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CHANGING CONTRACTS: THE IMPACT OF LENDER ENVIRONMENTAL LIABILITY ON SECURED DEBT, CORPORATE FINANCING AND PUBLIC POLICY

by

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Submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy

at

Dalhousie University
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FACULTY OF GRADUATE STUDIES

The undersigned hereby certify that they have read and recommend to the Faculty of

Graduate Studies for acceptance a thesis entitled "Changing Contracts: The Impact of

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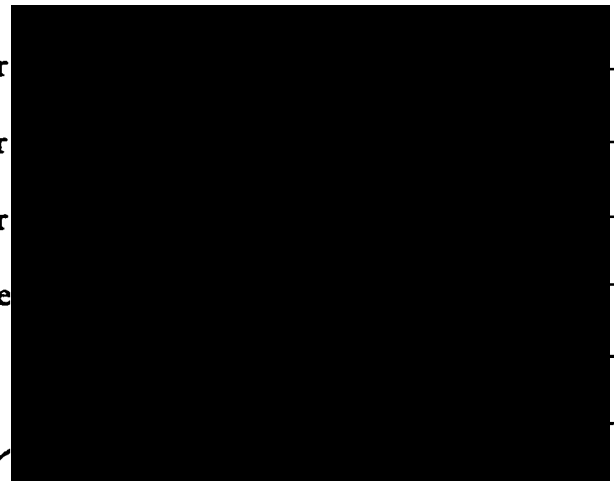
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Patricia A. McGraw

DEDICATION

This dissertation is dedicated in memory of my father, William J. McGraw, and my father-in-law, Norton F. Alcock.

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Abstract

Options theory is used to define the nature of the borrower-lender contract and to demonstrate that the existence of lender environmental liability fundamentally alters the risk-sharing for a bank lender with a secured debt contract. In the event of bankruptcy, some courts have passed environmental costs from the government to the secured lender by removing the liability limits inherent in the lending contract while continuing to allow the company's shareholders to retain their limited liability. Stulz and Johnson's (1985) model of secured debt is extended and the mathematical model of Lai (1995) is used to treat the process as the transfer of a guarantee from the government to the lender and to demonstrate that secured debt can be worth less than unsecured debt. The incentives created for borrowers, lenders and regulators are examined for their effects on capital markets.

Abbreviations and Glossary

American option: an option contract which can be exercised on or before its expiry date

call option: a contract which gives the holder the right, but not the obligation, to purchase a specified amount of an asset or security at a specified price on or before a specified time

CERCLA: Comprehensive Environmental Response, Compensation and Liability Act

EPA: Environmental Protection Agency

European option: an option contract which can only be exercised on its expiry date

holding a share long: ownership of a share by an investor; it indicates that the owner is exposed to price decreases and increases with respect to that share

in the money: a term describing an option contract on which the investor would gain should the contract be exercised

lien: a security interest in a property which gives the holder the right to possess the property until a debt is discharged

moral hazard: an additional loss faced by an insurer when the provision of insurance causes the insured to take additional risks

NWP: Northern Wood Preservers

OEPA: Ontario Environmental Protection Act

out of the money: a term describing an option contract on which the investor would lose should the contract be exercised

PRP: potentially responsible party under CERCLA

put option: a contract which gives the holder the right, but not the obligation, to sell a specified amount of an asset or security at a specified price on or before a specified time

RNVR: risk neutral valuation relationship

strict liability: the responsibility of an injurer to reimburse the injured regardless
                       of whether or not negligence on the part or the injurer can be
                       proven in law

Acknowledgements

I. Introduction

Lender environmental liability is a phenomenon which has been developing in Canada and in the United States since the 1980s, and which is in the early stages in the United Kingdom. Lender environmental liability arises when a secured borrower becomes bankrupt and the courts determine that lenders and sometimes receivers are obligated to pay for some of the costs related to environmental pollution created by the borrower. The legal treatment is still evolving, but the finding of lender liability in law so far centers around control and the ability of a lender to influence a borrower's environmental policies. The cases have involved private lending agreements rather than public debt such as bond issues and secured debt rather than unsecured debt.

The problem is primarily a question of contract law and it is driven by the fact that the ability to contract and the types of contracting permitted constitute the basis of North American legal and market systems. The exchange of goods and services in a market-based economic system is dependent on the participants having a clear understanding of the laws governing transactions.

The issue is complex because there are three main parties to the contract: the lender, the borrower and a participant who is usually unacknowledged, the government. With these three participants, the problem is interdisciplinary and touches on the areas of law, economics, finance, and public policy.

Secured debt is the primary vehicle through which lenders may attract lender environmental liability. Financial institutions act as intermediaries in a market-based economic system by channelling capital from savers to borrowers. Debt for which a borrower provides security is an important feature of the North American market system since it permits lenders to lower the risk inherent in the lending contract. The taking of security is an integral part of the risk analysis conducted by a lender, and if the liability under a lending contract is unclear, then the lender is unable to evaluate the risk and therefore unable to price it.

For its part, the borrower is looking to a financial intermediary to provide capital on terms and conditions which allow it to earn a return. While providing security may not be a borrower's first choice, secured debt is one option in the range of financing available to it. If lenders are unable or unwilling to provide capital to a firm on a secured basis, then the number of capital structure choices of the firm is reduced. The allocative function of financial intermediaries means that some firms will not obtain bank funding if the potential for lender environmental liability exists..

Public policy issues arise because regulators set the rules for firms and financial intermediaries and are responsible for monitoring compliance. When there is a market failure and a firm becomes bankrupt, environmental hazards which remain may be an issue of public health and safety and thus the government may be required to pay for the clean-up costs. The evolution of public policy with respect to environmental clean-ups therefore can

be viewed as a process of establishing liability for environmental clean-ups, as pollution prevention through regulatory incentives and as a process of establishing the incentives needed to foster economic growth and allow for an orderly market system while protecting the public interest.

Setting up incentives is particularly complicated for the regulators because the goals of economic growth and the goals of environmental policy are not always the same, and at times, may be conflicting. In addition, the monitoring conducted by regulators for compliance with environmental standards is different than the monitoring which a lender might conduct as part of the economic oversight of a borrower's operations.

One approach to the issue of lender environmental liability is to look at the system formed by government, private lenders, and companies in order to understand the risk profile for each party when a lending contract is formed. In order to do this, it is necessary to have a framework. In this thesis, the framework used is the financial theory of options as applied to lending contracts. The basic concepts of options theory as applied to lending contracts are provided in Chapter II.

Many authors have considered the firm as a complex aggregation of contracts.[1] This motif

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[1]Coase (1937:390-1) argues that a firm is established to reduce the number of contracts thereby decreasing the costs of using the market. However, Jensen and Meckling (1976: 310) state that "(c)ontractual relations are the essence of the firm, not only with employees but with suppliers, customers, creditors, etc." and go on to say that "most organizations are simply *legal fictions which serve as a nexus for a set of contracting*

is useful in the examination of financial institutions, particularly banks. By studying the nature of the contracts it is possible to put them within a system which will help us to understand and to predict the behaviour of financial institutions whose main function is the formulation and administration of contracts. Within the financial services industry, the evolution of these institutions as they respond to regulatory and legal changes provides a further insight into the financial intermediation process.

In this thesis, the options theory of finance is used as the basis for the analysis because it provides a simplification of the details of each contract and focusses attention on the broader implications of financial risk-sharing. Options theory highlights the zero-sum nature of financial contracts: the risk is **transferred**, not eliminated. Therefore, it is important to keep the position of all parties to the contract in mind when considering financial risk.

The borrower-lender contracting process is considered here as the source for the modelling of a loan. The borrower's incentives are to reduce costs and to maintain flexibility. Therefore, the borrower prefers a loan contract that contains as few options for the lender as possible. The lender, on the other hand, has the goal of minimizing the downside risk and in order to achieve this tries to include in the contract as many options as possible, options which allow for a transfer of risk, both anticipated and unanticipated, to the borrower in the event of changed circumstances. This means that collateral, as well as covenants which either (1) restrict the borrower's actions or (2) give the lender the ability

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relationships among individuals".

to act should there be adverse changes in the borrower's situation which have an impact on the lender's risk, may be required.

As a relatively recent development in capital markets, the concept of lender environmental liability is one which changes the nature of the borrower-lender contract for bank loans. Since financial institutions and other firms operate within the existing legal system, changes in the legal and regulatory processes have an impact on the contracting process thereby changing the nature and value of existing financial assets. In order to focus on financial intermediaries as entities which engage primarily in risk-transference, this thesis (1) examines the nature of a bank in terms of its contracting within the borrower-lender relationship, (2) compares it with the type of risk-transference inherent in shareholder liability, and (3) provides a model which demonstrates graphically and mathematically how the existence of lender environmental liability alters the nature of the borrower-lender contract.

Since the courts have only applied the concept of lender environmental liability to secured bank debt, this thesis concentrates on the examination of the nature of secured debt in terms of an options framework. Chapter II reviews the literature for secured debt, extends the models using options theory, and provides a graphical method of visualizing loan contracts. The terminology for discussing lending contracts in terms of options theory is developed for both unsecured and secured debt.

Chapter III introduces the concept of lender environmental liability within a legal framework and provides examples of court cases in the United States and Canada in which lender liability was found. The options framework is then used to show how the finding of lender environmental liability changes existing contracts for the lender. The graphical method allows for a visualization of the risk transfer.

Chapter IV takes a macroeconomic view of how the lending contracts fit within the legal framework in which firms, governments, and financial institutions operate. The borrower's risk profile is discussed and presented in terms of corporate financing with lender environmental liability. The legal inconsistency of having only bank lenders liable is examined by contrasting the private debt of bank lending with public debt of bond issues. The inconsistency of exempting other financial institutions such as pension funds who are issuing debt and who may also be significant shareholders from liability is also discussed. The role of government as an option writer in transferring the financial risk to the banks is examined. Finally, the existing risk profile of each of the participants is considered.

Chapter V uses the mathematics of finance to develop an options model to price lender environmental liability. Simulations are run on the model and the results presented. The model provides a method of pricing the risk and the decrease in value of a secured loan with lender environmental liability. Numerical simulations conducted on the mathematical model after Lai (1995) demonstrate that, under the conditions of lender environmental liability, secured debt for a lender becomes equal to or lower in value than unsecured debt.

The numerical simulations also indicate the sensitivity of the model to changes in variables and lead to the formulation of six testable hypotheses which form the basis of the discussion contained in Chapter VI. The opportunities for empirical testing identified from the testable hypotheses represent areas for further research which would extend our understanding of lender environmental liability.

The analysis contained in Chapters II-V leads to the conclusion, presented in Chapter VI, that establishing liability through a lending contract has consequences for the lender, the borrower, and the government. For an existing lending contract, lender environmental liability changes the nature of the contract, reducing the value of the contract to the lender and exposing the lender to additional risks. This provides incentives for lenders not to lend and also to forego the monitoring function in situations where a company's risk of exposure to environmental hazards is deemed to be unacceptably high.

From a borrower's perspective, to the extent that the nature of their business exposes them to environmental hazards, the ability to raise funds through bank borrowing may be hindered as a result of a bank's refusal to lend . In Chapter VI, several testable hypotheses are proposed which represent opportunities for further work and extensions of the theory presented herein. As lenders and borrowers become familiar with the issue of lender environmental liability, empirical data will become available to test the hypotheses and provide further support for the simulations presented at this stage of the research.

The implications for public policy are that, while the transfer of liability for environmental hazards from the government to the financial intermediary does pass the economic costs back to the market, the incentives created for a lender by the possibility of environmental liability within the lending contract have effects on behaviour which might not have been intended by the regulators.

II.   An Options Framework For Modelling Lending Contracts

In many jurisdictions, the legal system permits the writing of a loan contract which secures the debt by specific assets of the firm. This means that, in the event of bankruptcy, the secured creditor has the right to seize those assets and apply the proceeds of sale to the outstanding principal and interest on a loan. The security arrangement thus achieved allows the lender to rank ahead of other creditors. This prior ranking has implications for the choice of capital structure for a firm, and results in a different risk transference than would be achieved under unsecured debt. The following discussion presents a literature review of secured debt and a comparison of the lender's risk profiles for secured and unsecured debt.

II.1   Literature Review

Scott (1977) provided one of the first papers to discuss the use of secured debt by firms in terms of bankruptcy laws and optimal capital structure. He used a multi-period model to value equity, subordinated debt, and secured debt and concluded that a firm could increase the total value of the company by the issue of secured debt and would, in the optimal case, issue as much secured debt as possible. Part of his explanation for the value of secured debt was the contention that shareholders thereby sold a valuable right to rank ahead of other creditors in the event of bankruptcy, a right which shareholders, by law, were unable to exercise for themselves. The creation of this right by the lending contract creates an

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additional value to the asset. Scott does not use the term "option" to describe this right, but that is essentially what he was proposing.

At the time, Scott's conclusion (1977:15) that the type of debt affected the value of the firm went against the literature (Modigliani and Miller, 1958, Stiglitz, 1969) which postulated that the firm could not alter the total market value of its debt plus equity by altering its capital structure. Scott's article attracted the attention of Smith and Warner (1979a) who argued that the firm's operating income was not independent of the firm's level of secured debt. Scott had written that the issuance of secured debt reduced the amount of funds available to pay customers in the event of liability claims. Smith and Warner argued that customers would not pay as much for the product if there were no longer as much value available to meet their claims, and also that liability insurance would serve the same purpose. Smith and Warner provided their own hypothesis -- based on an economic efficiency argument -- postulating that secured debt reduced administrative costs for lenders by giving them clear title to property in the event of bankruptcy, thus preventing the borrower from engaging in asset substitution.

Smith and Warner concluded that the issuance of secured debt would be determined by a comparison of the costs and benefits. They referred the reader to Black and Scholes' (1973) paper on pricing options and Smith's (1976) review of option pricing, but only for support for the idea that a loan default was more likely if the value of the assets was more variable. Smith and Warner did not present an options framework in their paper. In a reply

to Smith and Warner, Scott (1979) discussed the fact that in an option-pricing framework, it is assumed that the generation of the firm's market value by a stochastic process is unaffected by the debt level (Scott, 1979: 256, Footnote 7), but he did not use an options framework to model the secured debt. Scott pointed out in his conclusions (1979:260) that:

> The mechanism by which optimizing firms decide whether to issue secured or unsecured debt is simple. All they need do is borrow on the best terms they find. Firms with low probabilities of failure will find the interest rate lower for unsecured debt. Firms with high probabilities of failure will find the interest rate lower for secured debt. Indeed, if usury ceilings are effective, firms with high probabilities of failure will find that the only kind of debt they can issue is secured debt.

Scott, in effect, agreed with Smith and Warner that the cost-benefit analysis of secured debt would determine its issuance. However, in the end, his justification for secured debt was unsatisfactory because he did not explain why, within the context of his model, given the value of secured debt, many large firms issue unsecured debt. Nor did he explain why secured debt is cheaper.

Smith and Warner's often-quoted paper, "On Financial Contracting: An Analysis of Bond Covenants" (1979b) discussed secured debt as lowering transactions costs in terms of the Costly Contracting Hypothesis.[2] Smith and Warner focussed on the firm's actions and the

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[2]Smith and Warner expanded on Jensen and Meckling's (1976) theory to propose the Costly Contracting Hypothesis whereby the value of the firm can be maximized by the set of financial contracts which it undertakes. In this context, even though there are costs involved for the firm in entering into debt contracts, to the extent that bondholders perform a monitoring function for the shareholders, the value of the firm can be increased.

use of bond covenants, and thus their main justification for secured debt was the reduction of potential foreclosure costs. They concluded that the Costly Contracting Hypothesis would ensure that firms with specialized assets will be less likely to use secured debt because the assets are of greater value to the firm rather than to the marketplace. They provided an options pricing framework for the firm's financial claims in an appendix, but did not include secured debt in the analysis.

Since Smith and Warner, there have been two major attempts to understand secured debt. One is from a legal perspective as presented by Schwartz (1981, 1984) and the other is in a valuation model by Stulz and Johnson (1985). Both approaches try to explain the existence of secured debt by considering the firm and its process of maximizing the return to shareholders. Thus, economic efficiency is examined by trying to explain why a firm would issue secured debt.

Schwartz (1981) reviewed existing theories on security and priorities in bankruptcy. He acknowledged that the legal constructs were well-established, but argued that financial theory lagged behind in providing explanations. Following Smith and Warner (1979a, b), he considered that short-term secured debt should be issued if it was economically efficient, that is, if the benefits exceeded the costs. His main efficiency argument against the issuance of secured debt was that the secured creditors would charge a lower interest rate while the unsecured creditors would charge a higher interest rate because in the event of bankruptcy the value of the assets available to the latter would be lower. Schwartz observed that since

the taking of security also had costs and the costs outweighed the benefits, secured debt would never be issued.[3] He considered the efficiency argument from three perspectives: monitoring costs, signalling costs, and staggering debt.

Schwartz examined the monitoring costs argument presented by Smith and Warner (1979a) in their comment on Scott (1977). Schwartz rejected this argument, primarily because the asset substitution which secured debt was postulated to control was not a problem in short-term debt and yet short-term debt, particularly for retailers, was commonly secured.

