in which a firm's facility operates. The main results still hold, supporting a causal relation between environmental liability and firms' capital structure.

To further substantiate our main findings, we employ several alternative measures of environmental liabilities. The first one is a dollarized measure of environmental liabilities capturing the financial expenses incurred by firms in complying with environmental laws and regulations. It is obtained by estimating the functional relation between the amount of toxic production-related waste and the sum of the cost of goods sold and capital expenditure. The second measure is from the Enforcement and Compliance Historical Online (ECHO) database that provides information about “compliance and enforcement information for approximately 800,000 EPA-regulated facilities”. From the ECHO database, we calculate the total cost imposed by the EPA or courts on firms for violating environmental regulations. Moreover, we rely on four alternative environmental data sources, namely, KLD Research & Analytics (KLD), Newsweek Green Rankings, Thomson Reuters Asset4, and Trucost to construct the environmental liability measures that capture not only toxic chemicals generated, but also various potential environmental damage costs and poor environmental policies and reputations. Our findings are robust to these alternative measures of environmental liabilities although sample size varies drastically.

Further analysis shows that the negative effect of environmental liabilities on financial leverage varies across firms and over time. In particular, the effect is more pronounced for firms with greater visibility, i.e., larger firms and firms covered by more analysts. We also find that the effect becomes stronger after the Financial Accounting Standards Board (FASB) enacted FIN 47 in 2005, which improves corporate environmental disclosure and increases recognition of environmental liabilities. In addition, firms that rely more heavily on principal customers and those with greater community concerns are found to exhibit a stronger substitution between environmental liabilities and financial liabilities.

Finally, we find that firms with higher environmental liabilities have a lower fraction of bank debt in total debt after controlling for the difference in financial leverage across firms. This finding is consistent with banks being more concerned about reputation risk and litigation risk in their lending decisions because their identities are more easily identified than other lenders, such as corporate bond holders (e.g., Chava 2014).

Our paper contributes to the corporate social responsibility (CSR hereafter) literature that examines the relation between CSR and various corporate policies.[6] In particular, we present empirical

[6] For example, firms with irresponsible CSR activities are more aggressive in avoiding taxes (Hoi, Wu, and Zhang 2013) and manipulating earnings (Kim, Park, and Wier 2012). Deng, Kang, and Low (2013) provide evidence that acquirers’ CSR

evidence on the effects of environmental liabilities on capital structure. Prior studies have documented that CSR or corporate environmental performance affects the *absolute* levels of the cost of equity and the cost of debt (e.g., Bauer and Hann 2010; Schneider 2011; El Ghoul et al. 2011; Dhaliwal et al. 2011; Chava 2014; El Ghoul et al. 2014). We complement these studies by investigating the leverage ratio, which is determined by firms' choice between debt and equity and captures the *relative* importance of the effects of environmental liabilities on the cost of debt and the cost of equity. In addition, to the best of our knowledge, we are among the first to empirically show that corporate environmental liabilities influence the fraction of bank debt in total debt. Furthermore, while a number of studies suggest that companies can do well (in terms of firm value and operating performance) by doing good for the environment and society (e.g., Orlitzky, Schmidt, and Rynes 2003, Guenster et al. 2011), few studies have examined the specific channels through which being socially responsible brings economic benefits. Our findings imply that being environmentally responsible can enhance firms' debt capacity and improve the availability of bank credit.

Our analysis also contributes to the capital structure literature. By showing environmental liabilities as an important determinant of capital structure, our study adds to the stakeholder theory of capital structure and reveals the importance of society stakeholders in influencing firms' financing decisions.[7] Moreover, while the bulk of capital structure research has focused on explaining the leverage choice as it is reported on the balance sheet, several studies have shown that off-balance-sheet liabilities, such as operating leases and pension liabilities, work as substitutes for on-balance-sheet financial debt (e.g., Graham, Lemmon, and Schallheim 1998; Shivdasani and Stefanesco 2011). We

has a positive effect on the investment quality and post-merger long-term performance. Albuquerque, Durnev, and Koskinen (2014) show that CSR lowers consumers' price elasticity and decreases systematic risk. Gao, Lisic, and Zhang (2014) document a negative association between CSR and insider trading profits.

[7] Maksimovic and Titman (1991) argue that employees and other stakeholders of a firm are reluctant to do business with a highly levered firm because of the concern about the highly-levered firm's ability to honor its obligations, explicit or implicit. Banerjee, Dasgupta, and Kim (2008) and Bae, Kang, and Wang (2011) provide empirical evidence in support of the predictions of Maksimovic and Titman's (1991) model. While the extant literature on nonfinancial stakeholders is mainly from the perspective of customer-supplier relations and the workforce, our study provides evidence on the role of the environment, an important society stakeholder, in a firm's financing decisions.

extend this literature by documenting the substituting effect of environmental liabilities on financial debt. Finally, our results help explain why firms appear to be underleveraged from a tax perspective (Graham 2000) - firms' debt policy should be less conservative in their capital structure decisions than has been previously thought, once environmental liabilities are accounted for.

The remainder of the paper is organized as follows. Section II discusses the important features of environmental liabilities and reviews the relevant literature briefly. We discuss our sample, variables, and summary statistics in Section III. Section IV presents our main empirical results regarding the effect of environmental liabilities on financial leverage. Section V reports additional analysis. Section VI concludes.

II. Institutional Features of Environmental Liabilities and the Literature Review

A. Debt Features of Environmental Liabilities

Environmental liabilities, according to the EPA's definition outlined in Section I, are the legal obligations governed by various environmental laws or regulations at federal, state and local levels, or even by the common law. Given their diverse sources, environmental liabilities can be further divided into six broad categories: (1) obligations to achieve and maintain compliance with environmental regulations and laws; (2) obligations imposed by pollution remediation or clean up laws; (3) obligations to pay civil and criminal fines and penalties for noncompliance; (4) obligations to compensate private parties for injury to human health, property and economic activity; (5) obligations to pay punitive damages for remiss conduct; (6) obligations to compensate governments for damages to natural resources (Barth and McNichols 1994; EPA 1996). Unlike the first category of environmental liabilities, categories (2)-(5) are conditional on firms' failure to demonstrate compliance and are often associated with accidents or uncontrollable events. These categories of liabilities are enforced either by public agencies or through private parties' suits. Though occasionally imposed, non-compliance induced environmental liabilities also entail a series of regular outlays over a long period of time until the violations are entirely corrected.[8]

Environmental liabilities have several key characteristics in common with financial debt. First, to achieve and maintain compliance with environmental laws and regulations, companies incur environmental operating expenses for environmental management activities, which are necessary for properly treating, recycling, recovering, and disposing pollutants prior to direct releases into the environment. In addition, capital expenditures are often made to purchase pollution control equipment and achieve pollution prevention through technology innovation, raw material substitution, or process modification.[9] These environmental outlays are regularly incurred on a long-term basis because environmental standards are constantly revised and new obligations are continuously imposed, and also because it usually takes years for firms to fully comply with new environmental regulations or laws. Thus, environmental liabilities are legally binding obligations that result in substantial and continuous outlays on a regular basis.[10] Second, environmental outlays are tax deductible, much like interest expenses on financial debt. Third, failure to comply with environmental obligations can lead to substantial penalties, compliance costs, operation shutdowns, or even bankruptcy. The possible claimants include governments at different levels, communities, and individuals. In terms of priority, the claims are junior to secured debt but senior to unsecured debt (e.g., Rogers 2005).

However there are also important differences between environmental liabilities and financial debt.

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[8] In particular, remediation liabilities require initial capital expenditures, followed by ongoing operating, maintenance, and monitoring expenses for more than 30 years (Barth and McNichols 1994). Also, compensation liabilities, such as asbestos liabilities, have long-lived nature due to the long-running mass tort litigations (Hadlock and Sonti 2011).

[9] For example, according to a report provided by the American Petroleum Institute, the petroleum industry has invested more than $148 billion toward improving the environmental performance of its operations and facilities during 1990–2005. In 2005, the environmental outlays hit $12.4 billion. While $1.7 billion was spent for “research and development, corporate environmental programs, and spill remediation”, $10.7 billion was spent to “implement technologies, create cleaner fuels, and finance environmental initiatives”.

[10] For instance, the EPA introduces four new environmental regulations to the electric power sector in 2011. The initial deadline falls between 2013 and 2018. Apart from maintaining the current compliance, firms in the industry need to invest approximately $10 billion annually to meet the emerging standards. Furthermore, firms make continuous environmental expenditures to enhance environmental reputation capital, which reduces litigations risk (Boone and Uysal 2012) and strengthens relationships with stakeholders (e.g., Jones 1995; Chang et al. 2014).

For instance, unlike financial debt, most environmental liabilities have no pre-specified maturity date. The principal value of environmental liabilities may fluctuate drastically in response to the development of environmental technologies and the changes in environmental regulations over time, and thus is nearly impossible to precisely estimate in dollar terms. In addition, firms have the flexibility to incur more environmental outlays in high marginal tax states of the world to maximize the tax benefits, a feature not present with financial debt. As a result, environmental liabilities and financial debt are unlikely to be *perfect* substitutes.

B. Financial Accounting for Environmental Liabilities

The Financial Accounting Standards Board (FASB) established FAS 5/FIN 14 in 1975 as the underlying framework for the accounting and disclosure of environmental liabilities. FAS 5/FIN 14 requires that environmental costs must be “reasonably estimable" in order to be accrued. Moreover, FAS 5 pertains only to losses or asset impairments up to the end of the accounting period. Future commitments, such as modifying production processes to prevent or reduce pollution, generally are not considered (Roberts 1995). Firms are also allowed to avoid the accrual of environmental liabilities if they can demonstrate that the liabilities do not exceed the low recognition threshold specified by FAS 5. Thus, several third-party investigations conducted in the 1990s reveal that FAS 5/FIN 14 results in disparate and inconsistent accounting practices and widespread underreporting of environmental liabilities (Lee and Trabucchi 2008).

FAS 143 was issued in 2003 by FASB to directly address the accounting of environmental liabilities. It mandates that environmental liabilities should be accounted for using the fair-value cost estimation methodology, which considers multiple cost estimate scenarios and probabilities instead of using the minimum allowed under FAS 5. FIN 47 further clarified FAS 143 and became effective in 2005. It requires the recognition of the fair value of environmental liabilities in the period in which they are incurred, even if the liabilities are conditional on future events such as the timing and method of settlement of the obligations. The effect of FIN 47 has been the immediate recognition of previously unrecorded environmental liabilities and the reevaluation of previously recorded liabilities (Lee and Trabucchi 2008).

Despite positive changes in accounting standards in recent years, most of the environmental liabilities are off the books over our sample period (1992-2013) because most companies have not established rigorous procedures that consistently identify, measure, and report environmental liabilities associated with properties and facilities owned and operated by them. Our empirical analysis thus mainly relies on non-financial measures that are supposed to be highly correlated with the magnitude of environmental liabilities.

C. A Brief Review of Relevant Literature

Our paper is closely related to recent studies examining how corporate social responsibility impacts companies' costs of financing. Bauer and Hann (2010) document that environmental performance affects the solvency of borrowing firm and that environmental concerns are associated with a higher cost of debt financing and lower credit ratings. Schneider (2011) finds that corporate environmental performance negatively affects bond yields in the paper and pulp and the chemical industries. El Ghoul et al. (2014) find that firms with higher corporate environmental responsibility have cheaper equity financing. Dhaliwal et al. (2011) show that firms with superior CSR performance are more likely to voluntarily disclose their CSR strategies, thereby reducing information asymmetry and enjoying a lower cost of equity capital. Cheng, Ioannou, Serafeim (2014) document that firms with better CSR performance face significantly lower capital constraints through enhanced stakeholder engagement and increased transparency. Chava (2014) shows that firms with more environmental concerns have higher costs of equity and debt capital. While these recent studies have documented that CSR or corporate environmental performance affects both the cost of equity and the cost of debt, by looking at the effects of environmental liabilities on the financial leverage ratio, we essentially investigate the choice between debt and equity and evaluate the cost of equity relative to the cost of debt, instead of trying to evaluate the absolute cost of equity or debt.