Next, Schwartz considered the signalling costs argument by which firms are expected to signal good news about their profitability, so that firms which expect to be highly profitable and therefore not limited in their actions by giving security would be more likely to issue secured debt. Firms that do not expect to be highly profitable would not want to give security because of the probability that they would be in a marginal position where the security provisions would be limiting. Schwartz postulated that since secured debt is more costly for a firm to issue, creditors would view the issue of security as a positive signal about the firm's potential profitability. He did not consider the possibility that firms with

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[3]The example provided by Schwartz assumed that $200 of new debt was secured by $100 of existing assets. If the debt were new debt secured by new assets which would generate a positive cash flow over and above the cash flow needed to service the debt, then the argument that the costs exceed the benefits would not hold. Existing creditors would be unaffected by the taking of security since their asset pool would remain the same and, to the extent that the new assets did not increase the variability of the cash flow available to service all of the debt, the existing creditors would be no worse off. If the cash flow's variability were less, then the additional cash flow available for debt service would make the existing creditors better off.

lower potential profitability might also have higher variability in cash flows, thus increasing the risk of bankruptcy and causing the lenders to require security to reduce their costs in the event of bankruptcy. He rejected the signalling hypothesis on the grounds that (1) the signal might be ambiguous, (2) the social gains might not be shown to exceed the social costs, and (3) it would be difficult to test the hypothesis empirically.

Finally, Schwartz considered the staggering of debt as a possibility. The idea here was that the firm would issue secured debt early in its lifetime when profitability was lower, thus taking advantage of lower interest costs, and issue unsecured debt later when profitability was higher and able to support higher interest rates. He rejected this argument because there were no empirical data to support the contention that firms actually issue debt in this order.

In 1984, Schwartz considered again what he called the "continuing puzzle of secured debt" (Schwartz, 1984: 1051-1069). He concluded that Levmore (1982), using monitoring and free-riding arguments, and White (1984), arguing that security is a net gain to the firm and that creditors are risk-averse, had tried to justify the existence of security on the basis of efficiency arguments, but both authors came up short. He also noted that neither Levmore nor White addressed in detail why there exists a great variety of debt instruments. Schwartz's examination of the Modigliani-Miller (MM) hypothesis also did not provide an answer because, based on the MM hypothesis, the interest on both secured and unsecured debt was deductible by firms and also taxable in the hands of debtholders. Schwartz

concluded by stating that, although secured debt exists, the reasons for this were still unknown. He argued that the answer to secured debt might be found in a difference in preferences between borrowers and lenders.

Stulz and Johnson (1985) provided an analysis of secured debt with pricing results to show the benefits of secured debt. The primary focus of the paper was on whether the existence of secured debt increased the value of the firm, which is a version of the efficiency argument used by Warner (1977) and Schwartz (1984). Stulz and Johnson considered values for secured debt and unsecured debt which were greater than or equal to zero. Note that a normal distribution would include negative values, which do not exist for debt since the limited liability or floor exists in all lending contracts. This assumption enabled Stulz and Johnson to use a lognormal distribution for the values of secured and unsecured debt. Stulz and Johnson used the following notation to model secured debt. They let A and B represent the two assets owned by the firm. A(t) and B(t) then represented the value at time t of the two assets owned by the firm; in addition,

(1) F represented the face value of debt secured by asset B(t)

(2) H represented the face value of all other debt, and

(3) T represented the maturity of all debt with no dividends or interest paid until this time.

Using these notations, Stulz and Johnson analysed two types of secured debt: junior secured debt, which was represented as DJ(T), and senior secured debt, which was

represented by DS(T). According to Stulz and Johnson, junior secured debt, DJ(T), would not participate in asset A for payment until the creditors of the other debt had been paid. The value of DJ(T) could be represented by the equation:

$$DJ(t) = \min\{B(T) + \max(A(T)-H, 0), F\}^{4}$$

Stulz and Johnson argued that senior secured debt, DS(t) would participate equally with H if B was not sufficient to pay off F at time T.

Stulz and Johnson also conceptualized an artificial asset which would pay B(T) + max {A(T)-H,0} at time T, as expressed by the equation:

$$Q(A,B,H,T-t) = B(t) + C(A,H,T-t).$$

That is to say, Q would be equal to the value of asset B plus a (European) call option, C, on asset H.[5]

Stulz and Johnson let R equal the constant interest rate per unit of time. Then, at any point in time, the value of junior secured debt, DJ(t) in terms of the artificial asset Q could be represented by the equation

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[4]Stulz and Johnson (1985:504) equation (1)

[5]Stulz and Johnson (1985:504), equation (2)

$$DJ(A,B,H,F,T-t) = Fe^{-R(T-t)}-P(Q,F,T-t).^{[6]}$$

The value of the junior secured debt would thus be equal to the value of a default-free discount bond maturing at the same time as the secured debt minus the value of a (European) put option on asset Q. The maximum payment would always be F at time of maturity, T, so that the lender would hold a put on Q which would only be exercised if B(T) was less than F. The value of the secured debt plus a put on the artificial asset, Q, would be equal to the value of a default-free bond which matured at the same time as the debt. In order for the secured debt to have the same value as the default-free bond, it would have to have had the put included.

If, in addition to the put on asset Q, the debt also had a put on asset A which ranked equally with the other existing debt, that is, the debt is senior secured debt, DS(t), then its value in terms of the artificial asset Q would be represented by the equation:

$$DS(A,B,H,F,T) = F- \max \{F - B(T)$$

$$- \{\max (F - B(T),0)/\max (F -B(T),0)+ H\}*A(T),0\}^{[7]}$$

This payoff again would be equal to the payoff from a default-free bond minus the payment on a put option. In effect, the lender would get F, or something less than F, F being the

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[6]Stulz and Johnson (1985:504), equation (3)

[7]Stulz and Johnson (1985), equation (6), 506

value of the option on asset B which would be exercised, plus the option on asset A which would be exercised only if the amount from B was not sufficient to make up the full amount of F.

The existence of other, unsecured debt, is crucial to Stulz and Johnson's analysis because from the perspective of the firm, issuing secured debt allows shareholders to sell claims to new projects which would otherwise go to existing creditors in the event of bankruptcy. In other words, from the firm's perspective, secured debt provides an option for another source of funding. Stulz and Johnson's analysis does not, however, explain what would motivate firms to provide secured debt at all if it were the first debt issue for the firm.

To answer this question, it is necessary to look at the other party to the debt contract[8], namely, the lender. An analysis of the risk profile for the lender provides insight into the borrower-lender dynamic and significantly extends Stulz and Johnson's analysis. The lender's position with respect to both unsecured and secured debt is analysed below.

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[8]Much of corporate finance theory has been focussed on understanding the different financing methods from the firm's perspective. However, in any contract, there are at least two participants, and, by understanding each side of the contracting process, it is possible to see how the risk has been allocated and for what price. Chan and Kanatas (1985:85) provide a model which shows that asymmetric valuations play a role in the contracting process. They argue that "collateral will be offered by the borrower when the lender has a lower valuation of the project, the specific amount being dependent on the size of the transactions costs associated with the use of collateral". It is possible, however, that the lender does not simply put a lower value on the project, but views the potential risk inherent in the loan contract as unacceptable and therefore will not extend funds unless its risks can be mitigated by the issuance of security. As will be shown below, the risk transference accomplished by a loan agreement is a major factor in providing differing incentives for borrowers and lenders.

Unsecured debt is considered first, then secured debt in order to demonstrate that security decreases the risk of a loan for the lender.

II.2   The Lender's Risk Profile For An Unsecured Loan

Financial institutions operate within a liability framework which determines the nature of the contracting in which they engage. A borrower-lender contract implies a specific type of risk-sharing. In the past, this type of contract was a large determinant of the function of banks in capital markets. Options theory can be used to demonstrate the nature of the debt contract from the lender's perspective and to provide an understanding of how changes in the legal environment alter the payoffs for a lender.

Options theory explains the concept of a *put* and a *call* as contracts which serve to transfer risk from one party to another. The six basic contracts which are the starting point in financial theory are: (1) holding a share long, (2) selling a share short, (3) buying a call, (4)selling a call, (5) buying a put, and, (6) selling a put. The last four contracts are known as options. In a financial context, options are <u>contracts</u> which give the holder the right, not the obligation, to buy or sell a financial asset under specified conditions of price and timing (Hull, 1991:5).

In finance, option contracts are also known as *derivative securities* because their value <u>derives from</u> the price of the underlying assets. Economic theory calls these contracts

contingent claims. A good understanding of the risks and rewards provides us with greater

insight into the nature of the risk transference which is legally inherent in the structure of

the contract.

Merton (1973) discusses the use of options theory and proposes some extensions for

valuing corporate liabilities. Merton (1974) further applies options theory to a

consideration of the impact of such factors as time to maturity, variance of the firm and firm

value on the value of corporate liabilities.

One way to illustrate the payouts on an options contract is to use Bachelier diagrams.[9]

Figure 1 shows a plot of the exposure for a lender against an investment project's cash

flows. The accompanying table shows the cash flows and the lender's payout at t=1, the

maturity date of the loan, for various levels of cash flow from the investment project .

Taxes are assumed to be zero. To simplify the analysis, the loan is conceptualized as a

discount loan of $10 million made at time t=0. No payments are assumed to be made

during the term of the loan, but a final payment of $15 million is assumed at the end of time

t=1. In Figure 1, the amount of cash flow the project will generate is arbitrarily set at $45.0

million. Transactions costs and taxes are assumed to be zero.

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[9]Bachelier, L. (1900), **Théorie de la Speculation**, Paris: Gauthier-Vilars,. Bachelier's (1900) paper has been reprinted in English in Paul H. Cootner, (1967), **The Random Character of Stock Market Prices**, Cambridge, Mass: M.I.T. Press. Bachelier diagrams represent a simple graphical method of illustrating the upper and lower bounds on the payoffs from financial contracts.

Figure 1: Lender's risk profile for an unsecured loan

Figure 1: Lender's risk profile for an unsecured loan
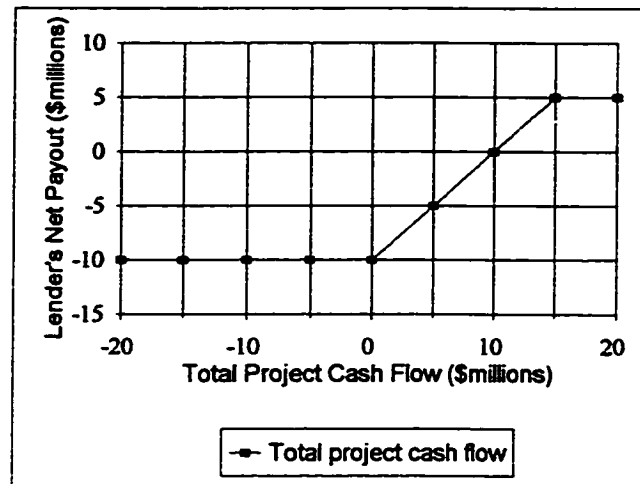
Table 1: Lender's net payout ($ millions) for an unsecured loan

Total project cash flow	-20	-15	-10	-5	0	5	10	15	20
Project cash flow to lender	0	0	0	0	0	5	10	15	15
Lender's net payout	-10	-10	-10	-10	-10	-5	0	5	5

Initial bank loan = $10,000,000
Loan repayment at maturity = $15,000,000

For the discount loan, the lender has a floor of $10 million which is the maximum amount which it can lose. The lender also has a cap of $5,000,000, which is the net cash inflow and the maximum possible profit. The lender's position is truncated at the time of maturity of the loan because there is no upside for the lender. The cash flows for the asset may continue, but the bank is taken out after the $15 million repayment of the loan.

The lender's payout plot looks much like the options pricing diagram for selling a put where the upside is capped at $5 million and the downside risk is limited only by the y-axis at -$10.0 million.

However, Figure 1 provides a modification of the standard put diagram. A horizontal line extending parallel to the negative x-axis is included to emphasize that the downside for the lender is limited to the initial amount of the loan advanced. It is characteristic of all loan contracts that the lender is not expected to take on any of the losses, but is also not able to share in any of the profits in excess of the contractual payment.

In general, Figure 1 provides a generic risk profile for a loan since the downside is limited to the amount of money advanced and the upside is limited by the contract. If the project fails to generate cash as might happen if, for example, a new technology turns out to be unfeasible, then the lender stands to lose the full loan amount if there are no other funds available from the borrower. However, if the project is successful, the lender earns back only the principal plus interest and does not participate in the additional profits.

When debt contracts are signed, then, there is an asymmetric sharing of cash flows. While the lender has a downside as does the borrower, the lender's upside is capped. The borrower has therefore sold a portion of its claim to the cash flows of an investment opportunity, in this case, $15.0 million of a project which will generate $45.0 million without selling much of the profit potential. If instead of debt, common shares had been issued to finance the investment, the existing shareholders would have had to share the total $45 million with the new shareholders who would have put in $10 million as equity.

The standard loan agreement can be viewed as a put sold by the lender and held by the borrower, as presented by Merton (1974). Since the bank has no upside the risk profile for the lender is definitely that of the writer of a put.

There are, however, several ways to combine the risk profiles to generate the required risk-sharing. If we go back to the standard definition of the ownership of a call as a right to buy and the ownership of a put as a right to sell, then it is possible to consider a loan as a lender's purchase of a cash flow (holding the company long) and the lender's sale of a call which the firm purchases and will exercise at the maturity of the debt. The combination of holding the cash flows long and selling a call generates the required risk profile for unsecured debt as presented in Figure 1.

Regardless of what combination of puts and calls is used to generate the risk profile, it is necessary to examine the benefits and costs to both parties to the contract. We see that the

lender has purchased a specified cash flow over a fixed time period with no upside while the firm has bought the call which enables it to benefit from cash flows generated beyond the debt repayment date by exercising the call. As long as the project is generating cash, the company will exercise the call and take out the bank at the end of the loan period.

It is important to note here that the lender does not own the assets but only the right to the cash flow. That is to say, a loan is in fact a derivative security whose value depends on the value of the cash flows that the borrower is able to generate to support the debt. The financial intermediation that banks provide is based on contractual rights and hence the importance of the principal-agent relationship.

Principal-agent conflict is significant for a lending contract. Once the contract is signed, the lender has no control over the risk-shifting practices or asset substitution engaged in by the borrower unless some mechanism has been written into the lending contract. Therefore, for a lender, the risk inherent in the contract has the potential to increase because of the borrower's behaviour. Smith and Warner (1979b) concentrate on the firm's side of the equation. In analysing the allocation of risk within the contract, it is important to emphasize that there are two parties to the lender-borrower agreement. The risk profile for a secured loan is now discussed in order to illustrate how security can reduce the risks from a lender's perspective.

II.3   The Lender's Risk Profile For A Secured Loan

Secured debt can be seen as the bank's buying a put on the project's assets in order to limit its downside risks. This results in a plot for the lender similar to Figure 1, but the horizontal line which marks the downside shifts upward to run along the negative x-axis. This is illustrated in Figure 2. The lender's risk profile now shows that the downside will stop at zero, assuming that the sale of the collateral in the event of default is sufficient to cover the initial loan amount.

It is important to note that the legal right of the lender to take possession of the assets is contingent on an event of default. The lender has only contracted for a specific cash flow, not for ownership of a specific asset under the lien theory which is more commonly used in Canada and in many states in the United States.[10] The exercise of the put is a true option for the bank because it will not, and cannot, legally, be exercised unless there is an event of default as defined in the loan contract. If the project generates cash flows as forecasted, then the option will expire, unexercised, with the retirement of the debt. In this case, the call held by the borrower will be in the money and the borrower will exercise it and take out the bank by paying the loan plus the interest.

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[10]Carol vanBergen (1994: 98-100) discusses the difference between the lien theory and the title theory used in some states. A lien represents only a security interest in an asset and no title transfer until the lender acts to take possession of the security. The title theory has implications for lender liability since it is assumed that the lender "owns" the asset until the loan is paid out. Ownership of the asset is more likely to result in the courts finding that a lender had control of an asset and therefore some influence on a firm's environmental policies.

Figure 2: Lender's risk profile for a secured loan

Figure 2: Lender's risk profile for a secured loan
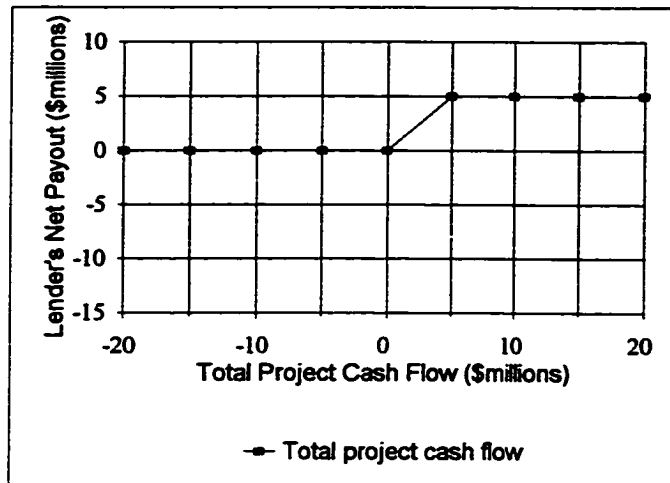
Table 2: Lender's net payout ($ millions) for a secured loan

Total project cash flow	-20	-15	-10	-5	0	5	10	15	20
Project cash flow to lender	0	0	0	0	0	5	10	15	15
Security value to lender	10	10	10	10	10	5	5	0	0
Lender's net payout	0	0	0	0	0	5	5	5	5

Initial bank loan = $10,000,000
Loan repayment at maturity = $15,000,000
Value of security = $10,000,000

In summary then, as shown above in Section II.2, for unsecured debt, the lender has bought the company long (holds the right to specific cash flows of the company), and has sold a call allowing the company to buy back the cash flows at the end of the contractual period. If the cash flows were to turn out to be negative, then the lender also holds a put, a form of limited liability, which does not allow the loss to be greater than the principal amount. With secured debt, the lender holds the cash flows long, has sold a call, and has purchased an additional put which allows it to exchange the loan for the security represented by the specified asset. Provided that the lender calculated correctly, and the asset has a net sale value equal to or greater than the loan amount, its loss will be zero and it will receive the contracted amount, $15 million. The difference between secured and unsecured debt therefore, is that with secured debt the lender has the additional put which limits its loss; that is, the floor on the profit profile is lifted from $10 million to zero in going from unsecured debt (Figure 1) to secured debt (Figure 2).

From the company's point of view, as noted previously and as mentioned by Scott (1977), the shareholders have sold an option, in this case a put, which has little value to them since they always rank last after all the other creditors. The firm has, however, reduced its options to finance with secured debt in the future. It should also have been able to contract for a lower interest rate since the debt with the put is now less risky for the lender, as seen in Figure 2. However, it is also possible that without the security, the debt would not have been available to the company at all, perhaps because the firm was too close to bankruptcy or because the lender was unfamiliar with the firm and therefore unable to assess the risk.

There are therefore two reasons why a firm might sell this put: (1) to obtain a lower interest rate, or (2) to obtain financing which would otherwise be unavailable because the lender judged the default risk to be too high without the security. In (2), if the security is easily valued and easily sold, then the secured debt could significantly lower the risk for the lender while providing a source of financing for the borrower.

If security lowers the risk for the lender, then one testable hypothesis is that secured debt should have a lower yield. The published research prior to 1984 tested this by comparing yields on bonds which were in the same bond rating category (Black and Cox, (1976); Boardman and McEnally, (1981)). The research seemed to suggest that security might actually increase the yield to maturity of debt.

An explanation for this finding was provided by Roberts and Viscione (1984, 1986). Unlike previous researchers, Roberts and Viscione's tests recognized that the rating given by a bond agency is a measure of the <u>total risk</u> of a particular bond issue as well as an assessment of the risk of the borrower. The inherent risk of a particular bond issue is dependent on the security and the covenants, that is, the options contained within the debt contract. When past researchers had compared bond issues of the same rating but with different borrowers, they achieved confusing results because they had not controlled for these two separate dimensions.

Since Roberts and Viscione postulated that the security supporting a bond issue has an impact on the bond price and bond yield, they chose pairs of bond issues <u>for the same company</u> which differed primarily in whether they were secured or unsecured. Their results showed that when a comparison is made between junior and senior bonds in which the only difference is the security, it can be demonstrated that unsecured debt requires a higher yield. This is so because the provision of collateral in support of a loan lowers the risk to the lender by providing an additional option which alters the risk profile of the contract for the lender as has been demonstrated above.

II.4 Summary Of The Options Framework

To return to the efficiency argument provided by Schwartz (1981), if secured debt is to exist, it must be economically efficient, that is, the benefits to firms who secure their debt must outweigh the costs. Schwartz's argument is, in brief, that when debt becomes secured, the secured creditor is removing the secured assets from the pool of assets available to service the unsecured debt. This act of taking security allows the secured creditor to lend at a lower rate since it prevents the borrower from substituting assets and thereby changing the riskiness of the cash flows supporting the loan. The unsecured creditor, seeing that the existing unsecured debt has become riskier because assets have been removed from the pool available for payment, will increase the rate on the unsecured debt. It might be thought that these two factors would cancel each other, and the borrower

would be no better off. However, since issuing security is costly, the borrower should be less well off and therefore a borrower would never sell secured debt (Schwartz, 1981:7). In addition, security also generates costs of registration which are borne by the borrower and it prevents the borrower from disposing of the assets without the consent of the lender.

In a negotiation process for a loan, borrowers and lenders are at two ends of a continuum, with the final contract falling somewhere between the two as shown schematically in Figure 3 below.

Figure 3:   **The negotiating process for a simple loan: borrower's flexibility versus lender's security**

borrower: unsecured debt ⇔ lender: secured debt

As a further generalization, the borrower is trying to decrease costs and maintain flexibility and in order to do this, wants as few options within the contract as possible. The lender, on the other hand, is trying to reduce its risk and does this by trying to hold as many options as possible, including security and covenants. It is these options that determine the nature of the contract and the risk from the lender's standpoint. Of course, the loan contract that results from the negotiation between the borrower and the lender can be a more complex structure of embedded options than the simple loan used above.

To summarize the borrower's position with respect to secured debt, the borrower sells an

option allowing the lender to rank higher in the pecking order in the event of bankruptcy, an option which the borrower is unable to exercise on its own behalf. Therefore, this option has little value to the borrower. At the same time, however, the borrower is also giving up the option of using that asset to obtain financing in the future. In some respects, any issue of debt reduces the borrower's future flexibility.

The lender for its part, buys the option to rank higher in the pecking order in the event of bankruptcy, thereby reducing its risk significantly. By encumbering the asset, the lender prevents the borrower from engaging in asset substitution. Stulz and Johnson (1985) do not consider the lender's side of the contracting process, and therefore they find that there is no strong support for the significant difference in secured versus unsecured lending. It is the lender's position which is greatly changed with the existence of secured debt, and whose contract is made less risky when secured debt exists.

Lender environmental liability results in a change in the standard legal definition of the liability inherent in a lending contract. The basic options model outlined above provides a framework for a discussion of the specific changes brought about in existing lending contracts by lender environmental liability.

III. Changing Contracts: Lender Environmental Liability

The legal theories regarding lender liability in general and lender environmental liability in particular have been evolving through the court systems in Canada and in the United States. The legal and economic impacts of lender environmental liability on secured loan contracts can be approached by linking the legal theories with their economic purpose.

III.1 The Legal Development Of Lender Environmental Liability

Lender liability occurs when the courts determine that a lender is liable for costs or damages over and above those contained in the original loan contract. As shown previously in Figures 1 and 2 in Chapter II, a bank lending contract has limited liability for a lender represented by the floor on the risk profile.

Cooter (1991:11) compares the objective of economics, which is reaching efficiency through incentives and risk-bearing, with the objectives of liability law, which are compensating victims, deterring injurers, and spreading risk. He links three liability rules with the economic mechanism used to enact it and the economic purpose of the mechanism. These linkages are presented as Table 3.

If the economic purpose is the internalization of costs, then the rule of strict liability can be used to achieve this. Under strict liability, the injurer who causes harm must compensate

Table 3: The relationship between liability rules, economic mechanisms, and economic purpose (after Cooter, 1991)

Liability Rule	Economic Mechanism	Economic Purpose
Strict Liability	Product Pricing	Internalization
Negligence	Standard Setting	Compliance
Property	Market Transactions	Exchange

the victim even if the injurer was not directly at fault. Firms will internalize all the costs of production, including potential damages, through the pricing of the product. In an economically efficient market, the price that consumers pay will therefore reflect the benefits they obtain from a product.

With the liability rule of negligence, a standard is set for all participants. Failure to comply with the standard may result in a legal finding of negligence. "Command-and-control" regimes which establish and enforce regulations without using market-based incentives operate through the mechanism of standard-setting.

Through the liability rule of property rights, contracts are established using the mechanisms of the market. The operation of a market removes the monitoring function from the government because exchanges through contracts act to allocate the property rights and thus the liability. The job of government is simplified in some respects by using a market mechanism, but the regulations must be written so as to incorporate the right incentives and to clearly state the rules.

Gott and Townsley (1988) examined the theories and trends in the development of lender liability. They divided lender liability into those cases stemming from "good faith" and cases arising from control.

Lender liability arising from good faith or fiduciary duty developed throughout the 1960s and 1970s in the United States. It occurred primarily through an expansion of tort law, which is mainly governed by the rule of negligence in Table 3. Actions by lenders to protect their capital can have adverse economic effects on the borrower, and these should be taken into account. If a lender has a fiduciary duty to its borrower, then a breach of this fiduciary duty should result in a lender being liable for damages. For example, if a lender cancels a borrower's line of credit without sufficient notice and if the borrower is unable to find another source of financing and subsequently goes bankrupt, then it can be argued that in acting precipitously, the lender had breached its duty of care and is partially liable for the borrower's failure.

As lender liability with respect to environmental damages has developed in the legal system, the primary source came from contracts, specifically, the loan contract. The question the court has used is the test of control: did the lender have the ability to control the borrower's actions and thus the ability to influence measures which affected the environmental impact of the borrower's activities? This falls under the category of property, or market exchanges in Table 3. From a legal standpoint, the courts have seen lender environmental liability as existing when the lender acts to realize on security when a loan

has gone into default (Requadt, 1992, vanBergen, 1994). The issue exists primarily for

secured creditors because, in theory, they are able to act to gain control of a borrower's

operations or make decisions about the disposal of assets (Tom, 1989, Fox, 1991, Toulme

and Cloud, 1991, McGaughan, 1993). Also, in some cases the lender takes title to the

assets and is involved in operating them either directly or through an agent until a buyer can

be found.

A similar question has also been applied to receivers appointed in bankruptcy proceedings

(Epling, 1991, Requadt, 1992). Previously, a receiver who acted on behalf of the lender

was guaranteed payment of its costs from the property ahead of any payments to others.

The receiver also normally has limited liability if acting in good faith to wind up a

company's operations. In some cases, as discussed below, these agents of the lenders have

been found liable for environmental costs or the proceeds of sale of assets have been used

to pay environmental costs prior to paying the receiver. This reverses the order of ranking

within the bankruptcy proceedings and makes it difficult for the courts to appoint a receiver

in cases where environmental hazards are known to exist.

The concept of liability within contract law results in a recognition of the reciprocal

principle as first discussed by Coase (1960:7). In the context of Coase's Theorem, once it

is established who has the liability, then the market can operate to maximize production:

> It is necessary to know whether the damaging business is liable or not for
> damage caused since without the establishment of this initial delimitation of

rights there can be no market transactions to transfer and recombine them. But the ultimate result (which maximises the value of production) is independent of the legal position if the pricing system is assumed to work without cost.

Coase recognized that while market transactions could be used to alter the initial distribution of liability, with the existence of transactions costs, the legal system may establish an initial set of rights which is inefficient, but which will not be altered by market transactions because the cost to do so is higher than the benefits which would occur. He thus concludes (13) that

the liability to pay damages may result in an activity being discontinued (or may prevent its being started) which would be undertaken if market transactions were costless. In these conditions the initial delimitation of legal rights does have an effect on the efficiency with which the economic system operates.

Thus, market participants do not formulate the rules, but react to maximize their benefits (or minimize their costs) as a result of the legal rules. Since transactions costs are incurred when financial institutions allocate funds to borrowers, the problem is to determine whether altering the legal framework to make lenders and receivers liable for environmental clean-up costs leads to an efficient allocation of funds which are correctly priced and which will maximize production. Since human well-being is involved in pollution issues, there is the additional question as to whether Coase's Theorem can be applied without reference to the ethical issues such as putting a price on human life and health.

III.1.1 United States Case Law

The basis for the United States cases of lender environmental liability has come from the Comprehensive Environmental Response, Compensation and Liability Act of 1980, or CERCLA, otherwise called the Superfund legislation.[11] The Superfund legislation was put into place to allow the Environmental Protection Agency (EPA) to clean up waste dump sites and then to obtain the costs of the cleanups from the parties responsible for the dumping. The liability under CERCLA is absolute, so that the courts do not need to prove negligence. It is also joint and several, so that a company can be required to pay all of the cleanup costs regardless of how much it contributed to the hazardous waste. In addition, the liability is retroactive.

CERCLA allows for a "security interest exemption"[12] which was initially interpreted by lenders and their lawyers to exempt lenders from being considered potentially responsible parties (PRPs) under the Act. The U.S. courts have expanded this interpretation to attribute liability to lenders if it can be shown that the lender had control of the property. It is the

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[11]CERCLA refers to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, Pub. L. No. 96-510 Stat. 2767 (1980), amended by the *Superfund Amendments and Reauthorization Act of 1986 (SARA)* Pub. L. No. 99-499, 100 Stat. 1613, amended by 42 U.S.C. §§ 9601-9657 (1988)

[12]Within CERCLA, an owner or operator includes any person owning or operating an onshore or offshore facility. However, under CERCLA (§101(20)(A)), "Such a term does not include a person, who, without participating in the management of a vessel or facility, holds indicia of ownership primarily to protect his security interest in the vessel or facility". This has also been called the "secured creditors' exemption".

determination of what constitutes control under CERCLA that has taken the central role in the U.S. cases discussed below.[13]

In the *United States* v. *Mirabile*[14] (*Mirabile*), the Environmental Protection Agency (EPA) sued the owner of a facility for recovery of $250,000 in costs to remove 550 drums of hazardous material left by a previous owner, Turco Coatings. The owner in turn took legal action against the two banks, American Bank and Mellon Bank which had financed the previous owner of the facility. The district court determined that American Bank, which held a first lien on the property and had bought the site at the foreclosure sale before selling it, did not participate in any operational management of the paint manufacturer and therefore was not subject to liability.

Mellon Bank, on the other hand, held the inventory and assets of Turco Coatings and had a loan officer who made frequent visits to the site and who participated in an advisory board and made decisions regarding shipments, manufacturing and personnel. This activity on the part of the bank raised legal questions about Mellon Bank's involvement in the management of the facility and the charges against Mellon were not dismissed as requested

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[13]Nicholson and Zuiderhoek (1993) provide a detailed look at the cases which have come under the CERCLA umbrella and outline some of the steps lenders have taken to ensure that their limited liability stays in place at a time when the interpretation of the law is uncertain. Geisinger (1994) discusses the attempt by the EPA to interpret the secured creditor exemption. The topic has received much attention from the U.S. legal community since the *Fleet Factors Case*. Further references are contained in the Bibliography.

[14]*United States* v. *Mirabile* (1985), 15 Envtl. L. Rep. 20994 (E.D.Pa)

pending further investigation. *Mirabile* was viewed as setting the test for lender liability, since the court indicated that financial control was not sufficient to trigger liability without some indication of management control.

The *Fleet Factors*[15] case went beyond the standard set by *Mirabile*. Fleet Factors held accounts receivable, property, plant and equipment, and inventory of Swainsboro Print Works, a cloth-printing operation, as collateral for its loans. When Swainsboro went bankrupt in December, 1981, Fleet foreclosed on its inventory and equipment and in June 1983, had Baldwin Industrial Liquidators auction the equipment. The property subsequently passed to Emanual County, Georgia, as a tax sale. When the EPA discovered 700 drums of hazardous materials and truckloads of asbestos on the property, they conducted a cleanup and sued Fleet for $400,000 of cleanup costs.

The court found that during the time of the loans, from February 1981 - May, 1982, the borrower, Swainsboro, had to seek Fleet's approval to ship goods, price excess inventory, and other items which demonstrated Fleet's control. A frequently-quoted section of the decision is as follows (*United States v. Fleet Factors Corp.*(1990:1557-58)):

> Under the standard we adopt today, a secured creditor may incur section 9607(a)(2) liability without being an operator, by participating in financial management of a facility to a degree indicating a capacity to influence the corporation's treatment of hazardous wastes. It is not necessary for the secured creditor actually to involve itself in the day-to-day operations of the

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[15]*United States* v. *Fleet Factors Corp.* (1990), 901 F. 2d 1550 (11th Cir.)

facility in order to be liable - although such activity will certainly lead to the loss of protection of the statutory exemption. Nor is it necessary for the secured creditor to participate in management decisions relating to hazardous waste. Rather, a secured creditor will be liable if its involvement with the management of the facility is sufficiently broad to support the inference that it could affect hazardous waste disposal decisions if it so chose.

In addition, the district court also intended the ruling (1558) to prompt lenders to act as gatekeepers in monitoring the waste disposal practices of their borrower. However, the case did not make clear exactly when the act of monitoring and influence over a borrower could trigger environmental liability for the lender.

Subsequent to *Fleet Factors*, in *Bergsoe Metals*[16], the Ninth Circuit court determined that a standard less strict than *Fleet Factors* should apply and that some management involvement on the part of the lender was necessary to trigger lender environmental liability. In *Bergsoe Metals*, the lender held title to the security as part of the financing arrangements, but had not instituted foreclosure and therefore lender environmental liability did not apply. *Bergsoe* thus contrasts with *Fleet* in which merely the ability of a lender to influence operations would result in a loss of the secured creditor's exemption.

Two years after *Fleet Factors*, on April 29, 1992[17], the EPA, in consultation with lenders, released the "final" rule on lender environmental liability As summarized by Nicholson and

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[16]Re Bergsoe Metal Corp., 910 F.2d 668 (9th Cir. 1990)

[17]57 Fed. Reg. 18344, 18374 (Apr. 29, 1992) codified at 40 C.F.R.§ 300.1100 (1992)

Zuiderhoek (1993:45-6), under the new rule the lender does not need to either prove it is entitled to the secured creditor's exemption nor to conduct pre-loan inspections to be protected from liability. However, the lender must not participate in the management of operations or in decisions about hazardous waste disposal or environmental compliance. The lender is permitted to police loans and conduct workouts, and after foreclosure, must act promptly to divest itself of a property. The final rule did not prove final after all, however.

In 1994, the ruling of the EPA was tested by *Kelley* v. *EPA*. The circuit court decided that the EPA did not have the power to issue that rule.[18] According to Geisinger (1994:42, Footnote 11) the United States Congress was acting in 1994 to allow the EPA to issue standards. Geisinger (1994) postulates that both the court-led decisions of *Fleet Factors* and related cases plus the EPA rule, which represented a negotiated agreement between the EPA and lenders, will be relevant to the process of determining how much liability a lender should have.

Thus, although the standard for lender environmental liability has evolved through decisions of the United States' courts and EPA enactments, a clear rule for lenders has yet to be established. The available standards and their weaknesses can be summarized as follows after Geisinger (1994):

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[18]*Kelley* v. *EPA*, 15 F.3d. 1100 (D.C. Cir. 1994)

1) the *Mirabile* decision:

The lender must have been actively involved in day-to-day operations before foreclosure. The objection is that this allows lenders to purchase property at foreclosure sales more cheaply than others and to benefit from the government's payment of the cleanup costs.