Our study also complements the literature on off-balance-sheet liabilities. Several studies show that firms have sizable liabilities that are not recorded on the balance sheet, and that these liabilities are negatively related to the amount of on-balance-sheet debt used by firms. For example, Graham, Lemmon, and Schallheim (1998) study operating leases as an off-balance-sheet liability and find that firms with low marginal tax rates use more operating leases and have lower levels of financial debt. Shivdasani and Stefanesco (2011) consider pension liabilities and show that one percentage point increase in the pension liability to total assets ratio is associated with a 0.36 percentage point decrease in the financial leverage ratio. We are among the first to provide evidence that environmental liabilities also have a partial substitution effect on financial debt.

Another closely related strand of the capital structure literature aims to understand why firms appear to be underleveraged from a tax perspective. Graham (2000) shows that firms are generally very conservative in their capital structure. The typical firm in his study could double tax benefit by issuing more financial debt until the marginal tax benefit begins to decline. This conservatism is often thought to be puzzling because tax benefits are a highly important determinant of financing decisions to most CFOs surveyed by Graham and Harvey (2001). To explain the debt conservatism puzzle, recent studies have suggested a number of factors, which include supply side constraints faced by lenders (Faulkender and Petersen 2006), distress risk premia (Almeida and Philippon 2007), depreciation and tax credits (Schallheim and Wells 2006), employee stock option expenses (Graham, Lang, and Shackelford 2004), the tax shield provided by defined benefit pension contributions (Shivdasani and Stefanesco 2011), the CEO and governance characteristics (Strebulaev and Yang 2013), and the risk of losing intellectual property to rivals (Klasa et al. 2014). As discussed in Section II.A, environmental outlays are substantial, provide a source of valuable tax shields, and may be timed to lower the marginal tax rate and tax benefits for financial debt. Once environmental liabilities are taken into account, firms should be less conservative in their choice of leverage than what they report on the balance sheet. Thus, our findings complement the existing explanation for debt conservatism.

III. Data, Variables, Models, and Summary Statistics

A. Data and Sample

Our sample consists of all firms that are included in the Compustat database and have at least one facility that reports to the EPA's TRI program at any point between 1992 and 2013. To measure environmental liabilities, we mainly reply on toxic waste data reported by firms under the TRI program. Financial data are from the Compustat Industrial Annual files. The amount of bank debt is collected from the Capital IQ database. Data on stock prices and returns are retrieved from the Center for Research in Security Prices (CRSP) files. Dollar values are converted into 2005 constant dollars using the GDP deflator.

We start the sample period in 1992 since the Pollution Prevention Act (PPA), which requires firms to provide detailed information about facility-level waste management and source reduction activities, took effect in 1991 and we use one-year lagged value of environmental liability measures in regressions so that they are available when firms make financing decisions in a given year. Following standard practice, we exclude financial, insurance, and real estate companies (SIC codes 6000–6900) because their capital structures are likely to be significantly different from the industrial companies in our sample.[11] Also discarded are firms with missing values for environmental liability and for the variables employed in our regression analysis. These restrictions lead to an unbalanced panel that

[11] Some previous studies on capital structure (e.g., Frank and Goyal 2003) exclude regulated utilities (SIC codes 4900–4999) because their financial policies are governed by regulatory requirements. We keep utilities companies in the analysis because utilities are among the most important heavily-polluting industrial sectors covered by the TRI database (Delmas and Toffel 2008). Our results (untabulated), however, remain qualitatively the same if we discard regulated utilities firms.

consists of 18,070 firm-year observations from 1,698 firms. To the best of our knowledge, the size of our sample is larger than those in previous studies that use the EPA's TRI data.[12]

B. Measuring Environmental Liabilities

As the current securities regulations and accounting standards leave firms considerable discretion in their environmental reporting, the environmental disclosure made by firms are often incomplete and inaccurate (Barth, McNichols, and Wilson 1997; Schneider 2011). We thus follow prior studies and rely on nonfinancial pollution measures from the TRI program to assess firms' environmental liabilities.[13] Compared with environmental performance metrics created by major social raters, the TRI program offers more objective and verifiable measures of corporate environmental performance, because it is under rigorous monitoring by EPA and contains very few subjective assessments.[14] In addition, the TRI data is less subject to selection biases as firms' environmental reporting is legally mandated.

The TRI program was established by the Section 313 Emergency Planning and Community Right-to-Know Act (EPCRA) of 1987 and has been expanded to contain information on over 650 toxic chemicals from more than 20,000 U.S. industrial facilities. Each year, facilities are required to report to TRI the quantities of chemicals disposed or released into the environment (air, water, and land) and those that are treated, recycled, and recovered.[15] As our study mainly focuses on the on-going and

[12] Previous studies either limit their samples to certain industries (e.g., Clarkson, Li, and Richardson 2004; Schneider 2011) or use TRI data from third parties which cover a subset of companies (e.g., Al-Tuwaijri, Christensen, and Hughes II 2004; and Chatterji and Toffel 2010).

[13] Barth and McNichols (1994) and Hughes (2000) show that nonfinancial pollution measures, i.e., the number of Superfund sites and sulfur dioxide emissions, respectively, capture the exposure of polluting firms to future environmental liabilities. Also see among others, Cormier, Magnan, and Morand (1993), Clarkson, Li, and Richardson (2004), and Carroll et al. (2004).

[14] To ensure the accuracy and reliability of the TRI data, EPA "*analyzes data for potential errors, contacts TRI facilities concerning potentially inaccurate submissions, provides guidance on reporting requirements, and takes enforcement actions against facilities that fail to comply with TRI requirement*".

[15] A facility is required by law to report to the TRI program if it meets the following three criteria: (1) it has 10 or more full-time employees, (2) its North American Industry Classification System (NAICS) code is covered by the TRI program, and (3) it processes, manufactures, or otherwise uses any listed toxic chemical in excess of the threshold amount.

future environmental liabilities caused by continuous production activities, chemicals released into the environment as a result of one-time accidents or catastrophic events are excluded when calculating the facility-level waste. Unreported robustness checks show that including releases caused by one-time accidents or catastrophic events has no material impact on our results.

We assume that firms are liable for the total amount of toxic waste, which is defined as the sum of toxic chemicals that are released, treated, recycled, and recovered. Environmental management activities, which include treatment, recovering, and recycling, reflect firms' on-going expenditures for compliance with current environmental laws and regulations, and for meeting self-set environmental performance standards. They are long-term and recurring obligations so long as a firm's production continues to generate any environmentally unfriendly substances. More importantly, the quantity of chemicals released are positively associated with firms' expenditures for compliance with future stringent environmental laws and regulations, the probability of future litigations, enforcement actions, and remediation activities arising from past and on-going environmental contamination as well as serious damages to human health, property, and economic activities. De Franco, Li, and Zhou (2013) show that the TRI's toxic emission data constitutes an important source of non-financial information for analysts to assess firms' future environmental risk exposure and financial prospect.

Specifically, we first calculate the facility-level production-related waste by summing up all the chemical waste in a given year. To account for the inherent heterogeneity of chemicals, we multiply the mass of each chemical by its toxicity, which is taken from the EPA's Risk-Screening Environmental indicator (RSEI) model. EPA provides two toxicity weights based on the exposure path: the inhalation toxicity weight and the oral toxicity weight. We follow EPA's methodology and use the inhalation toxicity weight for releases (transfers) to fugitive air, stack air, and off-site incinerations. The oral toxicity weight is used for releases (transfers) to direct water and publicly-owned treatment works (POTWs). If the path through which a chemical is released (transferred) is unknown, the higher of the two toxicity weights is used. For chemicals that have no assigned toxicity by EPA, we set toxicity equal to zero.

We then aggregate the toxicity-weighted amounts of waste across facilities owned by the firm to obtain the firm-level toxicity-weighted waste. The aggregation procedure gives rise to many extreme values because of the enormous variation in the toxicity of TRI chemicals, which spans seven orders of magnitude on a pound-for-pound basis. For instance, less-toxic chemicals, such as Formic acid and Ethylene, have toxicity less than 0.5, while the most toxic chemicals, such as, Asbestos and Thorium dioxide, have toxicity equal to 1,000,000. We then log-transform the firm-level toxicity-weighted waste to mitigate the effect of skewness and achieve normality (e.g., Berrone and Gomez-Mejia 2009; Delmas and Toffel 2008), and scale it using total sales to control for production scale. The resulting measure (*EnvLiab*) is our key variable of interest in the regression analysis, with higher values indicating higher environmental liabilities.

We acknowledge that *EnvLiab* offers an incomplete picture of a firm's environmental liabilities since it primarily focuses on toxic production-related waste. This limitation would work against finding a significant relation between environmental liabilities and capital structure. In Section IV.C, we show that our results are robust to alternative definitions and measures of environmental liabilities, which capture various aspects of environmental liabilities.

C. Other Variables

We measure capital structure using the leverage ratio (*Leverage*), which is defined as the ratio of total debt over total assets. The fraction of bank debt in total debt, *BD/D*, is computed as the amount of bank debt divided by total debt.

In our regression analysis, we control for a set of control variables that have been shown by previous studies as important determinants of financing decisions (e.g., Frank and Goyal 2003; Chang, Hilary, and Dasgupta 2006). Specifically, we include the natural log of total assets (*Ln*(*Assets*)) to control for firm size. To account for the effect of a firm's life cycle on its financial leverage, we employ the natural log of firm age, *Ln*(*Firm Age*), which is defined as the number of years elapsed since a firm enters the CRSP database. We use the market-to-book ratio (*M/B*) to proxy for growth opportunities and use *EBITDA*/*Assets* to capture profitability. As companies having more tangible assets are expected to support more debt as these assets can be pledged as collateral, we include the net Property, Plant, and Equipment scaled by total assets (*PPE/Assets*) to account for asset tangibility. Research and development expenses scaled by assets (*R&D/Assets*) can proxy for a variety of company characteristics, such as the uniqueness of the product (Titman 1984), information asymmetry, or growth potential. We also include an *R&D* indicator variable (*RNDD*) that equals one if R&D expenses are missing, and zero otherwise. To control for the risk and financial constraints faced by companies, we include a dividend payout indicator (*Dividend Payer*), Altman's (1968) unleveraged *Z-score*, and earnings volatility (σ(*Earnings*)). We expect that the incentive to take on debt increases with the company's marginal tax rate because of the tax deductibility of interest expenses. Thus, we include the corporate marginal tax rate (*MTR*) based on the operating income after interest expenses according to Graham (1996). Faulkender and Petersen (2006) document that companies having access to public bond markets, as measured by having a debt rating, take on more debt. We thus include a debt rating indicator variable (*Debt Rating*), which equals one if a company has a debt rating assigned by Standard & Poor's, and zero otherwise, to capture companies' access to corporate bond markets. Chang, Dasgupta, and Hilary (2006) show that companies with greater analyst coverage have lower leverage. Hence, we control for analyst following by including the maximum number of analysts that make annual earnings forecasts any month over a 12-month period (*NbrAnal*).