2) the *Fleet Factors* standard:

The ability to influence and participate in operating decisions can trigger environmental liability for lenders. This should cause lenders to monitor their borrowers to ensure compliance with hazardous waste disposal standards. A weakness is that lenders, being unable to evaluate and price the risk, will stop lending to risky companies rather than provide the monitoring function.

3) the EPA Rule:

This rule allows lenders to extend credit and conduct a purely financial relationship with their borrower without fear of environmental liability, outlines specific activities which trigger liability, and allows lenders to foreclose. The objection here is that it does not foster the gatekeeper role of monitoring borrower activities and does not provide incentives for lenders to spend on environmental cleanup before or after foreclosure.

III.1.2 Canadian Case Law

Canadian law contains two major cases relating to lender environmental liability: *Canadian National Railway* v. *Ontario (Director under the Environmental Protection Act)*[19] and *Panamericana de Bienes y Servicios* v. *Northern Badger Oil & Gas Ltd.*[20]

In the first case, *Northern Wood Preservers* was prosecuted under the Ontario Environmental Protection Act (OEPA)[21] in what was the first case to address the issue of lender environmental liability in Canada.[22] Canadian National (CN) leased a property to Abitibi-Price Inc. which operated a creosote plant which had a history of environmental problems. In 1982, Abitibi assigned the lease and sold the equipment to Northern Wood Preservers (NWP) which took over the outstanding environmental orders at that time. The mortgage provided security for the purchase price of $5 million. In 1987, a Director of the OEPA issued a control order against CN relating to the cleanup of creosote contamination of the harbour and plant site. CN then sued. In Divisional Court of Ontario on May 3,

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[19]*Canadian National Railways* v. *Ontario (Director under the Environmental Protection Act) (1991) 3 O.R. (3rd)609(Ont.Div.Ct.)*, referred to as *Northern Wood Preservers* or *NWP*

[20]*Panamericana de Bienes y Servicios* v. *Northern Badger Oil & Gas Ltd.* (June 12, 1991), AJ No. 575, Appeal Nos. 11698 and 11173 (Alta C.A.), referred to as *Northern Badger*

[21]Ontario Environmental Protection Act, R.S.O. 1990, c. E-19

[22]The facts of the case are outlined briefly here as background material to the economic implications of lender environmental liability. A detailed summary of the finer legal points of the case is provided by Requadt (1992:199-208).

1991, CN and Abitibi were released from any responsibility. CN, as owner and lessor was found not liable. Abitibi, despite having been a previous owner and knowledgeable about the contamination, was deemed not liable because, since assigning the lease to NWP, it had not taken any actions to regain control of the property. The court stated that a lender who did enter and take control of the property could be held liable for any existing environmental problems, establishing the basis for lender environmental liability.

Northern Badger relates to the responsibility of receivers with respect to environmental costs when acting for a lender. In May, 1987, the court appointed a Receiver for Northern Badger, the operator of 31 oil and gas wells in Alberta and Saskatchewan, on the petition of Panamericana de Bienes y Servicios, which held a floating charge over Northern Badger's assets. The Receiver continued to operate the oil and gas wells while it attempted to sell the properties. The Energy Resources Conservation Board of Alberta wrote to Northern Badger in July of 1987 ordering it under s. 7 of the *Oil and Gas Conservation Act* to properly abandon the 7 oil and gas wells which the Receiver had not been able to sell and which were non-operable. The cost to abandon the wells was approximately $200,000. The Receiver did not abandon the wells and applied for a discharge as the court-appointed Receiver and for permission to pay the asset realization of $226,000 to Panamerica.

The Court initially decided that the expense of abandoning the wells could not be applied against the Receiver personally because the environmental costs ranked as an unsecured claim against the estate, and Northern Badger was therefore responsible. Under the

Bankruptcy Act, the court did not subordinate the rights of the secured creditors and deprive them of the proceeds of sale of their security. However, on appeal, the court determined that the abandonment costs were not a claim but a statutory duty necessary to protect the public and that the Receiver must comply with the environmental order even if there were insufficient funds to cover the costs. The costs would be borne by the Receiver or by the lender in the case where the Receiver had been indemnified by the lender.

In this instance, the rule appeared to be that receivers appointed by the courts are responsible for pollution costs in excess of the estate unless they are indemnified by the lender. If they are to avoid liability, both lenders and receivers clearly have the onus to conduct an environmental audit on secured properties prior to receivership in order to avoid liability. If the environmental costs are greater than the realizable value, then the property would be abandoned.

The question of control of a borrower's operations is still undecided in Canada, primarily because there have been very few cases to test the laws. However, if Canadian law develops along the lines of the United States court and legislative interpretations, then there is potential for a major expansion of liability for lenders in Canada. As a practical matter, while the legal uncertainty exists, lenders must be sensitive to the issues which could trigger liability as well as evaluate the probability of the additional risk and factor this into the loan analysis.

III.1.3 Summary Of Canadian And United States Case Law

This brief outline of the history of lender environmental liability in the United States and Canada has been presented to illustrate how difficult the problem can be, and to demonstrate that uncertainty exists with respect to the rules. The combined effects of the legal process and the determination of liability can have significant economic consequences and can have an impact on the capital allocation process. Understanding the incentives created by legislation allows a better understanding of the economic efficiency implications of proposed legislation[23].

The problem is also global, since Canadian law in the lender liability issue will be influenced by American legal practice. The issue is developing in the European Community as documented by Jarvis and Fordham (1993). The following analysis uses the options framework to consider the impact of lender environmental liability on the borrower-lender contracting process.

III.2 Lender Environmental Liability Within The Options Framework

As has been demonstrated in Chapter II, in an unsecured borrower-lender contract, the

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[23]Sean P. Madden (1990:157) estimates that the legal costs related to CERCLA litigation constitute 60% of the environmental costs. The joint and several liability under CERCLA can present a significant incentive to try to pass the liability to another potentially responsible party (PRP), particularly if the total costs are great and the participation of the PRP was minor.

lender has a contracted claim on the borrower's cash flows but no claim to funds over and above the amount of the principal and the interest earned. The interest rate which is implicit in the discount debt used in the example of Figure 1 [24] reflects a market assessment of the risk to the borrower's cash flows and therefore incorporates the lender's quantification of the likelihood of default by the borrower. The discovery of a liability for an environmental cost creates an additional claim on the borrower's cash flow which will have an impact on the lender if it makes the payments to the lender more uncertain, or if the borrower becomes insolvent. It will not, however, create additional costs which the lender must pay. The lender's profit for this contract was shown as Figure 1 where the floor on the contract represents the limited liability of the lender.

The risk profile when a contract is signed for a secured loan has a floor on the downside risk at the negative x-axis (Figure 2), based on the assumption that the sale value of the security is at least equal to the initial loan value less transaction costs at the time of maturity of the contract. There is also the horizontal line which caps the upside profit. In a standard secured lending contract, the lender and the borrower have agreed that the lender will receive a specified return but will not share in the upside, and the pledge of assets provides a limit to the lender's downside risk. In terms of options, the lender holds the company long, has sold a call, and has bought a put on the specific assets of the firm which secure

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[24]In most bank lending contracts the interest rate would be specified and the loan would therefore be modelled as a series of contracts which are renewed each time a payment is made. This is more realistic, but makes the modelling more difficult. Therefore, the simple discount loan is used to illustrate the basic principles.

the debt.

When a loan is secured, the loan agreement creates an option for the lender on specified collateral assets of the borrower. This reduces the lender's downside risk and should decrease the required return. In the event of bankruptcy, the contract gives the lender a first charge on the secured assets for payment of interest and principal owing ahead of other creditors. The proceeds of sale of the collateral are applied directly to the outstanding debt regardless of other costs owed for unsecured creditors or environmental hazards. If the value of the assets sold is greater than or equal to the unpaid amount of the loan owing to the lender, then the capital is returned to the lender and the lender does not suffer a loss. Any excess funds are returned to the remaining creditors first, and then to the shareholders.

There are two stages possible with lender environmental liability. In the first stage, the value of the option to collect cash flow from the sale of the collateral is reduced by the amount of the clean-up costs. If the net value of the collateral asset is greater than zero, then the lender takes over the asset and receives some or all of its principal on the sale of the asset. If the value is less than zero, then the lender walks away from the collateral asset since the cost of the environmental clean-up is greater than the value of the asset.

The existence of lender liability has the potential to make the value of the lender's option on the collateral equal to zero because a claim ahead of the lender is established. This means that the risk profile for the lender changes from that shown for secured debt in

Figure 2, to that presented for unsecured debt in Figure 1. The floor on the lender's payoff has been moved downward from zero to the principal amount of the loan, as demonstrated in Figure 2. The exercise of the option is at the discretion of the lender.

The second stage of lender environmental liability occurs if the courts find that, for reasons of control, the lender is also liable for the environmental costs. Then, in addition to losing the prior security interest, the lender must pay costs in excess of the value of the loan, thus losing the value of the put and becoming subject to a downside risk limited only by the value of the lender's assets, as illustrated in Figure 4. The risk transfer is accomplished because it establishes a put option on the lender's assets by removing the floor on the risk profile. The lender loses its limited liability under the contract and is required to pay the environmental costs. The act of securing a property in a loan agreement could result in a contingent liability for a lender, as noted by Requadt (1992), particularly if the rule used is for joint and several liability as provided for under CERCLA.

Figure 4 shows how this process affects the lender. As presented in Table 4, the negative cash flows for the borrower, which are assumed to be environmental clean-up costs, now flow through to the lender. Figure 2, with a cap on the upside and with a floor on the downside, has become the risk profile as shown in Figure 4 with the floor on the downside removed from the diagram. The lender is thus now liable for negative outcomes.

The position of the floor is not shown in Figure 4, but it has the potential to be equal to the

Figure 4: Lender's risk profile for a secured loan with lender environmental liability
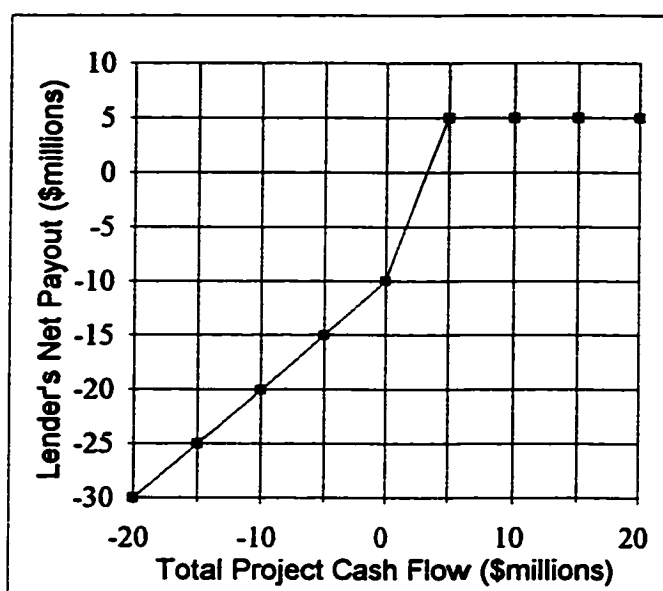
Table 4: Lender's net payout ($ millions) for a secured loan with lender environmental liability

Total project cash flow	-20	-15	-10	-5	0	5	10	15	20
Project cash flow to lender	0	0	0	0	0	5	10	15	15
Security value to lender	0	0	0	0	0	10	5	0	0
Lender environmental liability	-20	-15	-10	-5	0	0	0	0	0
Lender's net payout	-30	-25	-20	-15	-10	5	5	5	5

Initial bank loan = $10,000,000
Loan repayment at maturity = $15,000,000
Value of security = $10,000,000

total assets of the lender. With bank debt, if we are considering a Canadian bank, the assets of the lender can be assumed to be significantly higher than the value of the environmental hazard.[25] This graphically illustrates the "deep pockets" principle often cited as a reason for making lenders liable. The lender's put on the borrower's secured assets is "out of the money", that is the option will not be exercised since the security and therefore the option has no value. The put on the lender's assets is "in the money" since the lender has assets available to pay the environmental costs. This has a negative impact on the lender.

If the legal regime allows the risk to be clearly limited to the value of the security, then the cost is relatively easy to evaluate as the maximum of the value of the security less the value of the unpaid loans. However, if the existence of security creates a further risk of a transfer of liability such as described by Segerson (1993) and as discussed above, then the risk is potentially limited only to the assets of the lender. If the borrower is judgment-proof, that is, insolvent, then the lender could be liable for all of the clean-up costs. The nature of the liability does not permit the lender to draw the horizontal line which would provide a higher floor on the costs since the contract represents an unwritten, contingent liability. Thus the "insurance" provided by the risk-sharing with the lender is not equivalent to a third-party liability insurance contract which the borrower might have undertaken and which would specify a maximum amount payable as part of the written insurance contract. For example, the lender could end up paying $5 million in environmental clean-up costs in addition to

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[25]The assets of the "Big Six" Canadian banks at year-end, October 31, 1996 ranged from $218.0 billion for the Royal Bank of Canada to $53.1 billion for the National Bank of Canada

losing its $10 million in principal as well as any interest.

The insurance provided through this lending contract cannot be priced unless the risk and dollar amount of the clean-up can be ascertained. With the added dimension of time as the result of retrospective liability[26], the problem becomes more difficult. A prudent lender will therefore avoid lending to entities with high environmental risks; a lender will also lend only on an unsecured basis. Only those borrowers with "deep pockets" who are unlikely to be judgment-proof will receive funding. The allocation of funds will have one of two possible effects. Either products will not be produced because the environmental risks are too high, or, the funding will have to come from an equity market with shareholders who are willing to take on the risk since their profit potential is not limited as a lender's would be and they will be subject to the usual limited liability of a corporation.

The cost of first-party insurance (victims insuring against possible harm) and third-party insurance (injurers insuring against possible future damages) should be equivalent in an efficient market. Priest (1991) has shown that when they are not equivalent, products have been withdrawn from markets because consumers are unwilling to pay the cost for third-party insurance which is included in the product price. Similarly, the withdrawal of capital by lenders from industries with high environmental risks can be forecast if lender liability is unlimited.

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[26]Saxe (1992:493-94), provides a discussion of the Canadian situation with respect to retrospective liability.

As an alternative strategy, a lender might lend on a secured basis but, in the event of a borrower's inability to pay, decide to exercise the put at the time of insolvency. The value of this option can be expressed as:

$$p = \max \{S-X, 0\}$$

where p = the value of the put

S = realizable value of the security, net of clean-up costs

X = balance of the loan owing to the lender

If S-X is greater than zero, then the put will be exercised and the lender will realize on the security. If S-X is less than zero, the value of the put will be zero and it will not be exercised. If the borrower is insolvent and there is no one liable for the environmental clean-up costs, the property becomes an "orphan site", and the government assumes responsibility for the environmental cleanup.

The critical factor in determining the lender's behaviour is the estimate of the value of the environmental liability. With respect to hazardous waste clean-up, this number could be unquantifiable, depending on the nature of the pollution. However, the lender only needs to establish the expected value of the cleanup costs relative to the market value of the security since the asset price is adjusted downwards by the value of the clean-up costs.

According to Hull (1993), six factors determine the price of stock options. These six

factors can also be used to understand how a lender evaluates a loan. If a secured loan is viewed as an option contract held by a lender on a borrower's cash flows, then in assessing the risk in order to price the loan, the lender will consider six factors: (1) the value of the borrower's assets pledged as security, (2) the dollar amount of the loan relative to the security, (3) the term (time to expiration) of the loan, (4) the volatility of the cash flows available to pay back the loan, (5) the current risk-free rate of interest, and (6) the amount and timing of the cash flows to the lender over the life of the loan.

This leads to the conclusion that, if loans are a variation of an options contract, then there is a market mechanism common to the different sectors of the financial markets which is used to price risk. By extension, an insurance contract is also an option, and involves the assessment of and the transference of risk.

Thus, if the contracting of a loan is viewed as an option written on a borrower's cash flow, then it can be argued that the process of capital allocation by lenders based on environmental risk factors is no different than a normal loan analysis. The environmental risk is reflected in the volatility of the cash flows available to service the debt. In a competitive market for funds, the interest rate will incorporate the risk-free rate plus a risk premium. If the environmental risk can be evaluated by the financial institution, the capital allocation can still be carried out efficiently.

With lender environmental liability, as gatekeepers or private regulators, lenders will require

an environmental assessment from a borrower prior to advancing funds. Since this cost is borne by the borrower, it can be concluded that the potential polluter is paying. If the lender is able to pass the monitoring costs to the borrower through fees or an increased cost of borrowing, then the externalities will be internalized by the borrower.

However, to return to Coase's (1960) argument, in order for contracting to take place, it is necessary to know the legal regime. Knowing the legal regime allows one to estimate the risk.

When the regulations are changed to permit lender environmental liability, the floor on the risk profile is lowered. Figure 5 shows the payout for the lender for unsecured debt, secured debt, and secured debt with lender environmental liability. The process can be seen as negating the limited liability envisioned in the original contract by creating an option which, if exercised, will result in a loss for the lender. If the lender is not there to pass the risk to, then, because the company is bankrupt and because limited liability is in effect, the environmental costs become the responsibility of the government.

Figure 5: Comparison of lender's risk profiles for secured debt
with and without lender environmental liability
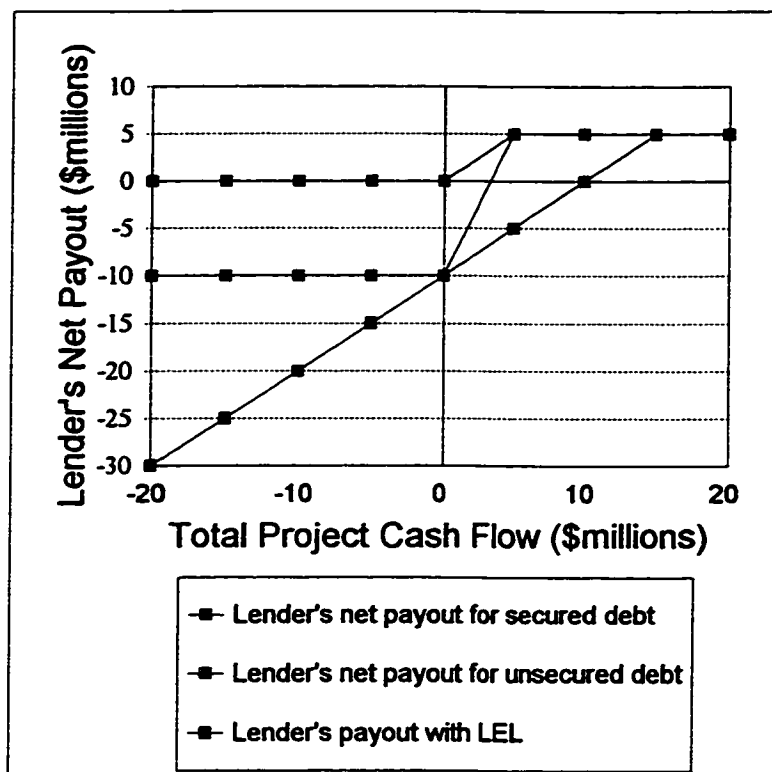
Table 5: Lender's net payout ($ millions) for a secured loan
with and without lender environmental liability

Total project cash flow	-20	-15	-10	-5	0	5	10	15	20
Lender's net payout for secured debt	0	0	0	0	0	5	5	5	5
Lender's net payout for unsecured debt	-10	-10	-10	-10	-10	-5	0	5	5
Lender's payout with LEL	-30	-25	-20	-15	-10	5	5	5	5

Initial bank loan = $10,000,000
Loan repayment at maturity = $15,000,000
Value of security = $10,000,000

IV. Implications Of Lender Environmental Liability

The existence of lender environmental liability raises many issues for lenders, borrowers, and government, some of which have been touched on in previous sections. Sections IV.1-IV.5 below discuss some of the implications in greater detail.

IV.1 Lender Behaviour: The Lender As Monitor

The duty of lenders towards borrowers is discussed by Fischel (1989:131) in the context of "the emergence of the booming area of lender liability [which has] dramatically changed the conventional understanding of the relationship between lenders and their borrowers".

Fischel discusses this relationship between lenders and borrowers in terms of contracting costs, monitoring costs, and bonding costs along the lines presented by Smith and Warner (1979b) with respect to bond covenants and Jensen and Meckling (1976) with respect to agency costs and the theory of the firm. Fischel notes that economic efficiency is promoted by lowering contracting costs and that contracts arise because borrowers and lenders are attempting to allay uncertainty about future events.

From a lender's perspective, once the capital is advanced to the borrower, the borrower may have incentives to engage in activities which are not in the lender's interests, such as

asset substitution. These are considered agency costs, and the contracting between borrower and lender attempts to minimize these costs.

In the context of lender environmental liability, examples of loan covenants which the courts might interpret as control are such things as restrictions on asset sales and purchases or minimum working capital requirements. Since the lender relies only on the cash flow of the borrower to repay the capital, suffers a loss if the cash flows are not adequate to repay the loan, and does not participate in excess profits earned above the required rate of return as set by the market at the inception of the loan, its intention with a loan covenant is not managerial control, but rather an attempt to limit the risks to the cash flows until the loan has been repaid.

As documented by Gott and Townsley (1988), the theory of lender liability developed from the decision of the Supreme Court of California in 1968 that a lender who had control over a developer could be held liable for damages resulting from structural defects in a house built by the developer. It is this issue of control which is involved in much of the present law regarding lender liability for environmental clean-up.

The control issue arises from the concept of property rights: an asset carries with it economic benefits and also economic responsibilities. Particularly in the area of land ownership, "persons", which in law includes corporations, have a responsibility to see that harm does not overflow the boundaries of their property and infringe on another's rights.

In general, in law, the owner of a property is liable for damages arising from that property.

Determining whether a lender had control of a property and therefore, in law, some influence over the asset and access to economic benefits, occurs for secured lenders when a borrower becomes bankrupt and the lender takes title to a property in the course of realizing on its security. Receivers in bankruptcy could also be subject to liability if they operate a company during a winding down process.

The extension of liability to lenders can be viewed in the larger context of the expansion of tort liability. In the United States, the court system in some cases has re-written the rules as to when liability arises and has taken the idea of compensation for wrongs beyond what was envisioned when contracts were signed, particularly for insurance contracts in the areas of product liability and environmental liability. Priest (1991) establishes this process as occurring during the 1960s when the courts adopted the idea that damages provided from product liabilities were a form of accident insurance for victims, and manufacturers were deemed to be able to provide insurance at a cheaper rate and to be able to pass the costs on to their customers in the form of higher product prices.

However, Priest (1991) presents evidence that this expansion has not reduced the accident rate but has shifted the risk from first-party insurance to third-party insurance. When there is first-party insurance, the costs of potential liability for product defects or environmental clean-up will be contained in the price a company charges for its products. Through third-

party insurance the liability risk is transferred to an insurance company through an options-type contract. The provider of insurance has sold a put which will be exercised by the company in the event of environmental damages and in most cases, there is a floor on the contract for the insurer since insurance is provided only up to the amount of the policy.

In competitive markets, if first-party and third-party insurance are equivalent, then shifting the insurance obligation to the injurer from the victim should have no effect. This is a version of the Coase Theorem which postulates that, in the absence of transactions costs, it does not matter how the initial liability is established because contracting will occur to allocate the risk. However, Priest (1987) demonstrates that the third-party insurance is three to five times as costly as first-party insurance, possibly indicating that either transactions costs are high, or that the market is inefficient.

In the area of environmental liability, expansion of liability and the interpretation of the courts of insurance policies beyond what was intended by the insuring agent has resulted in a crisis in the insurance market and the unavailability of insurance against environmental risks. Yandle (1991) further emphasizes the extent to which insurance contracts were interpreted to extend beyond accidental spills to cover longer-term pollution problems. The result for insurance companies has been responsibility for liability and therefore economic losses beyond what was envisioned at the time of the signing of the contracts.

The present legal situation with respect to lenders has resulted in two areas for analysis:

retrospective liability applicable to existing contracts and prospective liability arising from future environmental damages. One can envision three states of liability:

i)   no liability (Figure 2, secured)

ii)   liability limited to the value of the security (Figure 1, unsecured) and

iii)   joint and several liability up to the total value of the clean-up costs, or the total net worth of all joint and several parties, whichever is smaller (Figure 4, secured with lender environmental liability).

For a lender's existing loan portfolio the risk of environmental clean-ups might not have been evaluated when the loans were made. If an environmental liability is found to exist the value of the loan is lowered. The loan was underpriced for the risk that the lender took since the earned rate of return is reduced by the expected value of the liabilities imposed on the lender. The capital of the lender will be eroded if the loans are not repaid or if the lender has a liability beyond the value of the loan principal. Within the options model, the value of the lender's option on the borrower's assets has decreased and the joint and several liability creates an option on the lender's assets.

The accounting value of the physical asset is overstated because the economic benefits from that asset have gone to previous shareholders and also to customers through lower product prices which did not internalize the cost of pollution. The result has been a transfer of wealth to previous owners or operators and customers from the present owners and lenders

as noted by Menell (1991). This wealth transfer was not anticipated when the loan was made.

The legal framework thus can have an economic impact in terms of wealth transfers. To the extent that the liability regime is uncertain, and if insurers, lenders and receivers are unable to evaluate the risks, then there is potential to disrupt capital markets. Economic inefficiencies may also arise if the court systems are used to establish liability, primarily due to the high transactions costs involved in pursuing a judgement for liability through the court system.

Nicholson and Zuiderhoek (1993:40-1) report on an informal survey which they conducted to determine how American banks were reacting to the *Fleet Factors* case. They found that banks required completion of an environmental questionnaire prior to lending and, for commercial real property loans, an environmental audit in order to provide an environmental history.

IV.2   Legal Inconsistencies: Public Versus Private Debt

The risk profile with a lender is the same whether the lender is a bank or a bondholder. In lender environmental liability, so far only bank loans have been identified to be at risk. This could be viewed as an element of the uniqueness of bank loans because it is the monitoring

function performed by a single entity, the bank lending institution, which is the cause for the courts to find environmental liability. The incentive with lender environmental liability is for lenders to scrutinize how they perform the monitoring function and to determine if the risks outweigh the potential costs.

An example of the inconsistencies in the legal application of lender environmental liability is the presence of a financial institution such as a pension fund on both the debt and equity sides of the contract. So far, no pension funds have attracted lender environmental liability even though pension funds may participate in debt as lenders through private placements. A pension fund may have a significant shareholding in a company to which it lends. The shareholdings would give the fund limited liability. If lender environmental liability were applied to the pension fund, then the fund could potentially be liable through its lending, but not through its shareholding. It is inconsistent that significant control in one contract, a limited liability share, does not draw liability while the significant control in the other contract, a secured loan, does. The role of limited liability for contracts such as loans and securities is thus being rewritten by the courts.

IV.3 The Government As An Option Writer

According to Hawken (1993:106) limited liability can be considered as a "...gift from the state, a grant, a covenant, a form of permission that citizens, through their government, delegate to the corporation and its shareholders."

With the existence of limited liability, the corporation is able to contract to limit the exposure of its shareholders to the costs related to environmental risks, or, stated another way, the government has a role as "environmental underwriter" as coined by Oesterle (1991:39). What Oesterle is indicating is that, when limited liability exists, the downside risk has been partially transferred from the shareholders of the company to the government. The shareholders will lose, at maximum, their investment in the company. Figure 6 shows the shareholder's risk profile for limited liability. The horizontal line denotes the limited liability of the shareholder. The value of a traded security which has limited liability cannot go below zero because the contract expires at that point, but there are economic consequences which are negative. Some other entity, either government or a creditor holds the other side of the risk profile, either through written or unwritten contract. When there is a put holder there is another party who has written the put.

The other side of the contract which is unwritten is the government's role as a backstop for firms in the event of bankruptcy resulting from environmental costs. If the environmental cleanup costs are not internalized by the firm and it becomes impossible to make the polluter pay because the polluter is judgment-proof, then, if the lender has not had control and therefore should not be liable for the environmental degradation, the "pocket of last resort" is the government.

Oesterle (1991:41, Footnotes 2 and 3) explored the area of governments as guarantee writers. Oesterle views environmental liabilities as call options written by the government

Figure 6: Shareholder's risk profile with limited liabiliy and no debt
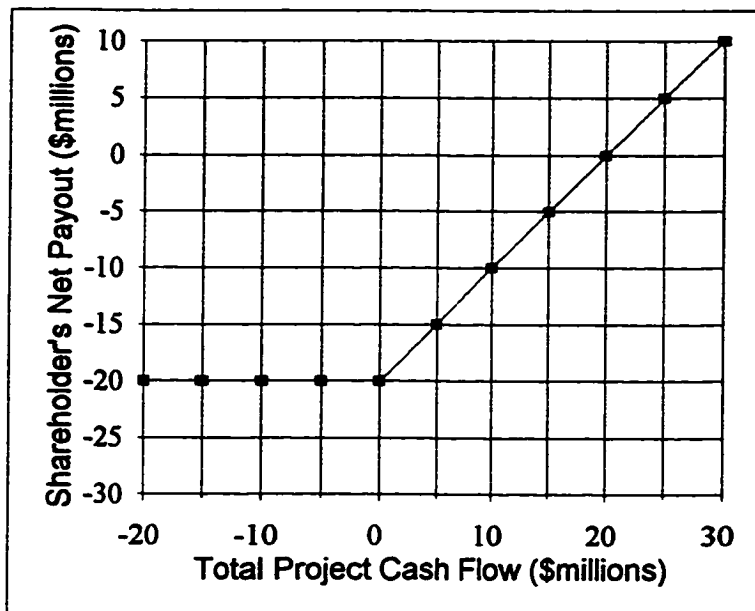
Table 6: Shareholder's net payout ($millions) with limited liability and no debt

Total project cash flow	-20	-15	-10	-5	0	5	10	15	20	25	30
Project cash flow to lender	0	0	0	0	0	0	0	0	0	0	0
Shareholder's cash flow	0	0	0	0	0	5	10	15	20	25	30
Shareholder's net payout	-20	-20	-20	-20	-20	-15	-10	-5	0	5	10

Initial bank loan = $0
Initial equity position = $20,000,000

on the assets of a firm. In this context, the exercise price of the option is the cost of the clean-up. If the value of the firm is greater than the cost of the clean-up, the firm holds the right to pay the clean-up costs and keep the assets.

While Oesterle's analysis provides insight for an understanding of the government's position as an insurer, it also presents the government's position from a different perspective. If it is considered that the government has sold a put, then the government suffers losses as the value of the firm declines and remains neutral, that is, the option remains unexercised, only if the value of the firm is greater than the value of the environmental costs. We can then view the shareholders' risk profile as holding the firm long, and also holding a put, which generates the same risk profile as Oesterle has proposed for the firm and the proper risk profile for the government.

The government is at risk only if the value of the firm decreases and there is no "upside" for the government. The government accepts losses as part of its contingent liability. In this respect, the government is acting as a backstop, or as an insurer as Oesterle asserts.[27]

In this respect, the environmental obligation is modelled similarly to other government guarantees. The best example of these is deposit insurance, which was first modelled as a European put option by Merton (1977), and then modified by Merton (1978), and

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[27]Oesterle (1991:45, footnote 12) states that the second way of looking at the option is to consider that the government has written a put, and he acknowledges that "the limited liability of the firm's owners creates the put option".

numerous other authors including Penacchi (1987), Ronn and Verma (1986), Markus and Shaked (1984), and Allen and Saunders (1993).

The primary goal of Oesterle's argument was to demonstrate that the government is the "fall guy" for environmental cleanup, and that as the writer of a put option, the government, unlike financial institutions who issue insurance contracts or debt contracts with protective covenants, is unable to control the risk-shifting behaviour of the firm. A cause for the failure of existing environmental legislation in the United States such as CERCLA is, therefore, that there is no mechanism by which the government can control the behaviour of the option-holder. It is in the marginal firm's self-interest as the option-holder and controller of the assets to increase the volatility of the assets and thus to increase the option's value. By engaging in increasingly risky behaviour, marginal firms can take the risk of increasing their upside, with protection by the government on the downside.

The value of the option is higher to the firm which is marginal, since the options are closer to being exercised, that is, they are in the money because default is highly probable. A highly solvent firm, on the other hand, is holding an option which is deeply out of the money, since the value of the firm far exceeds the environmental damages payable.

Oesterle argues that the government at the present time does not control the option-holder and therefore its exposure to risk. The government also does not adjust the put premium in response to varying degrees of risk. In some cases the put premium is charged by

environmental taxes. In most cases, the government does not try to reduce its exposure by requiring insurance or adequate capital of environmentally risky enterprises.

Put another way, CERCLA can encourage marginal firms to increase environmental risks and produce an effect opposite to the intention of the law. This is analogous to "moral hazard" which arises when insurance provides the incentive for a company or an individual to take risks because the insurer will bear the loss. An analogy with deposit insurance reinforces this point.

The system of deposit insurance provided by the federal government in the United States charged the same premium for all financial institutions. Grossman (1992), Kane (1987, 1989) John et al (1991), among others, discussed the role of deposit insurance as an incentive for excessive risk-taking by financial institutions and postulated that the deposit insurance system contributed to the seriousness of the United States savings and loan disaster in the 1980s. In 1991, the United States moved to a risk-based deposit insurance system.

Oesterle (1991:51) states that "(n)eedless to say, the more courts modify traditional notions of limited liability, the less powerful the government option analogy presented in this article." However, Oesterle's analysis can be expanded into a model for liability in general and environmental liability in particular by looking at all parties to the contracts by considering the borrower's position in Section IV.4 and then the government's position in

Section IV.5.

IV.4   Corporate Financing With Lender Environmental Liability

The study of lender environmental liability ties into the legal debate of recent years about the reasons for the existence of limited liability which have been discussed by many authors, among them Hansmann and Kraakman (1991), Grundfest (1992), and Halpern, Trebilcock and Turnbull (1980). As presented above, the lender's contract is altered by removing the floor. The shareholder remains protected by limited liability. This protection enhances the tendency for smaller, undercapitalized corporate entities to enter fields with high tort risk (Ringleb and Wiggins, 1990) and as might also be postulated, high risk of contract failure such as the lender environmental problem discussed here.