D. Summary Statistics

Table I reports the descriptive statistics for all firms in our sample. We winsorize the variables at the top and bottom 1% of their distributions. This approach reduces the impact of extreme observations by assigning the cutoff values to those that are beyond the cutoff points. Our results (untabulated) are qualitatively the same when we truncate (rather than winsorize) the distributions.

[Insert Table I here]

The distributions of raw waste and toxicity-weighted waste are highly skewed. An average (a median) firm in our sample generates 13.6 (0.4) million pounds of waste. The mean (median) value of toxicity-weighted waste is 43.3 billion (378.8 million). Our main measure of environmental liabilities (*EnvLiab*), after log transformation and being scaled by sales, has the mean value equal to 0.063 and has the standard deviation equal to 0.175.

The average (median) firm in our sample has leverage equal to 0.255 (0.245). Table I also reports summary statistics for the control variables described above. Since our sampling approach and variable construction criteria follow the literature, in the interest of brevity, we omit discussion of the descriptive statistics for control variables.

Appendix A tabulates the distribution of firms across industries classified using the two-digit SIC code. The highest fraction of firms is from Electrical Equipment industries (SIC = 36), followed by Chemicals and Allied Products (SIC = 28), Industrial and Commercial Machinery and Computer Equipment (SIC = 35), and Transportation Equipment (SIC = 37). Overall, the firm presence exhibits a large variation across industries. As environmental liability measures tend to be industry-specific (Clarkson, Li, and Richardson 2004), we include two-digit SIC industry fixed effects in our regression analysis to control for heterogeneity along the industry dimension.

IV. The Effect of Environmental Liabilities on Financial Leverage

A. Baseline Results

To study the effect of environmental liabilities on the leverage ratio, we estimate the model

$$Leverage_{i,t} = \alpha + \beta EnvLiab_{i,t-1} + \gamma X_{i,t-1} + \delta Industry_{i,t} + \theta Year_{i} + \varepsilon_{i,t}, \qquad (1)$$

where the key explanatory variable, *EnvLiab*, is measured one year before the leverage ratio is observed. The coefficient (β) on *EnvLiab* is expected to be negative. We include the two-digit SIC industry fixed effects (*Industry*) that control for heterogeneity across industries. Also included are year fixed effects (*Year*), which account for macro-economic factors that influence corporate capital structure.[16] The standard errors of the estimated coefficients allow for clustering of observations by firm but our conclusions are not affected if we allow clustering by both firm and year.

[Insert Table II here]

Column (1) of Table II presents our baseline results obtained by estimating equations (1). The coefficient estimate on *EnvLiab* is negative and statistically significant (*t*-statistic = -5.4), indicating that high environmental liabilities reduce firms' financial leverage. Economically, a one-standard deviation increase (0.175) in *EnvLiab* decreases the leverage ratio by 0.019 (= -0.109×0.175), which amounts to roughly 7.5% of the average leverage ratio (0.255). To put it into perspective, the market-to-book ratio (*M/B*), which has been suggested by previous studies to be one of the most important determinants of financial leverage, exhibits similar economic significance. A one-standard deviation increase (0.869) in *M/B* decreases the leverage ratio by 0.019 (= -0.022×0.869). The other control variables generally have signs consistent with those in prior literature (e.g., Frank and Goyal 2003; Chang, Dasgupta, and Hilary 2006). For example, companies that are younger, less profitable, or followed by more analysts have lower financial leverage. In contrast, firms that have credit ratings or make less investment in R&D use more debt in their capital structure. Robustness checks (untabulated) show that qualitatively similar results are obtained if we define *EnvLiab* without log-transforming the

[16] We do not include firm fixed effects in our main specifications because both *Leverage* and *EnvLiab* are highly persistent variables. The first order autocorrelations for *Leverage* and *EnvLiab* are 0.90 and 0.95, respectively. Zhou (2001) points out that the persistence of key variables can reduce the signal-to-noise ratio and lower the power of panel data estimators. Nevertheless, as we show in robustness checks described below, our main results hold when firm fixed effects are included.

firm-level toxicity-weighted waste or if we defining *EnvLiab* as percentile ranks of the firm-level toxicity-weighted waste scaled by sales.

In columns (2)-(4) of Table II, we show that our baseline results are robust to alternative model specifications and variable definitions. In particular, in column (2) we estimate equation (1) using the Fama-MacBeth (1973) procedure that corrects standard errors for cross-sectional correlations. In column (3) we estimate equations (1) with firm fixed effects that account for unidentified time-invariant firm characteristics. In column (4) we measure financial leverage using total debt divided by the quasi-market value of assets (total assets minus book value of equity plus market value of equity). The coefficients of *EnvLiab* remain both economically and statistically significant.

Taken together, our baseline results in Table II suggest that firms with higher environmental liabilities use less financial debt. These results are consistent with our view that the environmental liabilities lower firms' capacity for financial debt, reduce the tax benefits of debt, and increase firms' business risk.

B. Tests for Endogeneity

We have documented a robust relation between our measure of environmental liabilities and financial leverage, but its causal interpretation remains hypothetical. Our main results are potentially subject to two types of endogeneity. The first type is omitted variable bias. While we have controlled for a standard set of variables that have been shown by previous studies to affect capital structure, the relation that we observe may be spurious if our models omit any variables that affect both capital structure and environmental liabilities. The other possible endogeneity issue is reverse causality running from capital structure decisions to environmental liabilities. For example, firms may issue debt to finance expenditures on pollution control and prevention activities, resulting in a negative relation between current financial leverage and the total amount of toxic chemical waste. In both cases, the coefficient estimates in Tables II can be biased and inconsistent.

[Insert Table III here]

We perform several tests to alleviate endogeneity concerns, and tabulate the results in Table III. First, we explicitly control for past debt issues (*PastDebt*) and pollution control and prevention activities (*Prevention*). To measure *PastDebt*, we compute the volume of net debt issued over the past three years, and scale it using the book value of assets at *t*-1. Because firms do not disclose the amount of chemicals reduced by pollution prevention activities, we follow Doshi, Dowell, and Toffel (2013) and extrapolate the amount using the production ratio reported by the TRI database.[17] *Prevention* is then defined as the toxicity-weighted and log-transformed amount of waste reduced by pollution prevention activities and scaled by sales. The results reported in column (1) of Table III indicate that *EnvLiab* remains economically and statistically significant in the leverage regression, suggesting that our results are not driven by omitting pollution prevention activities financed by past debt issues.

In column (2), we use $EnvLiab_{t-3}$, instead of $EnvLiab_{t-1}$, as the key explanatory variable, because more distantly lagged values of *EnvLiab* should be less correlated with *current* omitted firm characteristics. Similar results are obtained. In column (3) we employ an instrumental variable approach to further mitigate endogeneity concerns. Specifically, we use two instrumental variables that are likely to satisfy both the relevant and exclusion criteria. The first instrument, *Ln*(1+*DisPro*), is the log of one plus the weighted average geographical distance between EPA regional offices and a firm's facilities. We first calculate the geographical distance for each facility-EPA regional office pair, and then weight the distance using the log-transformed toxicity-weighted waste generated by each facility scaled by sales. To the extent that information asymmetries and monitoring costs increase with the

[17] Specifically, the production ratio of a facility is the production level in the current year divided by the production level in the previous year (Berrone and Gomez-Mejia 2009). We predict the waste level generated in a given year by multiplying the production ratio by the total waste generated in the previous year, and then subtract the actual waste from the predicted waste to obtain the amount of waste that is reduced by pollution prevention.

physical distance from EPA regional offices, EPA regional offices would be less effective in making more remote firms reduce environmental liability, implying a positive relation between and *EnvLiab*. We use Coval and Moskowitz's (1999) formula to calculate the geographical distance for every facility-EPA regional office pair. The geographic coordinates of reported facilities are provided by the TRI database. The coordinates of EPA's regional offices are based on zip codes from EPA's website.

The second instrument variable, *Unemployment*, is the average unemployment rate among all the states in which a firm's facilities operate, weighted by the log-transformed toxicity-weighted waste generated by each facility scaled by sales.[18] Kah and Kotchen (2010) document that higher state unemployment rates are associated with fewer public environmental concerns, thereby leading to higher corporate environmental liabilities. These two instrumental variables, however, are not expected to directly influence financial leverage, rather than affecting it through environmental liabilities.

We take the instrumental variable approach in the framework of a two-stage least squares (2SLS) regression. The results of the first-stage regression are reported in column (1) of Appendix B. *Ln*(1+*DisPro*), and *Unemployment* are found to be significantly and positively related to *EnvLiab* (*t*-statistics are 4.0 and 10.0, respectively). The instruments pass the relevance test as the *F*-statistics from the joint test of excluded instruments are significant at the 1% level. The *p*-values of the over-identification tests are insignificantly different from zero, thereby confirming the validity of these instrumental variables. The results of the second-stage regression, which are reported in column (3) of Table III, reveal that the *EnvLiab* remains economically and statistically significant in leverage regression, implying a causal relation going from environmental liabilities to financial leverage.

C. Alternative Measures of Environmental Liabilities

[18] The state-level unemployment rate data are collected from the U.S. Bureau of Labor Statistics.

In the section we experiment with several alternative measures of environmental liabilities that are constructed using various data sources. We first measure environmental liabilities using toxic waste that is released into the environment (air, water, and land). We also scale the toxicity-weighted and log-transformed amount of releases by sales. The resulting measure is denoted by *EnvLiab_Release*. Compared with waste recycled, recovered, and treated, waste released is more likely to be related to *future* environmental regulations, litigations, and enforcement actions. The results reported in column (1) of Table IV reveal that *EnvLiab_Release* is negatively and significantly related to *Leverage*.

[Insert Table IV here]

Our main measure of environmental liabilities (*EnvLiab*) is a nonfinancial measure from the TRI program of EPA. By capturing the amount of waste complemented by toxicity information, *EnvLiab* should be highly correlated with, but is certainly not equivalent to the actual *financial* expenses paid by polluters to cope with the toxic waste in the present and in the future. To address this concern, we estimate the dollar amounts of environmental liabilities in several ways as follows.

First, we run the following regression to establish a functional relation between *EnvLiab* and the financial expenses incurred by firms in complying with environmental laws and regulations.

$$(COGS + CAPEX)\,/\,Sales_{i,t} = \alpha + \sum_{j=1}^{N} \beta_j Waste_{i,j,t} + \gamma X_{i,t-1} + \delta Firm_{i,t} + \theta Year_i + \varepsilon_{i,t}, \qquad (2)$$

where the dependent variable is the sum of operating expenses, which are measured by the cost of goods sold (*COGS*), and capital expenditure (*CAPEX*) scaled by sales. *Waste* is the amount of chemical j (in pounds) deflated by sales. Totally 549 chemicals (N = 549) are included in the regression. The underlying assumption of this equation is that *COGS* and *CAPEX* contain respectively current expenses and capital expenditures related to waste management. β_j captures the functional relation between environmental costs and each chemical that a firm reports. X represents the control variables included in equation (1). Firm and year fixed effects are added to account for unmodeled firm heterogeneity and unmodeled macroeconomic effects that affect operating expenses and capital expenditure. In addition, by including firm fixed effects, the estimated coefficient β_j captures the sensitivity of current operating expenses and capital expenditures to within-firm variations in the amount of toxic waste.

The results obtained by estimating equation (2) are reported in Appendix C. To save space, the coefficients of 549 chemicals are not tabulated. The dollarized amount of environmental liabilities is then computed as $\sum_{j=1}^{N} \beta_j Waste_{i,j,t}$ for each year based on all kinds of production-related waste that a firm reports. We then re-estimate equation (1) after replacing *EnvLiab* with $\sum_{j=1}^{N} \beta_j Waste_{i,j,t}$. The results reported in column (2) of Table IV illustrate that the negative effect of this dollarized proxy for environmental liabilities on financial leverage is significant at the 5% level.

Second, we then focus on a monetized part of environmental liabilities that arises from violations of environmental regulations and laws. EPA's ECHO (Enforcement and Compliance History Online) database contains facilities' compliance records, which include the occurrence of monitoring activities, the determination of violations, enforcement actions to address violations, and the costs associated with enforcement actions between 1992 and 2013.[19] Since most facilities resolve violations within a year, environmental obligations induced by violations and enforcement actions can be viewed as short-term liabilities. We compute the dollar amount of costs associated with the enforcement actions by summing up penalties, the compliance cost, recovery cost, and the supplemental project cost, and scale the sum by sales.[20] The resulting measure, *EnvLiab_ECHO*, is then used in the leverage ratio regression. After removing firm-years that are not covered by the ECHO database, the number of observations for this

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[19] The examples of violations include excessive pollutants release or failure to meet the toxic chemical handling requirements. EPA catches violations mainly through regular facility inspections and facilities' self-reporting. Once a violation is observed, federal and state governments will work together to force facilities to take actions and assure that these facilities will eventually return to compliance. EPA's ECHO focuses on facilities that violates Clean Air Act (CAA), Clean Water Act (CWA), Resource Conservation and Recovery Act (RCRA), and Safe Drinking Water Act (SDWA), however, it does not contain information on criminal enforcement actions.

[20] A supplemental environmental project (SEP) is an environmental and public health beneficial project which a violator voluntarily agrees to perform. In return, the project costs can be used to offset penalties.

test reduces to 2,890. Nevertheless, the results reported in column (3) of Table IV show that *EnvLiab_ECHO* is negatively and significantly related to *Leverage*.

A potential concern with our analysis is that our main measure of environmental liabilities only captures liabilities associated with a set of toxic chemicals specified by the EPA, and thus is unable to provide a comprehensive picture of a firm's environmental liabilities. To address the issue, we rely on four alternative data sources, namely, Kinder, Lydenberg, and Domini (KLD) Research & Analytics ,Newsweek Green Rankings, Thomson Reuters Asset4, and Trucost.

The KLD database has been widely used in prior studies of corporate social responsibility. It provides binary ratings to approximately 80 factors in seven CSR areas based on data from various sources, including company disclosures, media reports, data from government and non-government agencies, and dialogs with companies.[21] We use the ratings in the environmental concern category to measure corporate environmental liabilities. We first sum up environmental concern items to calculate raw environmental concern scores.[22] To address the concern that the number of environmental concerns varies across the sample period, we follow Deng, Kang, and Low (2013) and create an adjusted measure by dividing the raw environmental scores by the number of environmental concern indicators. The resulting measure is denoted by *EnvLiab_KLD*. By construction, a higher value of *EnvLiab_KLD* indicates a higher level of environmental liabilities. We identify 23,163 firm-year observations that are jointly covered by the KLD database and Compustat between 1992 and 2013.[23] Column (4) of Table IV presents the results obtained using *EnvLiab_KLD* as a proxy for environmental liabilities. Consistent

[21] See among others, El Ghoul et al. (2011), Kim, Park, and Wier (2012), Deng, Kang, and Low (2013), and Di Giuli and Kostovetsky (2014). The seven areas include environment, corporate governance, community, diversity, employee relations, human rights, and product. Each area has a set of strength factors and concern factors.

[22] KLD begun to provide a number of environmental concern ratings in 1991, including hazardous waste, regulation problems, ozone depleting chemicals, substantial emissions, agricultural chemicals, and other concerns. In 1999, climate change was added as an additional environmental concern. In 2009, KLD was acquired by RiskMetrics which was subsequently acquired by MSCI in 2010. While hazardous waste, ozone depleting chemicals, and agricultural chemicals were dropped, impact of products & services, biodiversity & land use, and operational waste were added. In 2012, MSCI expanded the environmental concern category by including supply chain management and water management.

[23] To be consistent with the analysis using the TRI data, we excluded financial, insurance, and real estate firms and firms with missing values for *EnvLiab_KLD* and for control variables employed in the regressions. Similar results are obtained if we use the raw environmental concern scores.

with the main results using the TRI data, we find that *EnvLiab_KLD* is negatively and significantly associated with the leverage ratio (*t*-statistic = -5.4), indicating that firms with more environmental concerns maintain lower leverage ratios.

Next, we use Newsweek's green rankings complied via collaborating with three agencies (i.e., Trucost, KLD Research & Analytics, and CorporateRegister.com) for 500 largest US companies from 2008 onwards. The green ranking is based on three components: the environmental impact score from Trucost, the green policy score derived from KLD, and the reputation score based on data collected by CorporateRegister.com. The three component scores are converted into standardized values called *Z*-scores. The overall green score is calculated as the weighted sums of the three Z-scores using the weights 45%, 45%, and 10%, respectively.[24] We converted the overall green score into percentile ranks ranging from 1 (best performing) to 100 (worst performing) and denote the resulting measure by *EnvLiab_Newsweek*. Firms with high potential environmental damage costs and poor environmental policies and reputations are assumed to have high values of *EnvLiab_Newsweek*. The sample size for this test reduces to 1,680 firm-year observations that are jointly covered in the Newsweek Green Rankings and Compustat between 2009 and 2012. Column (5) of Table IV shows that the coefficient

[24] The green scores are retrieved from Newsweek's official website. The background information of the three agencies and the methodology can be found at http://www.newsweek.com/newsweek-green-rankings-2012-full-methodology-65325. In 2011, Newsweek changed its data sources and methodology in several ways. First, Sustainalytics, another ESG research group, replaced KLD Research & Analytics to offer a new environmental management score. Second, a new environmental disclosure score also replaced the old reputation score to incorporate the breadth and quality of corporate reporting of environmental impacts and involvement in key transparency initiatives. Third, Newsweek drop the Z-score method but calculate the green score by weighing the environmental impact score, the new environmental management score, and the new environmental disclosure score using the proportions 45%, 45% and 10%, respectively. Newsweek states that the new weighting scheme not only improves the transparency of the score calculation, but also makes the scores in different years comparable. Finally, Newsweek redefined the industry classification and increased the number of industries from fifteen to nineteen. Nevertheless, the new methodology could affect the distribution of the green score. To examine the changes in the properties of the green score across two regimes, we compare the simple statistics of the green score in 2009 and 2010 versus those in 2011 and 2012. We find that the standard deviations of the green score are about the same in two regimes (10.3 in 2011 and 2012 versus 10.6 in 2009 and 2010) but the average score is much lower in 2011 and 2012 (52.4 versus 70.5). We also examine simple correlations in green score in consecutive years and find that the correlation between 2009 (2011) and 2010 (2012) is 0.89 (0.96) and that between 2010 and 2011 is 0.72. Therefore, though the methodology was changed in 2011, the relative green scores across firms are not very much affected. Newsweek green rankings were not published in 2013.

on *EnvLiab_Newsweek* remains negative and significant (*t*-statistic = -1.9), suggesting that firms that are more environmentally responsible have higher financial leverage.

Our third alternative measure of environmental liabilities is the environmental score provided by the Thomson Reuters Asset4 database, which has been widely used by prior studies (e.g., Cheng, Ioannou, Serafeim, 2014; Lys, Naughton, and Wang, 2013). Asset4 provides comprehensive data on the environmental impact of Russell 1000 firms from 2002. To the extent that a firm's environmental scores is directly related to its environmental expenditure, a high environmental score (*EnvLiab_Asset4*) indicates higher environmental liabilities (Lys, Naughton, and Wang, 2013). After matching with the Compustat database, we obtain a sample of 6,097 firm-year observations between 2003 and 2013. The results, reported in column (6) of Table IV, show that the estimated coefficient on *EnvLiab_Asset4* is negative and significant (*t*-statistic = -2.6), indicating that firms with higher level of environmental expenditures maintain low leverage ratio.

Finally, we collect information on corporate environmental cost from the Trucost database. Trucost uses a unique methodology to estimate corporate environmental costs based on an input-output model, and is currently the only data source that provides the environmental cost of firms in dollar amount. We identify 6,070 firm-year observations jointly covered by the Trucost and Compustat database between 2002 and 2013. The results are reported in column (7) of Table IV. Environmental cost (*EnvLiab_Trucost*) is negatively and significantly related to leverage ratio (*t*-statistic = -2.2). Taken together, our main findings are robust to using alternative measures of environmental liabilities from various data sources.

V. Further Analysis

In this section we first examine how our main results vary across time and across firms depending on various firm-specific characteristics. We then study the effect of environmental liabilities on the use of bank debt.

A. Heterogeneity in the Effect of Environmental Liabilities on Financial Leverage

To examine how the relation between environmental liabilities and financial leverage varies across firms and over time, we interact *EnvLiab* with several variables in the leverage ratio regressions. First, while generally there is a lack of consistency and accuracy in environmental reporting, the impact of environmental liabilities should be more likely to be properly recognized when firms are more visible. Moreover, firms with greater visibility are more subject to public scrutiny and have higher reputation risk and litigation risk, thus their financial policy should be more sensitive to environmental liabilities. In other words, we expect the effect of environmental liabilities to be more pronounced for firms with high visibility. We use firm size (Miller 2006) and analyst coverage (Mehran and Peristiani 2010) to measure firms' visibility. We then interact *EnvLiab* with *Ln*(*Assets*) and *NbrAnal* separately and report the results in columns (1) and (2) of Table V. The interaction terms are negative and significant for both regressions, consistent with our expectations.

[Insert Table V here]

Second, Maksimovic and Titman (1991) and Titman (1984) argue that customers may be reluctant to conduct business with suppliers with high financial leverage or financing difficulties, which weakens suppliers' ability to honour implicit contracts. To the extent that environmental liabilities lower firms' capacity for financial debt and increase firms' business risk, the effect of environmental liabilities on leverage is expected to be stronger for firms that rely heavily on large customers. Thus, we interact the fraction of sales to principal customers (*PriCus*) with *EnvLiab* and report the results in column (3) of Table V.[25] The interaction term is negative and significant, implying that firms with higher environmental liabilities are more likely to maintain lower leverage ratios to mitigate large customers' concerns about their financial health.

Third, local communities, as an important external stakeholder group, can exert pressure on companies via voting in elections, activism within environmental nongovernment organizations, and citizen lawsuits (Delmas and Toffel 2004). Firms with higher environmental liabilities tend to face more pressure on environmental performance and experience more uncertainty about their future financial performance and operations when they have poor relationships with communities. Thus, we expect that the negative impact of *EnvLiab* on *Leverage* will be more pronounced for firms with poorer community relations. To examine how community relations affect our findings, we use the Kinder, Lydenberg, and Domini's (KLD) community rating to measure a firm's community relations (*ComCon*).[26] We then interact *EnvLiab* with *ComCon* and report the results in column (4) of Table V. The interaction term is negative and significant, suggesting that firms with poor community relations reduce their financial debt more given the increased business risk caused by environmental liabilities.

Last, the FASB's FIN 47 became effective in 2005. Given that its effect has been the immediate recognition of previously unrecorded environmental liabilities and the re-evaluation of previously recorded liabilities (Lee and Trabucchi 2008), we conjecture that the effect of environmental liabilities on capital structure is stronger post-FIN 47. To explore this possibility, we introduce the indicator variable *Post_FIN47*, which equals one if the observation is in 2005 or later, and zero otherwise. We then augment equation (1) by including *Post_FIN47* and *EnvLiab×Post_FIN47* and run the regression without year fixed effects. The results are reported in column (5) of Table V. Consistent with our

[25] We identify principal customers using the Business Segment File of Compustat. Following Banerjee, Dasgupta, and Kim (2008), we define principal customers as those accounting for 10% or more of a firm's reported sales.