The borrower-lender risk-sharing within the contract is asymmetric. When lender environmental liability is found, the limited liability for the borrower has stayed in place, the borrower having been found judgement-proof. The position of the borrower as a shareholder with limited liability and bank debt is presented as Figure 7. Assuming that the investment project costs $20 million and the borrower is providing $10 million of its own funds in addition to obtaining the bank loan of $10 million, the initial net cash position to the borrower is also -$10.0 million and the debt/equity ratio is 1.0. However, the slope of the borrower's profit curve depends not only on the cash flows from the project but also

Figure 7: Shareholder's risk profile for limited liabiliy with bank debt
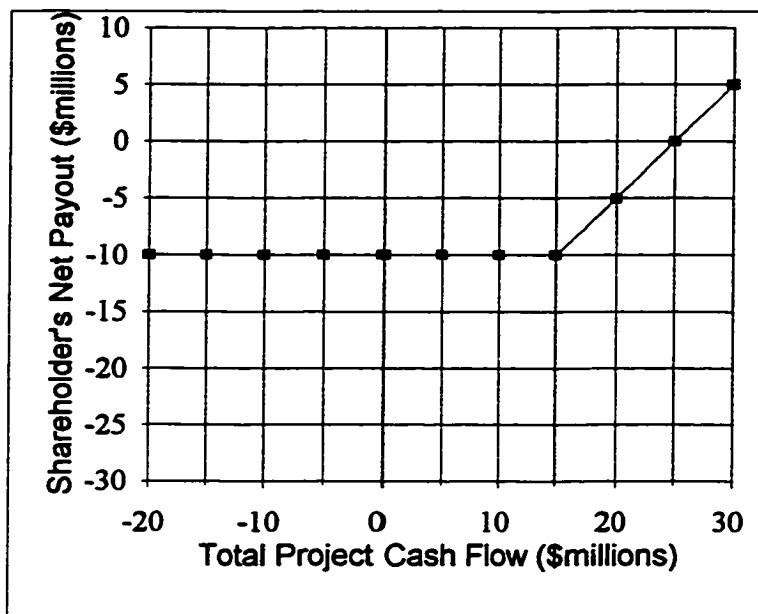
Table 7: Shareholder's net payout ($millions) for limited liability and bank debt

Total project cash flow	-20	-15	-10	-5	0	5	10	15	20	25	30
Project cash flow to lender	0	0	0	0	0	5	10	15	15	15	15
Shareholder's cash flow	0	0	0	0	0	0	0	0	5	10	15
Shareholder's net payout	-10	-10	-10	-10	-10	-10	-10	-10	-5	0	5

Initial bank loan = $10,000,000
Loan payment at maturity = $15,000,000
Initial equity position = $10,000,000

on how the loan is structured. The borrower's upside is limited only by the potential of the project. The graph shows the profile for holding a security long, but it is shifted to the right. This represents the call the borrower has sold to the lender which prevents a payoff to the borrower until after the $15 million has been given to the lender. By being further to the right on the total project cash flow axis, the borrow's risk is increased since shareholders now rank behind the lender. The floor on the risk profile represents the put held by the borrower in the form of limited liability.

The existence of lender environmental liability does not affect the borrower's position since the limited liability stays in place in the event of bankruptcy and the maximum the borrower can lose at all times is the $10.0 million. That is, the borrower exercises a put which allows the firm to declare bankruptcy, limiting its downside risk. The asymmetric risk is clear: shareholders with limited liability and no cap on their upside (Figure 7) are not affected beyond their initial investment but lenders, with a cap on their upside, are now responsible for costs which were not anticipated in the original lending contract. In some cases the courts have extended liability to managers, parents of subsidiary companies, and owners. This would alter Figure 7 by removing the floor, similar to what has been demonstrated for lender liability and deferring the point at which the government option is exercised.

Lender environmental liability can be expected to have an impact on the capital structure of firms which have a significant exposure to environmental hazards. Lenders will withdraw some forms of capital from those firms, and also will require higher equity levels. The

alterations in financing mean higher cost of capital for firms.

Alderson and Betker (1995) postulate that the costs of liquidating a firm affect the type of financing used. Generally, the higher the liquidation value of the assets the more likely is the firm to use secured debt and ordinary debt. In contrast, the firm whose assets have no large secondary market are more likely to be at the other end of the continuum with common and preferred shares. They also state that firms with restrictive debt are more likely to undergo bankruptcy. Alderson and Betker's (1995:49) approach is summarized in their statement that "(f)inancial claims therefore lie on a continuum ranging from borrowing agreements with specific security arrangements and strict covenants to claims such as unsecured debentures, preferred stock, and in the extreme, common equity."

If lender environmental liability is added to this equation, the nature of the continuum is changed. Barclay and Smith (1995:900, Table 1, reproduced here as Table 8) show capitalized leases, secured debt, ordinary debt, subordinated debt, preferred stock and common stock on a continuum with decreasing priority in bankruptcy from left to right. Alderson and Betker's (1995) proposal thus fits along this continuum because debt, other than leases, has the right to limit activities and force bankruptcy while shares do not.

With lender environmental liability, there is the probability of a lender being held liable for environmental costs if there is secured debt. Over time, if lender environmental liability becomes established in the legal system, firms exposed to environmental hazards will form

Table 8: The characteristics of corporate liabilities (Table 1 from Barclay and Smith, 1995:900)

Types of Corporate Liabilities	Capitalized Leases	Secured Debt	Ordinary Debt	Subordinated Debt	Preferred Stock	Common Stock
Priority of Claim	Highest					Lowest
Can default trigger bankruptcy?	Yes	Yes	Yes	Yes	No	No
Control Rights	Right to restrict use of leased asset only	Right to limit activities specified in covenants	Right to limit activities specified in covenants	Right to limit activities specified in covenants	Right to limit activities and conditional voting rights	Voting rights
Corporate tax shields: cash flows	Lease payments are deductible	Interest payments are deductible	Interest payments are deductible	Interest payments are deductible	Dividend payments are not deductible	Dividend payments are not deductible
Corporate tax shields: Depreciation	Depends on the structure of the contract	Assets can be depreciated	Assets can be depreciated	Assets can be depreciated	Assets can be depreciated	Assets can be depreciated
Corporate tax shields: Flotation costs	In the lease payment	Amortized over the life of the issue	Amortized over the life of the issue	Amortized over the life of the issue	Not deductible	Not deductible
Tax liability for claimholders: Individuals	Lease payments are ordinary income	Interest payments are ordinary income	Interest payments are ordinary income	Interest payments are ordinary income	Dividends are ordinary income	Dividends are ordinary income
Tax liability for claimholders: Corporations	Lease payments are ordinary income	Interest payments are ordinary income	Interest payments are ordinary income	Interest payments are ordinary income	70 % of dividends excluded from taxable income	70 % of dividends excluded from taxable income

a Preferred stockholders can limit activities specified in the covenants, such as prohibiting payment of dividends to common shareholders while preferred dividends are in arrears. Voting rights for preferred shares are usually conditional on corporate events such as changes in control or omission of preferred dividends.

b Common shareholders elect the board of directors.

c In the U.S., 70% of dividends are excluded from taxable income.

a special subset of the firms identified by Barclay and Smith (1995) and Alderson and Betker (1995). For these firms, the debt/equity ratios should be lower since there may be less debt available to them. This tendency is also driven by the fact that monitoring the borrower could result in triggering lender environmental liability. Therefore the greater the required equity in terms of a debt/equity ratio contained in the covenants of the loan contract, the safer are the lender's funds. Debt/equity covenants have been standard in loan agreements but lender environmental liability should reinforce this trend.

IV.5   A General Framework For Modelling Liability

Tietenberg (1989:517) has argued that "judicial remedies frequently represent an incomplete approach to environmental incidents and must therefore be complemented by ex ante regulatory strategies." The goals of the ex ante regulatory strategies should be to enhance the internalization of environmental costs to make the polluter pay and to ensure precaution by companies engaged in environmentally risky activities. In order to do this, it is necessary to consider all participants and how to allocate costs and benefits to them. By using this "systems" approach, changes in one part of the system can be examined for their impact on other players. This allows regulations which provide the appropriate incentives to be implemented.

Each of the participants in the benefits and costs that arise from economic activity are discussed above: the lender, the company, and the government. The traditional economic

risk-sharing within the American and Canadian liability frameworks can be seen graphically as presented in Figure 8. The firm's risk profile shows no cap on the upside, and there is a floor on the downside representing the limited liability which comes into effect in the event that the firm becomes bankrupt.

The lender's standard secured debt contract shows the floor on the contract at zero, in line with an assumption that the security is at least equal to the principal amount of the debt. There is a cap on the upside at the net total payment to the lender. The government's position shows no floor on the downside which is consistent with the government becoming liable should the firm become bankrupt. If we assume the absence of taxes, then there is no upside for the government: its contract comes into effect only in the event of negative consequences. If taxes were considered, then the premium for the put which the government is selling is represented by the taxes paid by the firm. The government's risk profile shown can be considered a special case where the government neither receives income taxes nor environmental taxes in return for providing the guarantee in the event of bankruptcy of the firm.

In this traditional, or status quo set of risk profiles, it is apparent that the lender has traditionally been an "intermediary" and has neither an unlimited upside nor an unlimited downside. The firm has an unlimited upside and a limited downside and the government's profile is the opposite with a limited upside but an unlimited downside. It is only the government whose downside is potentially unlimited since an unsecured lender or
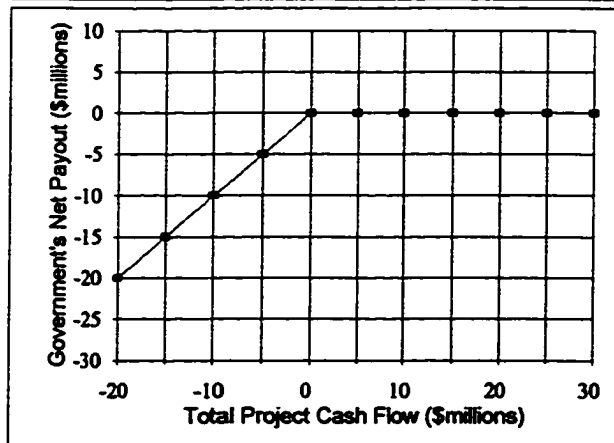
Figure 8: Shareholder's, lender's and government's risk
profiles without lender environmental liability
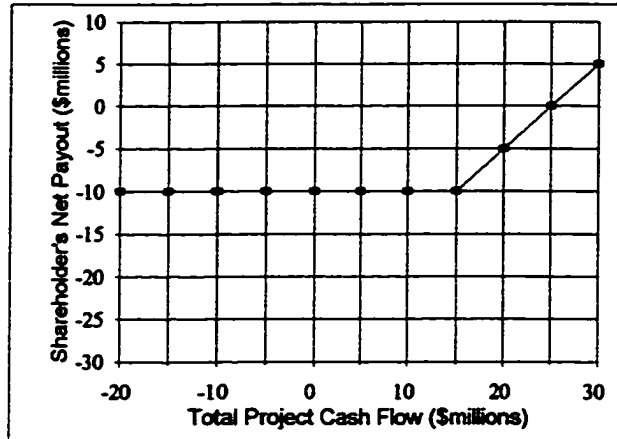
SHAREHOLDER
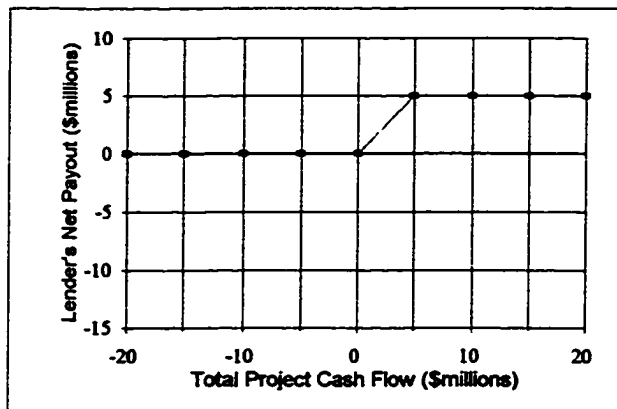
LENDER

GOVERNMENT

unsecured creditor, similar to the secured lender, would not take on any liability beyond the initial loan amount or product supplied to the company. Each risk profile is distinctive and defines the participant graphically.

Figure 9 shows the set of risk profiles with lender environmental liability. The floor has been removed from the lender's risk profile and placed on the government's risk profile. This figure shows visually how the guarantee provided by the government has been shifted to the lender.

If the capital markets were complete as understood in financial theory, then another participant, the insurance company, would be available to take on the environmental risk. The risk profile for an insurance company providing environmental insurance would have a cap representing the insurance premium and a floor representing the amount of insurance provided. The government's liability would not start until the environmental costs exceeded the amount of the insurance, causing the government's risk profile to be shifted to the left. If the courts were to open up the insurance contract and ascribe an amount greater than the stated policy to be paid through the insurance, then the insurance contract would be opened up much the same way as the floor is removed from the loan contract with lender liability. In this case, the government's liability would be completely transferred to the insurance company. The insurance company in this case has the same position as the lender except that the original insurance contract placed no capital at risk. In this manner, the insurance company has sold only a put, and does not hold the company long and sell a share as the lender does. The insurer thus has a risk profile which
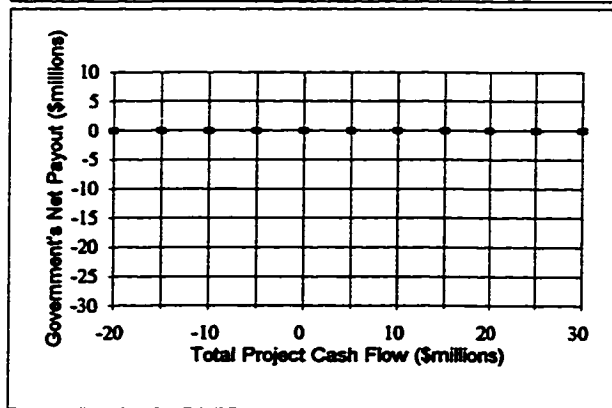
Figure 9: Shareholder's, lender's and government's risk profiles with lender environmental liability
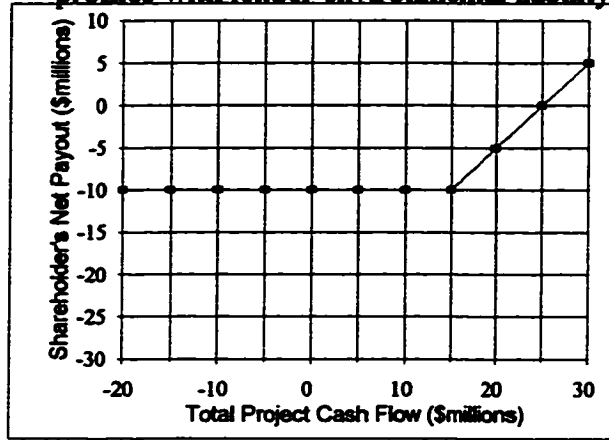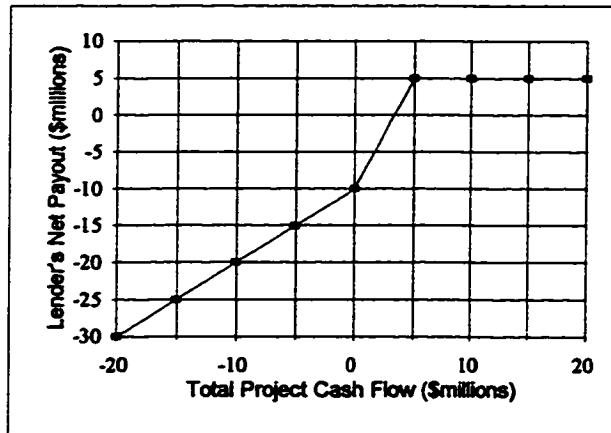
distinguishes its function in capital markets.

In the cases considered above, the limited liability of the shareholders has been inviolate. The limited liability provides shareholders with incentives to minimize the amount of equity in a firm (Ringleb and Wiggins, 1990). The floor provided by limited liability gives incentives for shareholders to limit the amount of equity they provide to a project or a company and in the case of hazardous activities, to use debt. Debt does not cap their upside but it does move their risk profile upward, moving the floor up and the payoff to the right, deferring the payoff from the project.

IV.6   Summary Of Implications Of Lender Environmental Liability

In the case where lender environmental liability does not exist, the risk profile for a financial intermediary such as a lender or insurance company has a cap on the upside and a floor on the downside. The borrower's risk profile has no cap on the upside, but does have a floor on the downside which represents limited liability. The government's risk profile has a cap on the upside and no floor on the downside since it is the 'lender of last resort' in the event of bankruptcy.

Lender environmental liability effects a change in the lending contract which removes the floor on the lender's risk profile and places it on the government's risk profile. The lender thus becomes subject to unlimited liability with respect to a specific lending contract. The

other participant, the borrower, a participant who has direct control over the environmentally hazardous activities, does not have its risk changed. The existence of lender environmental liability does not therefore induce precaution in the borrower's activities. As shown in Table 3, liability should result in product pricing which internalizes the cost of producing a specific product. With the potential for liability which extends beyond bankruptcy, in evaluating the potential risks of its actions, a firm might be inclined to incorporate the precautionary principle into its actions. By the precautionary principle which has been developed in environmental law in recent years, given uncertainty about the environmental effects of a particular action, a firm would exercise precaution and not produce a product in order to avoid potential liability.

While lender environmental liability does create an incentive for the lender to monitor the borrower's activities, the incentive is hampered by the possibility that the monitoring activity itself may trigger lender environmental liability. The legal framework thus does not adequately address all participants and does not set up an incentive system which would enhance the precautionary principle and provide limits on the environmental risks undertaken by firms.

V. Mathematical Model For Pricing Lender Environmental Liability

As shown above, environmental costs are externalities which have overflowed the boundaries of the borrower-lender contract. In the standard legal framework, in the event of bankruptcy of the firm, the company and the lender keep their limited liability and the government becomes the backstop to absorb the negative cash flows. Environmental hazards represent a special case of unsecured costs because in the interests of public safety, money must be spent to contain or remove the hazards. In the ideal situation, the polluter will pay.

The government's role can also be considered as that of a guarantor of the environmental costs in the event of the bankruptcy of the firm. The following sections develop a mathematical model to value the guarantee provided by the government and then to demonstrate the impact on the value of a loan when this guarantee is passed to the lender via lender environmental liability.