[26] Our community relation data is from the KLD database. *ComCon* covers the concern in four categories, namely, investment controversies, negative economic impact, tax disputes, and other concern. A higher value of *ComCon* indicates poorer relations with communities. In addition, to account for missing values of *ComCon*, we include an additional control (*ComConDum*), which equals one if *ComCon* is missing, and zero otherwise. Similar results (untabulated) are obtained if we drop firms with missing values of *ComCon* in the regression.

conjecture, the interaction term is negative and significant, suggesting that the substitution between environmental liabilities and financial liabilities becomes stronger after FIN47 improves corporate environmental disclosure and increases recognition of environmental liabilities.

B. The Effect of Environmental Liabilities on the Use of Bank Debt

We then examine the effect of environmental liabilities on the fraction of bank debt in total debt. We expect that compared with other creditors (e.g., corporate bond holders), banks are more sensitive to borrowers' environmental liabilities, since they are more identifiable and more likely to be held responsible for environmental damages caused by borrowers. We employ the following model to study the relation between environmental liabilities and the use of bank debt in total debt.

$$(BD/D)_{i,t} = \alpha + \beta EnvLiab_{i,t-1} + \gamma Leverage_{i,t-1} + \rho Z_{i,t-1} + \delta Industry_{i,t} + \theta Year_{i} + \varepsilon_{i,t}, \quad (3)$$

where we include *Leverage* as a control variable as previous studies document a negative relation between the use of bank debt and leverage (Houston and James 1996; Denis and Mihov 2003). Our bank debt sample starts from 1994 as Capital IQ has been collecting detailed information on debt structure from 1994. We exclude firm-years with missing or zero total debt. The number of observations is reduced to 14,831.[27]

[Insert Table VI here]

The results reported in column (1) of Table VI show that *EnvLiab* attracts a negative and statistically significant coefficient (*t*-statistic = -6.8), suggesting that firms with high environmental liabilities rely less on bank debt. Economically, a one standard deviation increase (0.175) in *EnvLiab* reduces the ratio of bank debt to total debt by 0.038 (= -0.219×0.175), which amounts to roughly 21%

[27] The number of observations is reduced as the coverage by Capital IQ is comprehensive only from 2002 onwards. Moreover, the coverage of the Capital IQ database is also different from that of the Compustat database. As a robustness check, we re-estimate the model using firms in our main sample that also exist in Capital IQ, and find similar results (untabulated).

of the average bank debt to total debt ratio (0.184). Consistent with previous studies (Houston and James 1996; Denis and Mihov 2003), we find that larger firms, more profitable firms, firms with higher leverage, and firms with credit ratings tend to have a lower proportion of bank financing in debt structure.

Columns (2)-(4) report the results obtained using alternative specifications. In column (2) we estimate equation (3) using the Fama-MacBeth (1973) procedure that corrects standard errors for cross-sectional correlations. In column (3) equation (3) is estimated with firm fixed effects (rather than industry fixed effects). In column (4) we report the second-stage of the 2SLS regression, which involve using *Ln*(1+*DisPro*) and *Unemployment* as instruments for *EnvLiab*. The results of the first-stage regression are reported in column (2) of Appendix B. The effects of environmental liabilities remain significant across all alternative specifications, suggesting a robust and causal relation running from environmental liabilities to the use of bank debt. In untabulated tests, we interact *EnvLiab* with several variables described in Section V.A that proxy for firm visibility, the reliance on principal customers, and community concerns, respectively. We find that the interaction terms are statistically insignificant in the bank debt regressions, suggesting the effect of environmental liabilities on the use of bank debt does not vary significantly across the firms in our sample according to these characteristics.

VI. Conclusions

In recent years, environmental issues have increasing impacts on corporate decisions in light of global increasing awareness on corporate environmental impacts. Although environmental liabilities have been staggering and become an increasingly important issue for investors and corporate managers, relatively few previous studies examine the impact environmental liabilities on corporate financing decisions, capital structure decisions in particular. The study fills this gap in the literature.

Using a large sample of firms covered by the TRI database and the Compustat between 1992 and 2013, we investigate how environmental liability affect two important aspects of corporate capital structure, namely the leverage ratio and the use of bank debt. We find that firms with high environmental liability maintain low leverage ratios and have a higher fraction of bank debt in total debt. Our results are robust to a variety of tests on variable definitions, endogeneity issues, and alternative measures of environmental liabilities.

Appendix A Industry distribution

The sample consists of firm-years jointly covered in Compustat and the TRI program between 1992 and 2013. *N* is the number of firms in a two-digit SIC industry.

Two-digit SIC	Industry Name	*N*
1	Agricultural Production Crops	17
7	Agricultural Services	1
10	Metal Mining	179
12	Coal Mining	77
13	Oil & Gas Extraction	180
14	Mining & Quarrying of Nonmetallic Minerals, Except Fuels	100
16	Heavy Construction Other Than Building Construction Contractors	40
17	Construction Special Trade Contractors	35
20	Food & Kindred Products	912
21	Tobacco Products	46
22	Textile Mill Products	264
23	Apparel & other finished products	51
24	Lumber & Wood Products, Except Furniture	211
25	Furniture & Fixtures	402
26	Paper & Allied Products	650
27	Printing Publishing & Allied Products	195
28	Chemicals & Allied Products	2,345
29	Petroleum Refining & Related Industries	436
30	Rubber & Miscellaneous Plastics Products	474
31	Leather & Leather Products	60
32	Stone, Clay, Glass, & Concrete Products	366
33	Primary Metal Industries	1,028
34	Fabricated Metal Products, Except Machinery & Transportation Equipment	925
35	Industrial & Commercial Machinery & Computer Equipment	1,776
36	Electronic & Other Electrical Equipment & Components, Except Computer Equipment	2,438
37	Transportation Equipment	1,304
38	Measuring, Analyzing, & Controlling Instruments; Photographic, Medical & Optical Goods; Watches & Clocks	1,286
39	Miscellaneous Manufacturing Industries	306
40	Railroad Transportation	3
42	Motor Freight Transportation & Warehousing	3
44	Water Transportation	16
45	Transportation by Air	12
46	Pipelines, Except Natural Gas	2
47	Transportation Services	20
48	Communications	36
49	Electric, Gas, & Sanitary Services	868
50	Wholesale Trade-durable Goods	308
51	Wholesale Trade-non-durable Goods	152
52	Building Materials, Hardware, Garden Supply, & Mobile Home Dealers	9
53	General Merchandise Stores	10
54	Food Stores	114
55	Automotive Dealers & Gasoline Service Stations	16
56	Apparel & Accessory Stores	18
57	Home Furniture, Furnishings, & Equipment Stores	17
58	Eating & Drinking Places	31
59	Miscellaneous Retail	17
70	Hotels, Rooming Houses, Camps, & Other Lodging Places	12
72	Personal Services	21
73	Business Services	127
75	Automotive Repair, Services, & Parking	6
76	Miscellaneous Repair Services	1
79	Amusement & Recreation Services	20
80	Health Services	7
82	Educational Services	5
87	Engineering, Accounting, Research, Management, & Related Services	36
99	Nonclassifiable Establishments	79
Sum		18,070

Appendix B Instrumental variable approach – First stage regressions

The sample consists of firm-years jointly covered in Compustat and the TRI program between 1992 and 2013. *EnvLiab* is *Ln*(1 + *Weighted Waste*)/*Sales*. *Weighted Waste* is obtained by multiplying the mass of each chemical by its toxicity. *DisPro* is the weighted average geographical distance between EPA regional offices and a firm's facilities. *Unemployment* is the weighted average unemployment rate among all the states in which a firm's facilities operate. Other variable definitions are in the legend of Table I. Constant terms, year fixed effects, and two-digit SIC industry fixed effects are included in all regressions but their coefficients are not reported. The *t*-statistics in parentheses are calculated from the Huber/White/Sandwich heteroskedastic consistent errors, which are also corrected for correlation across observations for a given firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Dependent Variable: *EnvLiab*	(1)	(2)
Ln(1+*DisPro*)	0.051***	0.051***
	(4.0)	(3.1)
Unemployment	0.027***	0.023***
	(10.0)	(9.1)
Leverage		-0.093***
		(-4.8)
Ln(*Assets*)	-0.050***	-0.048***
	(-11.2)	(-10.5)
Ln(*Firm Age*)	0.007**	0.009***
	(2.6)	(3.0)
M/B	0.037***	0.031***
	(4.6)	(3.2)
EBITDA/Assets	-0.334***	-0.230***
	(-4.7)	(-3.2)
PPE/Assets	-0.057***	-0.025
	(-2.7)	(-1.2)
R&D/Assets	-0.030	-0.054
	(-0.3)	(-0.4)
RNDD	-0.004	-0.001
	(-0.6)	(-0.2)
Dividend Payer	0.016***	0.010**
	(3.0)	(2.1)
Z-score	-0.036***	-0.041***
	(-6.9)	(-7.1)
σ(*Earnings*)	0.259***	0.216***
	(3.4)	(3.0)
MTR	-0.007	0.005
	(-0.2)	(0.2)
Debt Rating	0.013**	0.015***
	(2.4)	(2.7)
NbrAnal	0.003***	0.003***
	(5.3)	(5.5)
Year and Industry Fixed Effects	Y	Y
Joint test of excluded instruments	Prob > F = 0.00	Prob > F = 0.00
J-Statistics (p-value)	0.66	0.42
N	18,068	14,829
R^2	0.51	0.50

Appendix C Functional relation between environmental liabilities and financial expenses

The sample consists of firm-years jointly covered in Compustat and the TRI program between 1992 and 2013. (*COGS* + *CAPEX*)/*Sales* is cost of goods sold (*COGS*), and capital expenditure (*CAPEX*) scaled by sales. $Waste_j$ is the amount of chemical *j* (in pounds) deflated by sales. Other variable definitions are in the legend of Table I. $Waste_j$, constant terms, year fixed effects, and firm fixed effects are included in all regressions but their coefficients are not reported. The *t*-statistics in parentheses are calculated from the Huber/White/Sandwich heteroskedastic consistent errors, which are also corrected for correlation across observations for a given firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Dependent Variable:	(*COGS* + *CAPEX*)/*Sales*
$Waste_j$	Y
Ln(*Assets*)	0.012**
	(2.0)
Ln(*Firm Age*)	-0.007
	(-1.3)
M/B	0.007
	(1.4)
EBITDA/Assets	-0.348***
	(-5.8)
PPE/Assets	0.022
	(0.8)
R&D/Assets	-0.668***
	(-3.0)
RNDD	-0.020*
	(-1.7)
Dividend Payer	-0.005
	(-0.9)
Z-score	0.029***
	(4.3)
σ(*Earnings*)	0.164**
	(2.5)
MTR	0.010
	(0.6)
Debt Rating	-0.016**
	(-2.2)
NbrAnal	-0.002***
	(-2.8)
Year & Firm Fixed Effects	Y
N	16,587
R^2	0.83

References

Albuquerque, Rui, Art Durnev, and Yrjo Koskinen, 2014, Corporate social responsibility and asset pricing in industry equilibrium, Working Paper, Boston University, University of Iowa, and University of Pennsylvania.

Almedia, Heitor, Murillo Campello, and Michael S. Weisbach, 2004, The cash flow sensitivity of cash, *Journal of Finance* 59, 1777-1804.

Al-Tuwaijri, Sulaiman A, Theodore E Christensen, and KE Hughes II, 2004, The relations among environmental disclosure, environmental performance, and economic performance: A simultaneous equations approach, *Accounting, organizations and society* 29, 447-471.

Bae, Kee-Hong, Jun-Koo Kang, and Jin Wang, 2011, Employee treatment and firm leverage: A test of the stakeholder theory of capital structure, *Journal of Financial Economics* 100, 130-153.

Banerjee, Shantanu, Sudipto Dasgupta, and Yungsan Kim, 2008, Buyer–supplier relationships and the stakeholder theory of capital structure, *Journal of Finance* 63, 2507-2552.

Barth, Mary E., and Maureen F. McNichols, 1994, Estimation and market valuation of environmental liabilities relating to superfund sites, *Journal of Accounting Research* 32, 177-209.

Barth, Mary E., Maureen F. McNichols, and G. Peter Wilson, 1997, Factors influencing firms' disclosures about environmental liabilities, *Review of Accounting Studies* 2, 35-64.

Bauer, Rob, and Daniel Hann, 2010, Corporate environmental management and credit risk, Working Paper, Maastricht University.

Berrone, Pascual, and Luis R. Gomez-Mejia, 2009, Environmental performance and executive compensation: An integrated agency-institutional perspective, *Academy of Management Journal* 52, 103-126.

Boone, Audra L., and Vahap B. Uysal, 2012, Reputational concerns in the market for corporate control, Working Paper, Texas A&M University and University of Oklahoma.

Chang, Xin, Sudipto Dasgupta, and Gilles Hilary, 2006, Analyst coverage and financing decisions, *Journal of Finance* 61, 3009-3048.

Chang, Xin, Banerjee, Shantanu , Kangkang Fu, Tao Li, and George Wong, 2014, Corporate environmental risk and the customer-supplier relationship, Working Paper, Nanyang Technological University.

Cheng, Beiting, Ioannis Ioannou, and George Serafeim, 2014, Corporate social responsibility and access to finance, *Strategic Management Journal* 35, 1-23.

Clarkson, Peter M., Yue Li, and Gordon D. Richardson, 2004, The market valuation of environmental capital expenditures by pulp and paper companies, *The Accounting Review* 79, 329-353.

Clarkson, Peter M., Yue Li, Gordon D. Richardson, and Florin P. Vasvari, 2011, Does it really pay to be green? Determinants and consequences of proactive environmental strategies, *Journal of Accounting and Public Policy* 30, 122-144.

Carroll, Stephen, Deborah Hensler, Allan Abrahamse, Jennifer Gross, Michelle White, F. Scott Ashwood, and Elizabeth Sloss. 2004. *Asbestos Litigation Costs and Compensation* Santa Monica, Calif.: RAND Corporation.

Chatterji, Aaron K., David I. Levine and Michael W. Toffel, 2009. How well do social ratings actually measure corporate social responsibility? *Journal of Economics & Management Strategy* 18, 125-169.

Chatterji, Aaron K, and Michael W Toffel, 2010, How firms respond to being rated, *Strategic Management Journal* 31, 917-945.

Chava, Sudheer, 2014, Environmental externalities and cost of capital, *Management Science* 60, 2223-2247.

Cogan D., 2008, Corporate Governance and Climate Change: The Banking Sector, Report, Ceres.

Cormier, D., M. Magnan, and B. Morard, 1993, The impact of corporate pollution on market valuation: Some empirical evidence, *Ecological Economics* 8, 135.

Coval, Joshua D., and Tobias J. Moskowitz, 1999, Home bias at home: Local equity preference in domestic portfolios, *Journal of Finance* 54, 2045-2073.
DeAngelo, Harry, and Ronald W. Masulis, 1980, Optimal capital structure under corporate and personal taxation, *Journal of Financial Economics* 8, 3-29.
De Franco, Gus, Yue Li, and Yibin Zhou, 2013, Corporate environmental risk exposure and analyst behavior, Working Paper, University of Toronto and University of Texas at Dallas.
Delmas, Magali A., and Michael W Toffel, 2004, Stakeholders and environmental management practices: An institutional framework, *Business strategy and the Environment* 13, 209-222.
Delmas, Magali A., and Michael W. Toffel, 2008, Organizational responses to environmental demands: Opening the black box, *Strategic Management Journal* 29, 1027-1055.
Deng, Xin, Jun-koo Kang, and Buen Sin Low, 2013, Corporate social responsibility and stakeholder value maximization: Evidence from mergers, *Journal of financial Economics* 110, 87-109.
Denis, David J, and Vassil T Mihov, 2003, The choice among bank debt, non-bank private debt, and public debt: Evidence from new corporate borrowings, *Journal of Financial Economics* 70, 3-28.
Doshi, Anil R., Glen W. S. Dowell, and Michael W. Toffel, 2013, How firms respond to mandatory information disclosure, *Strategic Management Journal, forthcoming*.
Diamond, Douglas W., 1991, Debt maturity structure and liquidity risk, *The Quarterly Journal of Economics* 106, 709-737.
El Ghoul, Sadok, Omrane Guedhami, Chuck C. Y. Kwok, and Dev R. Mishra, 2011, Does corporate social responsibility affect the cost of capital? *Journal of Banking and Finance* 35, 2388-2406.
El Ghoul, Sadok, Omrane Guedhami, Hakkon Kim, and Kwangwoo Park, 2014, Corporate environmental responsibility and the cost of capital: International evidence, Working Paper, University of South Carolina, and University of Alberta, and Korea Advanced Institute of Science and Technology.
Environmental Protection Agency, 1996, Valuing Potential Environmental Liability for Managerial Decision-making: A Review of Available Techniques, United States Environmental Protection Agency, Office of Pollution Prevention and Toxic, Washington.
Fama, Eugene F., and James D. MacBeth, 1973, Risk, return, and equilibrium: Empirical tests, *Journal of Political Economy* 81, 607-636.
Flammer, Caroline, 2013, Corporate social responsibility and shareholder reaction: The environmental awareness of investors, *Academy of Management Journal* 56, 758-781.
Faulkender, Michael, and Mitchell A. Petersen, 2006, Does the source of capital affect capital structure? *Review of Financial Studies* 19, 45-79.
Frank, Murray Z, and Vidhan K Goyal, 2003, Testing the pecking order theory of capital structure, *Journal of financial economics* 67, 217-248.
Frank, Murray Z., and Vidhan K. Goyal, 2009, Capital structure decisions: Which factors are reliably important? *Financial Management* 38, 1-37.
Gao, Feng, Ling Lei Lisic, and Ivy Xiying Zhang, 2014, Commitment to social good and insider trading, *Journal of Accounting and Economics* 57, 149-175.
Garriga, Elisabet, and Domènec Melé, 2004, Corporate social responsibility theories: Mapping the territory, *Journal of Business Ethics* 53, 51-71.
Graham, John R., 1996, Proxies for the corporate marginal tax rate, *Journal of Financial Economics* 42, 187-221.
Graham, John R., 2000, How big are the tax benefits of debt? *Journal of Finance* 55, 1901-1941.
Graham, John R., and Alan L. Tucker, 2006, Tax shelters and corporate debt policy, *Journal of Financial Economics* 81, 563-594.
Graham, John R., and Campbell R. Harvey, 2001, The theory and practice of corporate finance: Evidence from the field, *Journal of Financial Economics* 60, 187-243.
Graham, John R, Mark H Lang, and Douglas A Shackelford, 2004, Employee stock options, corporate taxes, and debt policy, *Journal of Finance* 59, 1585-1618.

Graham, John R., Michael L. Lemmon, and James S. Schallheim, 1998, Debt, leases, taxes, and the endogeneity of corporate tax status, *Journal of Finance* 53, 131-162.

Godfrey, Paul C., 2005, The relationship between corporate philanthropy and shareholder wealth: A risk management perspective, *Academy of Management Review* 30, 777-798.

Gormley, Todd A, and David A Matsa, 2011, Growing out of trouble? Corporate responses to liability risk, *Review of Financial Studies* 24, 2781-2821.

Guenster, Nadja, Rob Bauer, Jeroen Derwall, and Kees Koedijk, 2011, The economic value of corporate eco-efficiency, *European Financial Management* 17, 679-704.

Harris, Milton, and Artur Raviv, 1991, The theory of capital structure, *Journal of Finance* 46, 297-355.

Hadlock, Charles J., and Ramana Sonti, 2012, Financial strength and product market competition: Evidence from asbestos litigation, *Journal of Financial and Quantitative Analysis* 47, 179-211.

Hasan, Iftekhar, Chun Keung Hoi, Qiang Wu, and Hao Zhang, 2014, Beauty is in the eye of the beholder: The effect of corporate tax avoidance on the cost of bank loans, *Journal of Financial Economics* 113, 109-130.

Hoi, Chun Keung, Qiang Wu, and Hao Zhang, 2013, Is corporate social responsibility (CSR) associated with tax avoidance? Evidence from irresponsible CSR activities, *The Accounting Review* 88, 2025-2059.

Houston, Joel, and Christopher James, 1996, Bank information monopolies and the mix of private and public debt claims, *Journal of Finance* 51, 1863-1889.

Hughes, K. E., II, 2000, The value relevance of nonfinancial measures of air pollution in the electric utility industry, *The Accounting Review* 75, 209-228.

Jones, Thomas M., 1995, Instrumental stakeholder theory: A synthesis of ethics and economics, *Academy of Management Review* 20, 404-437.

Klasa, Sandy, Hernán Ortiz-Molina, Matthew A Serfling, and Shweta Srinivasan, 2014, Protection of trade secrets and capital structure decisions, Working Paper, University of Arizona and University of British Columbia.

Kim, Yongtae, Myung Seok Park, and Benson Wier, 2012, Is earnings quality associated with corporate social responsibility? *The Accounting Review* 87, 761-796.

Lee, Christine, and Chiara, Trabucchi, 2008, Preliminary summary of financial accounting standards for environmental liabilities, intangible assets and climate change, IEC Report.

Li, Yue, Dan Simunic, and Minlei Ye, 2014, Corporate environmental risk exposure and audit fees, Working Paper, University of Toronto and University of British Columbia.

Li, Yue, Gus De Franco, and Yibin Zhou, 2013, Corporate environmental risk exposure and analyst behavior, Working Paper, University of Toronto and University of Texas at Dallas.

Lys, Thomas, James P. Naughton, and Clare Wang, 2015, Signaling through corporate accountability reporting, *Journal of Accounting and Economics* 60, 56-72.

Maksimovic, Vojislav, and Sheridan Titman, 1991, Financial policy and reputation for product quality, *Review of Financial Studies* 4, 175-200.

McWilliams, Abagail, and Donald Siegel, 2000, Corporate social responsibility and financial performance: Correlation or misspecification? *Strategic Management Journal* 21, 603-609.

Mehran, Hamid, and Stavros Peristiani, 2010, Financial visibility and the decision to go private, *Review of Financial Studies* 23, 519-547.

Miller, Gregory S, 2006, The press as a watchdog for accounting fraud, *Journal of Accounting Research* 44, 1001-1033.

Orlitzky, Marc, Frank L Schmidt, and Sara L Rynes, 2003, Corporate social and financial performance: A meta-analysis, *Organization studies* 24, 403-441.

Rajan, Raghuram G., and Luigi Zingales, 1995, What do we know about capital structure? Some evidence from international data, *Journal of Finance* 50, 1421–1460.

Renneboog, Luc, Jenke Ter Horst and Chendi Zhang, 2008a. Socially responsible investments: Institutional aspects, performance, and investor behavior, *Journal of Banking and Finance* 32, 1723-1742.