V.1 Lender Environmental Liability As A Guarantee

When a loan is made, in the terminology of Merton and Bodie (1992), the lender provides a guarantee of the debt of the borrower, absorbs the loss of the loan principal in the event of a default and pays no other costs. Similarly, the government provides a guarantee of the borrower's environmental costs and absorbs these losses in the event of bankruptcy. When

finding lender environmental liability, the courts pass the guarantee of the environmental liabilities from the government to the lender.

The valuation of guarantees, both default-free government guarantees and private guarantees, has been studied by several authors. Sosin (1980) conducts a study of loan guarantees provided by the federal government of the United States to corporations under the Federal Loan Guarantee Programs. Chen, Chen and Sears (1986) model the United States government loan guarantee to Chrysler Corporation in the 1980s. Lai (1992) extends Chen et al's analysis to look at private loan guarantees. He further refines his analysis (Lai, 1995) by comparing private and government guarantees and showing comparative statics by conducting numerical simulations. It is Lai's (1995) analysis which is used here to provide a framework for examining the nature of lender environmental liability as a guarantee.

Both Chen et al's (1986) and Lai's (1992, 1995) analysis of loan guarantees are based on the risk neutral valuation relationship (RNVR) of Rubinstein (1976), Brennan (1979), and Stapleton and Subrahmanyam (1984) for discrete time contingent claims such as debt which are not continuously traded. By analysing the guarantees in the context of discrete time, one is able to circumvent the assumption of continuous hedging inherent in the continuous time models. In the case of bank debt and the liability created by environmental externalities, the existence of continuous trading is not possible. Since the discrete time model also assumes a normal distribution, it is appropriate for the valuation of claims which

may have negative values.

Chen et al's (1986) analysis involves constant absolute risk-aversion (CARA) by investors and normal distributions of asset prices and wealth. Lai (1992, 1995) uses the RNVR but assumes constant proportional risk-aversion (CPRA) of investors and lognormal distributions to value the private and government guarantees. The CARA assumes that as wealth increases, the dollar amount held in risky assets remains the same. CPRA assumes that the percentage of wealth held by the investor in risky assets remains unchanged as wealth increases. The CPRA may be a more realistic assumption since as their wealth increases, it is generally agreed that investors hold more wealth in risky assets, thus showing decreasing absolute risk-aversion.[28]

The methodology of Chen et al and Lai is to find the value of equity and debt in the absence of a loan guarantee. It is assumed that the debt is senior to all other claims, which establishes it as secured debt in terms of the payout on the dissolution of the firm. The debt and equity are assumed to have no payouts, either dividends or interest, until dissolution. Chen et al and Lai then introduce a new project to the firm which is financed with junior debt which Lai values with and without private and public guarantees.

In modifying Lai (1995), the analysis below considers that a liability created by the discovery of an environmental cost is equivalent to junior debt. In the analysis, it is

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[28]See Elton and Gruber (1991:194-201) for a discussion of utility functions.

necessary to assume that the environmental costs are known. In reality, only an approximation of the costs may be known at the point of discovery. However, this does not limit the utility of the analysis, since an estimate of the upper limit of the costs provides an indication of the maximum impact of the environmental cost on the lender and on the firm. Future models could be modified by treating the environmental liability as a stochastic variable. Initially, the costs are considered to be guaranteed by the government. The model is then modified to consider lender environmental liability as a cost transferred from the government to the lender.

The mathematical approach has three steps:

(a) The valuation of secured debt in the absence of environmental liability,

(b) The valuation of secured debt with the discovery of an environmental liability which is paid after the secured debt at the dissolution of the firm (case i), and

(c) The valuation of secured debt with the environmental liability transferred to the lender at the dissolution of the firm. Two stages of lender environmental liability are modelled. In case ii, the lender loses its first call on the assets and ranks second to the environmental costs. In case iii, the worst case scenario from the lender's perspective, the lender loses its limited liability and takes the place of the government in paying the environmental costs which could be greater than the principal amount of the loan.

Figure 10 summarizes the changes in the lender's risk profiles in moving from secured debt with no lender environmental liability (case i), secured debt with lender environmental liability limited to the value of the loan (case ii), and secured debt with lender environmental liability greater than the value of the loan (case iii).

In all three steps, the limited liability of the shareholders remains in place, as has been the practice in both Chen et al's (1986) and Lai's (1992, 1995) studies of guarantees, and as has been upheld in the courts with respect to environmental liability.

(a) The Valuation of Secured Debt with no Environmental Liability

The initial analysis follows Lai's (1995) model and uses Lai's nomenclature. It is assumed that the firm consists of common equity (E), and a loan which is equivalent to a discount bond which pays D at maturity. There are no payments of dividends or interest until the termination of the company at time T and there is only one type of debt which, because it has a first call on the cash flow ahead of the shareholder's equity, is the equivalent of secured debt.[29] The end of period value of the firm is assumed to be lognormally distributed and is equal to V_T. As used by Black and Scholes (1973) the equity represents a call on the cash flow of the firm in discrete time so that the cash flow to the shareholders at the end

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[29]In terms of the mathematical model, the debt is senior in the cash flow pecking order to the equity and other claims which are introduced later. It is the senior ranking which makes the debt the equivalent of secured debt. So far the courts have found lender liability only for debt which is contractually secured and therefore the senior ranking is necessary for the subsequent analysis.

Figure 10: Comparison of lender's risk profiles for case i,
case ii and case iii
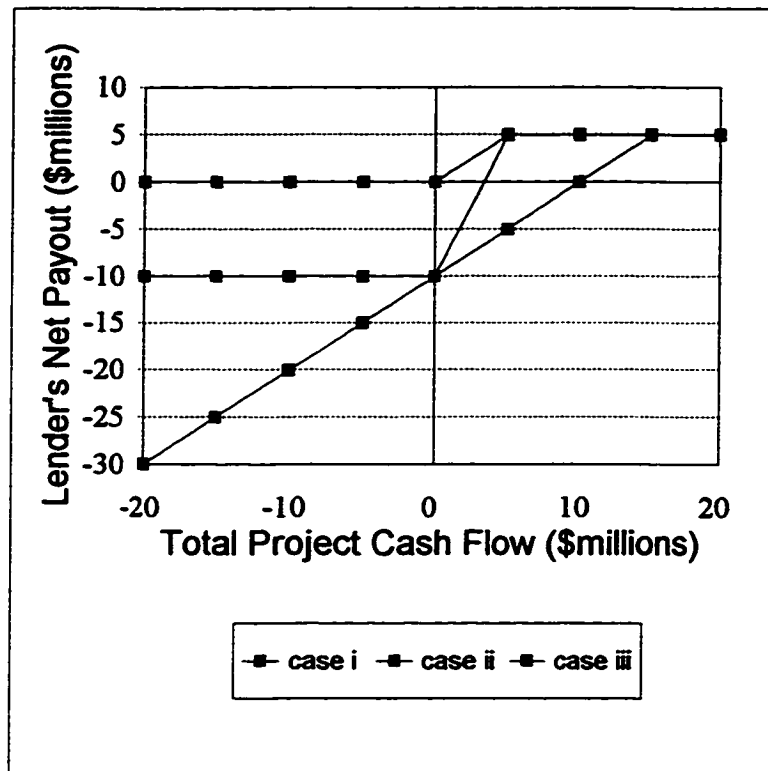
case i	no lender environmental liability
case ii	lender environmental liability limited to the value of the security
case iii	lender environmental liability greater than the value of the loan

of the term, Y_E is given by max $[V_T - D, 0]$. The payoffs to the shareholders at the end of

the term are then equal to:

$$Y_E = \begin{cases} V_T\text{-} D & \text{if } V_T > D \\ 0 & \text{if } V_T \leq D. \end{cases}$$

In other words, the shareholders receive the difference between the total market value of

the firm, V_T, and the debt, D, or, if the cash flow is less than the value of the debt, then the

shareholders receive 0. The limited liability of the shareholders is established here since the

shareholders cannot receive less than 0 and therefore are not permitted to have a liability

to the firm.

The current market value of the equity, E, is calculated using the RNVR as:

$$E = VN(d1) - R_f^{-1}DN(d2) \tag{1}[30]$$

where:

V = current market value of the firm

R_f = 1 plus the risk-free interest rate, r_f

σ_V = the constant (non-stochastic) standard deviation of the natural logarithm

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[30]Lai (1995:144, Equation (1))

(ln) of the value of the firm, V

N($\cdot$)   = the cumulative standard normal distribution function

d1   = (ln V + ln R_f -lnD + $\sigma^2_V/2$)/ σ_V.

d2   = d1 - σ_V

The payoff for the debt, denoted Y_{BSr} to distinguish it from the payoff to the junior liability introduced later, is summarized as:

$$Y_{BSr} = \begin{cases} D & \text{if } V_T \geq D \\ V_T & \text{if } 0 < V_T < D \\ 0 & \text{if } V_T \leq 0. \end{cases}$$

In words, if the market value of the firm at time T is greater than the value of the debt, the lender receives the full value of the debt, D. The lender receives all of the cash flow if V_T is less than the principal value, and zero if the cash flow is zero or negative, retaining the limited liability for the lender.

Again using RNVR, the current market value for the senior debt is given by:

$$BSr = R_f^{-1}DN(d2) + (V + R_f^{-1}V_c)[N(d1') - N(d1'')]$$

$$-R_f^{-1}V_c[N(d2^y) - N(d2^{*y})] \qquad (2)^{31}$$

where

$d1^y \quad = \{\ln[(V + R_f^{-1}V_c)/V_c)] + \ln R_f + \sigma^2_V/2\}/\sigma_V$

$d2^y \quad = d1^y - \sigma_V$

$d1^{*y} \quad = \{\ln[(V + R_f^{-1}V_c)/(D + V_c)] + \ln R_f + \sigma^2_V/2\}/\sigma_V$

$d2^{*y} \quad = d1^{*y} - \sigma_V$

$V_c \quad$ = an arbitrary non-zero value for V which acts as a constant in the limit of

integration to avoid an indetermination in taking the logarithm of zero.

In equation (2), the first term represents the present value of the debt if there is no default, the second and third terms the present value of the payment to the debtholder if there is a default.

This is the basic model where, on dissolution, the proceeds are allocated first to the debt and then to the equity. Negative values flow out of the system since the government's position as a guarantor is not specifically included or considered and negative values are not relevant to either the shareholder or the lender who both have limited liability. If the value of V_T is negative, then the cash flow to the senior debtholder and to the shareholders is zero. In other words, both the shareholder and the senior debtholder have a floor on their risk profile.

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[31]Lai (1995:144, Equation (2))

(b) The Valuation of Secured Debt with an Environmental Liability

In the second stage of the model it is assumed that there is a new project financed with junior debt which costs I and which generates returns over the project life. The returns are represented by ξI, where ξ is the profitability index for the project. It is assumed that $\xi >$ 0, and a value of 1 is equal to a net present value of 0 which represents a project generating cash flows just equal to its cost, I. A value of ξ close to zero implies that the project does not contribute anything towards increasing the value of the firm, since the post-project firm value is given by:

$$V_p = V + \xi I.$$

The entire value of the new project is financed by a new issue of junior debt whose face value payable at time T on dissolution of the firm is $F = IR_f$. If the value of ξ is less than or equal to 1, because a new liability in the form of a junior debt issue is created, there is a wealth transfer from the existing shareholders to the new junior debtholder. At the time of dissolution, it is assumed that the senior debtholder ranks first, followed by the junior debtholder, and then by the shareholders.

Case i extends Lai's (1995) model by assuming that the new project, I, represents the discovery of an environmental liability. It is assumed that $\xi \doteq 0$, or is very close to 0. If the

ranking in bankruptcy holds, then the new liability is paid after the senior debt. It is assumed that the variance of the natural logarithms of the post-investment cash flows, σ_p^2, may differ from the variance of the pre-investment cash flows, σ_V^2. It is unlikely that the new investment would have exactly the same risk characteristics of the existing assets and therefore the variance of the cash flows is not expected to be the same post-investment.

Next, the value of the equity and senior debt is calculated assuming that environmental liability comes with a private guarantee. This could be equivalent to an insurance policy which guarantees a portion, α, of the liability for a fixed insurance premium rate, p, per dollar of the beginning of period value of the environmental liability, I. The premium is paid up front and is deducted from the borrower's assets. Using the subscript P to denote the valuation after the finding of the liability and the subscript T to denote the end-of-period values, the payoffs to the shareholders ($Y_{E,P}$) and to the debtholders ($Y_{BS,P}$) with the environmental liability are as follows:

$$Y_{E,P} = \begin{cases} (V_{P,T} - p\alpha F) - D - F, & \text{if } V_{P,T} - p\alpha > D + F \\ 0 & \text{if } V_{P,T} - p\alpha \leq D + F \end{cases}$$

$$Y_{BS,P} = \begin{cases} D & \text{if } V_{P,T} - p\alpha F \geq D \\ (V_{P,T} - p\alpha F) & \text{if } 0 < V_{P,T} - p\alpha < D \\ 0 & \text{if } V_{P,T} - p\alpha F \leq 0 \end{cases}$$

The market values of the common stock post-project, $E_{P,p}$, and of the senior debt post-project, $BS_{P,p}$, where p denotes the existence of a private guarantee, are calculated using the RNVR and are equal to:

$$E_{P,p} = [V + (\xi - p\alpha)I]N(dpp1) - R_f^{-1}(D + IR_f)N(dpp2) \qquad (1)^*$$

where

$$dpp2 = \{\ln[V + (\xi - p\alpha)I] + \ln R_f - \ln(D + Ir_f) - \sigma_p^2/2\}\sigma_p$$

$$dpp1 = dpp2 + \sigma_p$$

and

$$BS_{P,p} = R_f^{-1}DN(dsp2) + [V + (\xi - p\alpha)I + R_f^{-1}V_c][N(dp1^{yp}) - N(dp1^{*yp})]$$

$$-R_f^{-1}V_c[N(dp2^{yp}) - N(dp2^{*yp})] \qquad (2)^*$$

where

$$dsp2 = \{\ln[V + (\xi - p\alpha)I] + \ln R_f - \ln D - \sigma_p^2/2\}/\sigma_p$$

$$dp1^{yp} = (\ln\{[V + (\xi - p\alpha)I]/V_c\} + \ln R_f + \sigma_p^2/2)/\sigma_p$$

$$dp2^{yp} = dp1^{yp} - \sigma_p$$

$$dp1^{*yp} = (\ln\{[V + (\xi - p\alpha I]/(D + V_c)\} + \ln R_f + \sigma_p^2/2\}/\sigma_p$$

$$dp2^{yp} = dp1^{yp} - \sigma_p.$$

In order to designate that the environmental liability carries a government guarantee, $p\alpha$ is replaced with $g\beta$. The guarantee is assumed to be implicit so that the premium, g, is equal to zero. The guarantee is also 100% so that $\beta = 1$. Equations (1)* and (2)* are thus simplified as the $p\alpha$ $(g\beta)$ term becomes equal to zero.

The payoff on the environmental liability without a guarantee can be estimated as follows:

$$Y_{BNJ} = \begin{cases} F(=IR_f) & \text{if } V_{P,T} \geq D + F \\ V_{P,T} - D & \text{if } D < V_{P,T} < D + F \\ 0 & \text{if } V_{P,T} \leq D \end{cases}$$

By using the RNVR, the value of the unguaranteed environmental liability (BNJ) is calculated as:

$$BNJ = IN(dj2) + (V + \xi I)[N(dju1) - N(djuf1)]$$
$$- R^{-1}_f D[N(dju2) - N(djuf2)] \qquad (3)^{32}$$

where

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[32]Lai (1995:147, Equation (3))

$$dj2 \quad = [\ln(V + \xi I) + \ln R_f - \ln(D + IR_f) - \sigma^2_p /2] /\sigma_p$$

$$dju2 \quad = [\ln(V + \xi I) + \ln R_f - \ln D - \sigma^2_p/2]\sigma_p$$

$$dju1 \quad = dju2 + \sigma_p$$

$$djuf2 \quad = [\ln(V + \xi I) + \ln R_f - \ln(D + IR_f) - \sigma^2_p/2]/\sigma_p$$

$$djfu1 \quad = djfu2 + \sigma_p$$

The value of the environmental liability with a government guarantee is given by

$$Bgf \quad = R^{-1}_f \beta F = R^{-1}_f \beta I R_f = \beta I \qquad\qquad (4)[33]$$

that is, the environmental liability is now default-free.

The value of the government guarantee is given by the value of the liability with the guarantee minus the value without the guarantee, that is, equation (4) - equation (3) as follows:

$$GfJS \quad = [\beta - N(dj2)]I - (V + \xi I)[N(dju1) - N(djuf1)]$$

$$+ R^{-1}_f D[N(dju2) - N(djuf2)] \qquad\qquad (5)[34]$$

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[33]Lai(1995:148, Equation (5))

[34]Lai (1995:150, Equation (7)). The equation as printed in the article has an error in the signs which is corrected above.

Equation (5) gives the value of the guarantee in case i where there is no lender environmental liability and the environmental costs are paid after the secured creditor.

(c) The Valuation of Secured Debt with Lender Environmental Liability

Case ii represents the situation where the courts re-interpret the bankruptcy laws to rank environmental liabilities ahead of the secured creditor. This results in the senior debt ranking behind the environmental liability on the dissolution of the firm, but the lender's limited liability remains in place so that the lender does not lose more than the loan principal.

The variables in this case, are defined as follows:

D	=	the face value of the senior debt payable at time T
D_e	=	the face value of the environmental liability payable at time T
BSRlel(1)	=	the present market value of the senior debt which ranks behind the environmental liability and stands to lose only up to the principal amount.