Renneboog, Luc, Jenke Ter Horst and Chendi Zhang, 2008b. The price of ethics and stakeholder governance: The performance of socially responsible mutual funds, *Journal of Corporate Finance* 14, 302-322.

Roberts, R. 1995. Remarks of Richard Y. Roberts, Commissioner U.S. Securities and Exchange Commission, Washington D.C.: Environmental liability disclosure update. Critical Environmental Issues for Corporate Counsel Conference, New Jersey Institute for Continuing Legal Education, New Brunswick, NJ, May 5.

Rogers, C.G., 2005. Financial reporting of environmental liabilities and risks after Sarbanes-Oxley. John Wiley & Sons.

Schallheim, James, and Kyle Wells, 2006, Are firms really under-levered? Working Paper, University of Utah.

Schneider, Thomas E., 2011, Is environmental performance a determinant of bond pricing? Evidence from the U.S. pulp and paper and chemical industries, *Contemporary Accounting Research* 28, 1537-1561.

Shivdasani, Anil, and Irina Stefanescu, 2010, How do pensions affect corporate capital structure decisions? *Review of Financial Studies* 23, 1287-1323.

Strebulaev, Ilya A, and Baozhong Yang, 2013, The mystery of zero-leverage firms, *Journal of Financial Economics* 109, 1-23.

Titman, Sheridan, 1984. The effect of capital structure on a firm's liquidation decision, *Journal of Financial Economics* 13, 137-151.

White, Michelle J., 2002, Why the asbestos genie won't stay in the bankruptcy bottle, *Univ Cincinnati Law Review* 70, 1319-1340.

Table I Summary statistics

The sample consists of firm-years jointly covered in Compustat and the TRI program between 1992 and 2013. *Raw Waste* is the amount of chemicals generated in a given year. *Weighted Waste* is obtained by multiplying the mass of each chemical by its toxicity. *EnvLiab* is *Ln*(1 + *Weighted Waste*)/*Sales*. *Leverage* is the ratio of total debt over total assets. *BD/D* is the amount of bank debt divided by total debt. *Sales* is net sales. *Assets* is the book value of total assets. *Firm Age* is the number of years elapsed since a firm enters the CRSP database. *M/B* is the market-to-book ratio defined as (*Assets* + Market value of equity - Book value of equity)/*Assets*. *EBITDA/Assets* is earnings before interest, taxes, depreciation and amortization scaled by *Assets*. *PPE/Assets* is net Property, Plant, and Equipment (*PPE*) scaled by *Assets*. *R&D/Assets* is R&D expenses scaled by *Assets*. *RNDD* is a dummy variable that equals one if R&D expenses are missing, and zero otherwise. *Dividend Payer* is a dummy variable that equals one if company paid dividends, and zero otherwise. Z-*score* is (3.3 × pretax income + *Sales* + 1.4 × retained earnings + 1.2 × (current assets − current liabilities))/*Assets*. *σ*(*Earnings*) is the historical standard deviation (using available data during the previous 5 years) of the ratio of *EBITDA/Assets*. *MTR* is the simulated marginal tax rate after interest expenses obtained from John Graham's Web site. *Debt Rating* is a dummy variable equal to one if the firm has a debt rating assigned by Standard & Poor's and zero otherwise. *NbrAnal* is the maximum number of analysts making annual earnings forecast any month over a 3-month period. Dollar values are converted into 2005 constant dollars using the GDP deflator. Q1 and Q3 stand for the 25^{th} and 75^{th} percentiles of the distribution, respectively. All variables are winsorized at the top and bottom 1% of their distributions.

Variables	Mean	Standard Deviation	Q1	Median	Q3
Raw Waste (*million pounds*)	13.63	49.82	0.047	0.398	3.602
Weighted Waste (*millions*)	43261.9	187092.5	4.485	378.8	10192.3
EnvLiab	0.063	0.175	0.004	0.015	0.048
Leverage	0.255	0.172	0.128	0.245	0.359
BD/D	0.184	0.316	0.000	0.000	0.238
Assets(*$millions*)	5721.4	13975.3	292.3	1044.3	4176.2
Ln(*Assets*)	7.013	1.906	5.681	6.952	8.337
Firm Age (*years*)	26.40	20.13	10.00	22.00	37.00
M/B	1.660	0.869	1.121	1.399	1.890
EBITDA/Assets.	0.089	0.083	0.051	0.090	0.133
PPE/Assets	0.324	0.180	0.185	0.287	0.429
R&D/Assets	0.024	0.036	0.000	0.009	0.031
RNDD	0.355	0.478	0.000	0.000	1.000
Dividend Payer	0.590	0.492	0.000	1.000	1.000
Z-score	1.987	1.099	1.401	2.034	2.662
σ(*Earnings*)	0.049	0.047	0.020	0.035	0.060
MTR	0.312	0.085	0.329	0.350	0.351
Debt Rating	0.509	0.500	0.000	1.000	1.000
NbrAnal	7.218	7.137	1.500	5.000	11.00

Table II The effect of environmental liabilities on financial leverage

The sample consists of firm-years jointly covered in Compustat and the TRI program between 1992 and 2013. The dependent variable, *Leverage*, is the ratio of total debt over total assets. *EnvLiab* is *Ln*(1+*Weighted Waste*)/*Sales*. *Weighted Waste* is in millions and obtained by multiplying the mass of each chemical by its toxicity. *Sales* is net sales. *Assets* is the book value of total assets. Other explanatory variables are defined in the legend of Table I. All explanatory variables are lagged one period relative to the dependent variable. Constant terms are included in all regressions but their coefficients are not reported. In column (1), year and two-digit SIC industry fixed effects are included in the regression. Column (2) reports the results obtained using the Fama-MacBeth (1973) procedure. Column (3) includes both year and firm fixed effects. In column (4), the dependent variable (*Leverage_M*) is computed as total debt divided by the quasi-market value of assets (total assets minus book value of equity plus market value of equity). The *t*-statistics in parentheses are calculated from the Huber/White/Sandwich heteroskedastic consistent errors, which are also corrected for correlation across observations for a given firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Dependent Variable:	*Leverage*	*Leverage*	*Leverage*	*Leverage_M*
	Industry Fixed Effects	Fama-MacBeth	Firm Fixed Effects	Industry Fixed Effects
EnvLiab	-0.109***	-0.125***	-0.107***	-0.077***
	(-5.4)	(-11.9)	(-3.8)	(-4.2)
Ln(*Assets*)	-0.005	-0.006***	0.019***	-0.002
	(-1.5)	(-5.2)	(3.7)	(-1.0)
Ln(*Firm Age*)	-0.008***	-0.007***	-0.003	-0.008***
	(-2.7)	(-3.7)	(-0.7)	(-3.6)
M/B	-0.022***	-0.016***	-0.015***	-0.051***
	(-6.5)	(-3.5)	(-4.9)	(-20.5)
EBITDA/Assets	0.330***	0.347***	0.130***	0.128***
	(6.4)	(10.7)	(2.6)	(3.5)
PPE/Assets	0.034*	0.037***	0.069**	0.039**
	(1.7)	(4.4)	(2.4)	(2.5)
R&D/Assets	-0.665***	-0.627***	-0.084	-0.506***
	(-7.2)	(-13.5)	(-0.6)	(-7.7)
RNDD	0.023***	0.025***	0.001	0.030***
	(3.1)	(11.0)	(0.1)	(5.0)
Dividend Payer	-0.030***	-0.029***	0.006	-0.033***
	(-4.9)	(-10.0)	(0.9)	(-6.7)
Z-score	-0.067***	-0.069***	-0.057***	-0.043***
	(-13.6)	(-20.1)	(-9.6)	(-12.2)
σ(*Earnings*)	-0.023	-0.099**	0.070	-0.010
	(-0.4)	(-2.4)	(1.2)	(-0.2)
MTR	0.023	0.029	0.004	0.032*
	(1.0)	(1.3)	(0.2)	(1.7)
Debt Rating	0.080***	0.075***	0.038***	0.053***
	(10.2)	(31.2)	(4.5)	(9.0)
NbrAnal	-0.001***	-0.001*	-0.002***	-0.002***
	(-2.8)	(-2.0)	(-3.7)	(-3.7)
N	18,070	18,070	18,070	18,033
R^2	0.33	0.29	0.70	0.42

Table III Tests for endogeneity

The sample consists of firm-years jointly covered in Compustat and the TRI program between 1992 and 2013. The dependent variable, *Leverage*, is the ratio of total debt over total assets. *EnvLiab* is *Ln*(1+*Weighted Waste*)/*Sales*. *Weighted Waste* is obtained by multiplying the mass of each chemical by its toxicity. *PastDebt* is the sum of debt issues over the past three years divided by *Assets* at *t-1*. *Prevention* is the toxicity-weighted and log-transformed amount of waste reduced by pollution prevention activities scaled by *Sales*. Other variable definitions are in the legend of Table I. All explanatory variables are lagged one period relative to the dependent variable. Constant terms, year fixed effects, and two-digit SIC industry fixed effects are included in all regressions but their coefficients are not reported. In column (1) we add past debt issues and pollution prevention activities as additional controls. Column (2) uses $EnvLiab_{t-3}$ as the key independent variable. Column (3) reports the second stage of the 2SLS regression. The *t*-statistics in parentheses are calculated from the Huber/White/Sandwich heteroskedastic consistent errors, which are also corrected for correlation across observations for a given firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)
Dependent Variable:		*Leverage*	
$EnvLiab_{t-1}$	-0.067***		-0.118**
	(-3.3)		(-2.1)
PastDebt	0.058***		
	(10.2)		
Prevention	-0.114***		
	(-4.2)		
$EnvLiab_{t-3}$		-0.091***	
		(-4.4)	
Ln(*Assets*)	-0.006**	-0.005	-0.007
	(-2.0)	(-1.5)	(-1.5)
Ln(*Firm Age*)	-0.006*	-0.010***	-0.009***
	(-1.8)	(-2.9)	(-2.9)
M/B	-0.021***	-0.020***	-0.023***
	(-6.3)	(-5.4)	(-5.7)
EBITDA/Assets	0.334***	0.352***	0.311***
	(6.6)	(6.3)	(5.7)
PPE/Assets	0.051***	0.022	0.010
	(2.6)	(1.0)	(0.5)
R&D/Assets	-0.591***	-0.654***	-0.645***
	(-6.5)	(-6.2)	(-7.0)
RNDD	0.023***	0.023***	0.021***
	(3.1)	(2.9)	(2.8)
Dividend Payer	-0.030***	-0.028***	-0.031***
	(-5.0)	(-4.3)	(-5.0)
Z-score	-0.063***	-0.066***	-0.064***
	(-13.1)	(-12.3)	(-11.7)
σ(*Earnings*)	-0.181***	-0.016	-0.068
	(-3.3)	(-0.3)	(-1.2)
MTR	0.002	0.025	0.022
	(0.1)	(1.0)	(0.9)
Debt Rating	0.080***	0.080***	0.082***
	(10.5)	(9.5)	(10.3)
NbrAnal	-0.002***	-0.001**	-0.001**
	(-3.1)	(-2.0)	(-2.1)
N	17,412	15,227	18,068
R^2	0.36	0.33	0.32

Table IV Alternative measures of environmental liabilities

The dependent variable *Leverage* is the ratio of total debt over total assets. *EnvLiab_Release* is the toxicity-weighted and log-transformed amount of releases scaled by sales. $\sum_{j=1}^{549}\beta_j Waste_j$ is computed by summing up $\beta_j Waste_j$ where $Waste_j$ is the amount of chemical *j* (in pounds) deflated by *Sales* and β_j is estimated using equation (2) for chemical *j* that a firm reports. *EnvLiab_ECHO* is the summation of penalties, compliance cost, recovery cost, and supplemental project cost scaled by *Sales*. *EnvLiab_KLD* is defined as the total environmental concerns divided by the number of concerns in that year. *EnvLiab_Newsweek* is computed based on the green scores retrieved from Newsweek's website. *EnvLiab_Asset4* is the environmental score extracted from Thomson Reuters Asset4 database. *EnvLiab_Trucost* is the environmental cost from the Trucost database. Other variable definitions are defined in the legend of Table I. All explanatory variables are lagged one period relative to the dependent variable. Constant terms, year fixed effects, and two-digit SIC industry fixed effects are included in all regressions but their coefficients are not reported. The *t*-statistics in parentheses are calculated from the Huber/White/Sandwich heteroskedastic consistent errors, which are also corrected for correlation across observations for a given firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent Variable:				*Leverage*			
EnvLiab_Release	-0.126***						
	(-5.1)						
$\sum_{j=1}^{549}\beta_j Waste_j$		-0.093**					
		(-2.1)					
EnvLiab_ECHO			-1.429***				
			(-2.81)				
EnvLiab_KLD				-0.094***			
				(-5.4)			
EnvLiab_Newsweek					-0.089*		
					(-1.9)		
EnvLiab_Asset4						-0.035***	
						(-2.6)	
EnvLiab_Trucost							-0.126**
							(-2.2)
Ln(*Assets*)	-0.004	0.002	-0.002	0.025***	-0.011*	0.012**	0.000
	(-1.4)	(0.7)	(-0.45)	(9.6)	(-1.8)	(2.1)	(0.0)
Ln(*Firm Age*)	-0.008***	-0.009***	-0.017***	-0.013***	-0.007	-0.010*	-0.011**
	(-2.7)	(-3.0)	(-3.17)	(-4.8)	(-1.1)	(-1.7)	(-2.0)
M/B	-0.022***	-0.026***	-0.019**	-0.007***	-0.012*	0.004	-0.003
	(-6.6)	(-7.7)	(-2.38)	(-4.0)	(-1.7)	(1.2)	(-0.6)
EBITDA/Assets	0.334***	0.367***	0.338***	0.111***	0.497***	-0.112*	0.373***
	(6.5)	(6.8)	(3.32)	(3.6)	(4.8)	(-1.8)	(4.8)
PPE/Assets	0.035*	0.036*	-0.013	0.135***	0.186***	0.171***	0.160***
	(1.8)	(1.8)	(-0.37)	(8.6)	(6.0)	(5.5)	(5.2)
R&D/Assets	-0.668***	-0.642***	-0.585***	-0.232***	-0.652***	-0.398***	-0.513***
	(-7.3)	(-6.8)	(-2.59)	(-5.0)	(-3.8)	(-3.7)	(-3.3)
RNDD	0.023***	0.023***	0.035***	0.033***	-0.006	0.034**	0.026*
	(3.0)	(3.0)	(2.92)	(5.1)	(-0.4)	(2.4)	(1.8)
Dividend Payer	-0.030***	-0.033***	-0.020*	-0.020***	-0.032**	-0.015	-0.028**
	(-4.9)	(-5.3)	(-1.80)	(-3.8)	(-2.2)	(-1.5)	(-2.6)
Z-score	-0.066***	-0.062***	-0.061***	-0.027***	-0.055***	-0.005	-0.057***
	(-13.6)	(-13.3)	(-7.18)	(-9.4)	(-8.7)	(-1.4)	(-9.2)
σ(*Earnings*)	-0.032	-0.058	0.115	-0.073***	-0.413***	-0.059	-0.238**
	(-0.6)	(-1.1)	(0.77)	(-2.9)	(-3.0)	(-0.9)	(-2.4)
MTR	0.022	0.025	0.033	-0.080***	-0.135*	-0.111***	-0.075*
	(1.0)	(1.1)	(0.67)	(-3.6)	(-1.9)	(-2.9)	(-2.0)
Debt Rating	0.079***	0.078***	0.066***	0.093***	0.094***	0.084***	0.094***
	(10.2)	(10.1)	(4.83)	(15.0)	(5.3)	(6.3)	(6.7)
NbrAnal	-0.001***	-0.002***	-0.000	-0.004***	-0.003***	-0.003***	-0.003***
	(-2.8)	(-3.4)	(-0.48)	(-9.1)	(-2.8)	(-3.1)	(-3.8)
N	18,070	17,949	2,890	23,163	1,680	6,097	6,070
R^2	0.33	0.33	0.30	0.38	0.42	0.37	0.40

Table V Variations in the effect of environmental liabilities on financial leverage

The sample consists of firm-years jointly covered in Compustat and the TRI program between 1992 and 2013. The dependent variable (*Leverage*) and control variables are defined in the legend of Table I. *PriCus* is the fraction of sales to all principal customers. *ComCon* is formed by summing up the KLD ratings on community concerns. *ComConDum* is a dummy variable that equals one if *ComCon* is missing, and zero otherwise. *Post_FIN47* is a dummy variable that equals one if the observation is in 2005 or later, and zero otherwise. All explanatory variables are lagged one period relative to the dependent variable. In columns (1)-(4), constant terms, year fixed effects, and two-digit SIC industry fixed effects are included in all regressions but their coefficients are not reported. Column (5) does not include year fixed effects. The *t*-statistics in parentheses are calculated from the Huber/White/Sandwich heteroskedastic consistent errors, which are also corrected for correlation across observations for a given firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Dependent Variable: *Leverage*	(1)	(2)	(3)	(4)	(5)
EnvLiab	0.033	-0.096***	-0.094***	-0.110***	-0.092***
	(0.5)	(-4.7)	(-4.2)	(-5.4)	(-4.1)
EnvLiab × *Ln*(*Assets*)	-0.050**				
	(-2.5)				
EnvLiab × *NbrAnal*		-0.025**			
		(-2.1)			
EnvLiab × *PriCus*			-0.075*		
			(-2.0)		
EnvLiab × *ComCon*				-1.059**	
				(-2.2)	
EnvLiab × *Post_FIN47*					-0.084***
					(-2.9)
Ln(*Assets*)	-0.006*	-0.005*	-0.005	-0.004	-0.006**
	(-1.8)	(-1.7)	(-1.5)	(-1.3)	(-2.0)
Ln(*Firm Age*)	-0.008***	-0.009***	-0.008***	-0.007**	-0.009***
	(-2.7)	(-2.9)	(-2.6)	(-2.3)	(-2.9)
M/B	-0.021***	-0.020***	-0.021***	-0.021***	-0.021***
	(-6.5)	(-6.1)	(-6.3)	(-6.3)	(-6.4)
EBITDA/Assets	0.323***	0.320***	0.330***	0.328***	0.356***
	(6.3)	(6.2)	(6.4)	(6.4)	(6.9)
PPE/Assets	0.034*	0.035*	0.036*	0.034*	0.042**
	(1.7)	(1.7)	(1.8)	(1.7)	(2.1)
R&D/Assets	-0.649***	-0.648***	-0.676***	-0.669***	-0.655***
	(-7.1)	(-7.0)	(-7.4)	(-7.3)	(-7.1)
RNDD	0.023***	0.023***	0.022***	0.022***	0.024***
	(3.1)	(3.1)	(3.0)	(3.0)	(3.2)
Dividend Payer	-0.030***	-0.030***	-0.030***	-0.029***	-0.028***
	(-4.9)	(-4.9)	(-4.9)	(-4.7)	(-4.6)
Z-score	-0.068***	-0.067***	-0.067***	-0.066***	-0.068***
	(-13.6)	(-13.6)	(-13.6)	(-13.5)	(-13.7)
σ(*Earnings*)	-0.024	-0.019	-0.020	-0.022	-0.019
	(-0.4)	(-0.3)	(-0.4)	(-0.4)	(-0.4)
MTR	0.025	0.023	0.025	0.023	0.031
	(1.1)	(1.0)	(1.1)	(1.0)	(1.3)
Debt Rating	0.077***	0.078***	0.079***	0.080***	0.078***
	(10.0)	(10.1)	(10.2)	(10.3)	(10.0)
NbrAnal	-0.001***	-0.001**	-0.001***	-0.001**	-0.001**
	(-2.9)	(-2.3)	(-2.7)	(-2.2)	(-2.3)
PriCus			-0.001		
			(-0.1)		
ComCon				-0.007	
				(-0.9)	
ComConDum				0.015***	
				(2.6)	
Post_FIN47					-0.040***
					(-8.5)
N	18,070	18,070	18,070	18,070	18,070
R^2	0.33	0.33	0.33	0.33	0.32

Table VI Effect of environmental liabilities on the use of bank debt

The sample consists of firm-years jointly covered in Compustat and the TRI program between 1992 and 2013. *BD/D* is the amount of bank debt divided by total debt. *EnvLiab* is *Ln*(1 + *Weighted Waste*)/*Sales*. *Weighted Waste* is obtained by multiplying the mass of each chemical by its toxicity. Other variable definitions are in the legend of Table I. All explanatory variables are lagged one period relative to the dependent variable. Constant terms, year fixed effects, and two-digit SIC industry fixed effects are included in all regressions but their coefficients are not reported. The *t*-statistics in parentheses are calculated from the Huber/White/Sandwich heteroskedastic consistent errors, which are also corrected for correlation across observations for a given firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Dependent Variable: *BD/D*	(1) Industry Fixed Effects	(2) Fama-MacBeth	(3) Firm Fixed Effects	(4) 2nd stage of 2SLS
EnvLiab	-0.219***	-0.155***	-0.314***	-0.170*
	(-6.8)	(-5.8)	(-4.4)	(-2.0)
Leverage	-0.055*	-0.035	-0.109***	-0.045
	(-1.7)	(-1.3)	(-2.7)	(-1.3)
Ln(*Assets*)	-0.047***	-0.036***	-0.047***	-0.044***
	(-8.0)	(-4.8)	(-4.1)	(-6.0)
Ln(*Firm Age*)	-0.009*	-0.025***	0.044***	-0.010*
	(-1.8)	(-5.5)	(3.4)	(-1.9)
M/B	-0.002	-0.008	0.020***	-0.004
	(-0.3)	(-1.4)	(3.0)	(-0.5)
EBITDA/Assets	0.124	0.262***	0.015	0.129
	(1.6)	(3.7)	(0.2)	(1.6)
PPE/Assets	0.043	0.012	0.012	0.037
	(1.3)	(0.8)	(0.2)	(1.1)
R&D/Assets	-0.612***	-0.546***	0.119	-0.596***
	(-4.0)	(-5.3)	(0.4)	(-3.9)
RNDD	0.001	0.004	0.023	0.000
	(0.1)	(0.6)	(1.0)	(0.0)
Dividend Payer	-0.025**	-0.029***	-0.019	-0.026**
	(-2.2)	(-4.2)	(-1.2)	(-2.3)
Z-score	-0.020***	-0.014***	-0.033***	-0.017**
	(-2.7)	(-4.3)	(-3.0)	(-2.0)
σ(*Earnings*)	-0.013	0.117	0.063	-0.035
	(-0.1)	(1.3)	(0.5)	(-0.3)
MTR	0.061	0.056**	0.026	0.060
	(1.4)	(2.6)	(0.7)	(1.4)
Debt Rating	-0.066***	-0.085***	-0.043**	-0.067***
	(-4.6)	(-6.0)	(-2.2)	(-4.7)
NbrAnal	-0.001	-0.004***	0.004***	-0.001
	(-0.6)	(-6.1)	(3.0)	(-0.7)
N	14,831	14,831	14,831	14,829
R^2	0.33	0.07	0.59	0.33