Then substituting DR^{-1}_f for I and D_e for D in equation (3):

$$BSRlel(1) \quad = \quad DR^{-1}{}_f(dj2) + (V + \xi DR^{-1}{}_f)[N(dju1) - N(djuf1)]$$

$$- D_e R^{-1}{}_f[N(dju2)-N(djuf2)] \qquad (6)$$

where:

dj2 $\quad = [ln(V + \xi DR^{-1}{}_f)+ ln R_f - ln(D_e + D) - \sigma^2{}_p /2] / \sigma_p$

dju2 $\quad = [ln(V + \xi DR^{-1}{}_f) + ln R_f - ln D_e - \sigma^2{}_p/2]\sigma_p$

dju1 $\quad = dju2 + \sigma_p$

djuf2 $\quad = [ln(V + \xi DR^{-1}{}_f) + ln R_f - ln(D_e + D) - \sigma^2{}_p/2]/\sigma_p$

djuf1 $\quad = djfu2 + \sigma_p$

In this case, ξ, the profitability index, remains equal to zero because only the ranking of the senior debt has changed. The value of the firm is not enhanced by the change in ranking. The terms containing ξ thus drop out of the equation in the comparative statics below.

The current market value of the senior debt with lender environmental liability in case ii is thus determined by the value of the senior debt (the first term in equation (6)), the value of the firm plus the contribution of the debt to the firm's value, zero by definition (the second term), less the third term which is a function of D_e, the face value of the environmental liability. As the value of the environmental liability increases, the market value of the debt tracks downward since the firm's value goes to pay the environmental liability first. The existence of lender environmental liability in case ii lowers the value of the senior debt, as

was shown graphically for the payoff diagram of Figure 10.

In case iii, the environmental liability is transferred to the lender when the court passes the government guarantee to the senior debt. This can breach the limited liability and make the senior debtholder responsible for all of the environmental costs. As before,

D = the face value of the senior debt

D_e =IR_f= the face value of the environmental liability payable at time

T .

g =guarantee premium = 0

β =amount of the liability guaranteed =1 and

BSRlel(2) =the market value of the senior debt with the guarantee of the environmental liability

The market value of the senior debt when a full guarantee of the junior debt is provided by the government is then calculated using equation (2)*:

$$BSp = R^{-1}_f DN(dsp2) + [V + \xi D_e R^{-1}_f + R^{-1}_f V_c][N(dp1^{yp}) - N(dp1^{\gamma p})]$$

$$-R^{-1}_f V_c[N(dp2^{yp}) - N(dp2^{\gamma p})] \tag{7}$$

where

$$\text{dsp2} = \{\ln[V + \xi \, D_e R^{-1}{}_f] + \ln R_f - \ln D - \sigma^2{}_p/2\}/\sigma_p$$

$$\text{dp1}^{yp} = (\ln\{[V + \xi D_e \, R^{-1}{}_f]/V_c\} + \ln R_f + \sigma^2{}_p/2)/\sigma_p$$

$$\text{dp2}^{yp} = \text{dp1}^{yp} - \sigma_p$$

$$\text{dp1}^{*yp} = (\ln\{[V + \xi D_e \, R^{-1}{}_f]/(D + V_c)\} + \ln R_f + \sigma^2{}_p/2)/\sigma_p$$

$$\text{dp2}^{*yp} = \text{dp1}^{*yp} - \sigma_p.$$

Further, since ξ is assumed to be zero, equation (7) is simplified as:

$$\text{BSp} = R^{-1}{}_f DN(\text{dsp2}) + [V + R^{-1}{}_f V_c][N(\text{dp1}^{yp}) - N(\text{dp1}^{*yp})]$$

$$-R^{-1}{}_f V_c [N(\text{dp2}^{yp}) - N(\text{dp2}^{*yp})] \tag{8}$$

where

$$\text{dsp2} = \{\ln V + \ln R_f - \ln D - \sigma^2{}_p/2\}/\sigma_p$$

$$\text{dp1}^{yp} = (\ln\{V/V_c\} + \ln R_f + \sigma^2{}_p/2)/\sigma_p$$

$$\text{dp2}^{yp} = \text{dp1}^{yp} - \sigma_p$$

$$\text{dp1}^{*yp} = (\ln\{V/(D + V_c)\} + \ln R_f + \sigma^2{}_p/2)/\sigma_p$$

$$\text{dp2}^{*yp} = \text{dp1}^{*yp} - \sigma_p.$$

The value of the government guarantee, GfJS, equation (5), with $\xi=0$ and $I=D_e \, R^{-1}{}_f$, and β =1 is given by:

$$\text{GfJS} = [1 - N(\text{dj2})]D_e R^{-1}{}_f - V[N(\text{dju1}) - N(\text{djuf1})]$$

$$+ R^{-1}_f D[N(dju2) - N(djuf2)]$$ (9)

In case iii, the liability rules pass the full value of the government guarantee to the lender when the court determines that the lender exercised control of the borrower's operations. As a result, the market value of the senior debt, BSRlel(2) is equal to BSp minus the liability to the lender, GfJS, which is the value of the guarantee. It is assumed that the lender's private guarantee is equivalent to the government's public guarantee in being default-free due to the bank's large asset base relative to the size of the environmental liability.[35] The value of the senior debt, BSRlel(2), is equal to BSp-GfJS since in this case the value of the debt to the lender is reduced by the cost of the liability. The equation for the senior debt in case iii is given by equation (8)-equation (9) as follows:

$$BSRlel(2) = R^{-1}_f DN(dsp2) + [V + R^{-1}_f V_c][N(dp1^{yp}) - N(dp1^{*yp})] - R^{-1}_f V_c[N(dp2^{yp})$$

$$- N(dp2^{*yp})] - [1 - N(dj2)]D_c R^{-1}_f + V[N(dju1) - N(djuf1)]$$

$$- R^{-1}_f D[N(dju2) - N(djuf2)]$$ (10)

The value of the senior debt decreases as the value of the environmental liability rises since the value of the guarantee as a liability to the lender increases. The loss by the lender can exceed the value of the initial principal amount in this scenario.

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[35] It is possible to modify the equations to consider third-party guarantees which Lai (1995) has done, but the assumption that the lender is a default-free guarantor is reasonable and allows for simplification of the equations.

V.2   Comparative Statics: Testing Of The Mathematical Model

To illustrate the impact of lender environmental liability, the equations developed above are used to look at the value of the lender's and the government's payoffs under different assumptions. Lai's (1995) assumptions were:

V=current value of the firm =$2100

D=$1000=face value of the senior debt payable at time T

r_f=the risk-free rate=0.10

R_f=1 + r_f=1.10

σ_V=standard deviation prior to junior debt =1.0

σ_p=standard deviation after introduction of new project =1.0

P=g=private/government insurance premium=.005

α=β=portion of junior debt guaranteed=.90

ξ=profitability index=.90

I=present value of the junior debt =F/R_f =$1000.

F=$1100= face value of the junior debt payable at time, T

The base case used here with lender environmental liability adopts Lai's assumptions with the following modifications:

α=β=1.00

ξ = 0.00000001

P=g=private/government insurance premium=0.

I=D_e= present value of environmental liability=F/R_f=$1000/1.10

The equation used to calculate the cumulative normal distribution function, N, is the fifth-degree polynomial approximation used by Abramowitz and Stegun (1972) which is used by Hull (1993:26-27).

The revised assumptions produce comparative statics diagrams similar to Lai's. Figure 11 shows the base case for the value of the unguaranteed junior debt, BNJ (equation 3), the government-guaranteed junior debt, Bgf (equation 4), and the government guarantee, GfJS (equation 5), as the value of the firm, V, varies.[36] The value of the government guarantee decreases as the value of the firm increases since more assets are available to apply to the junior debt. Because ξ=0, the new junior debt is not contributing to the value of the firm, and also because 100% of the debt is guaranteed, the value of the government guarantee reaches $1000 at the value of the firm of V=$100.

Figure 11 shows graphically that the lower the value of the firm, the higher is the government's implicit guarantee. The government could therefore minimize its guarantees by requiring minimum equity for risky firms. A corollary to this is that firms with exposure

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[36]This diagram is the equivalent of Figure 3a presented in Lai (1995:163).

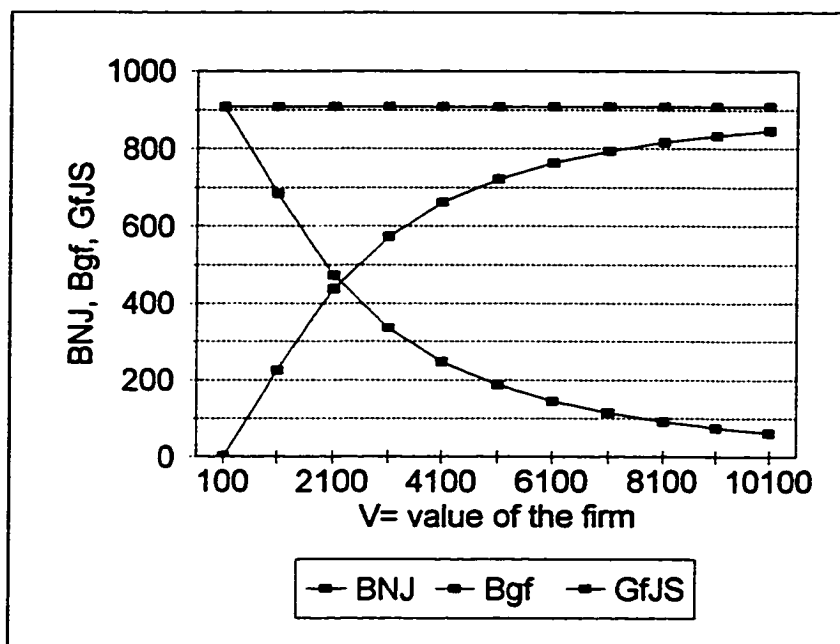Figure 11: Value of the government guarantee (GfJS = Bgf - BNJ) as firm value varies

Table 9: Values of BNJ, Bgf, GfJS and V used to plot Figure 11

BNJ	1	225	437	573	662	722	764	795	817	834	848
Bgf	909	909	909	909	909	909	909	909	909	909	909
GfJS	908	684	472	336	247	187	145	114	92	75	62
V	100	1100	2100	3100	4100	5100	6100	7100	8100	9100	10100

BNJ =   market value of unguaranteed junior debt (eq. (3))
Bgf =   junior debt with government guarantee (eq. (4))
GfJS =   value of the government guarantee (eq. (5) = Eq. (4) - Eq. (3))
V =   value of the firm

Figure 12: Value of the government guarantee (GfJS) as environmental liability (De) increases
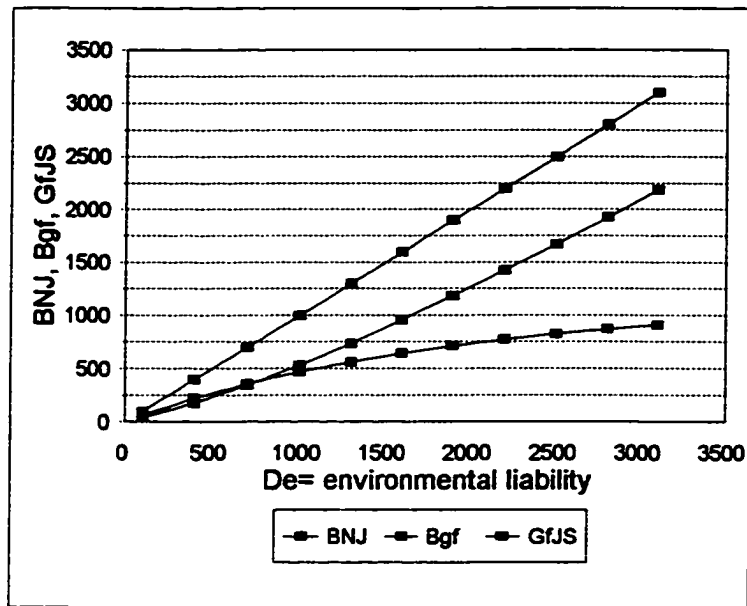

Table 10: Values of BNJ, Bgf, GfJS and De used to plot Figure 12

BNJ	61	223	357	469	564	645	714	774	826	872	912
Bgf	100	400	700	1000	1300	1600	1900	2200	2500	2800	3100
GfJS	39	177	343	531	736	955	1186	1426	1674	1928	2188
I = De	100	400	700	1000	1300	1600	1900	2200	2500	2800	3100

BNJ = market value of unguaranteed jr. debt/environmental liability (Eq. (3))

I = De = face value of junior debt (environmental liability)

Bgf= junior debt (environmental liability) with 100% government guarantee (Eq. (4))

GfJS= value of the government guarantee (Eq. (5) = Eq. (4) - Eq. (3))

to risky activities can maximize the value of their limited liability by keeping the value of the equity in the firm low and implicitly transferring as much of the risk as possible to the government. A case can also be made to maximize debt since this also minimizes the shareholders' exposure. This provides one explanation of Ringleb and Wiggins's (1990) finding that firms with the potential for large tort liabilities tend to be smaller.

The value of the government guarantee also varies with the value of the environmental liability. Figure 12 shows graphically how the market value of the environmental liability without a guarantee, BNJ, the market value of the environmental liability with the 100% government guarantee, Bgf, and the value of the guarantee, GfJS vary as the environmental liability, $I = D_e$ increases. The equations assume that the senior debt ranks ahead of the environmental liability as in case i. The government guarantee increases as the value of the environmental liability increases, and the government guarantee increases the value of the liability. This is because, as the environmental liability increases, the senior debt is still taken out first and the assets of the firm, assumed fixed at $2100, are not able to cover all of the payouts. In this scenario, there are no assets left for distribution to the shareholder.

Figure 13 shows the value of senior debt in each of the three cases. In case i, the market value of the senior debt, Bsp (equation 2*) is unaffected by the value of the environmental liability since the senior debt is paid off first from the assets of the firm. Figure 13 shows the straight line for the senior debt when the firm value of $2100 covers the face value of senior debt at D=$1000.

Figure 13: Value of secured debt (BSp, BSRlel(1), BSRlel(2))
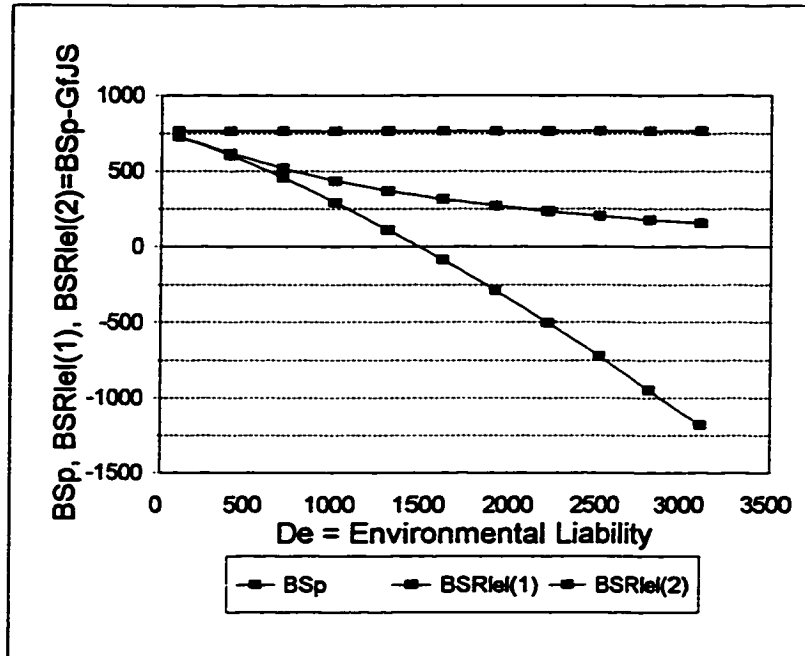with and without lender environmental liability

Table 11: Values of BSp, BSRlel(1), BSRlel(2) and De used to plot
Figure 13

BSp	765	765	765	765	765	765	765	765	765	765	765
BSRlel(1)	730	619	519	437	370	316	272	235	205	180	158
BSRlel(2)	730	606	459	293	111	-83	-287	-500	-721	-947	-1179
De	100	400	700	1000	1300	1600	1900	2200	2500	2800	3100

BSp = market value of the senior debt (Eq. (2*)), case i

BSRlel(1) = value of senior debt, environmental liability ranked first (Eq. (6)), case ii

BSRlel(2) = BSp-GfJS = value of senior debt minus the guarantee (Eq. 10)), case iii

De = face value of the environmental liability

There are two ways in which the model allows us to look at transferring the liability to the senior debt. Case ii assumes that the bankruptcy legislation changes to rank environmental liabilities ahead of secured creditors as discussed previously.[37] The value of the senior debt with lender environmental liability, BSRlel(1) from equation (6) is determined by the value of the senior debt, the value of the firm plus the contribution of the debt to the firm's value, zero by definition (the second term of equation (6)), less the third term which is a function of D_e, the face value of the environmental liability. Thus, as the value of the environmental liability increases, as shown in Figure 13, the market value of the debt, BSRlel(1) tracks downward since the firm's value goes to pay the environmental liability first.

The second method of transferring the environmental liability to the lender is to assume that the court passes the government guarantee to the senior debt, as in case iii. This can breach the limited liability of the senior debtholder and make it responsible for all of the environmental costs.[38] Figure 13 shows how equation (10), BSRlel(2) decreases as the value of the environmental liability increases. The value of the senior debt in this case does not trend to zero, but can be negative as the value of the guarantee increases and reduces the value of the debt.

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[37]This is basically what happened in the *Northern Badger* case in Canada where the court determined that the receiver in bankruptcy must pay Cdn.$200,000 in environmental costs prior to any distributions to the secured lender of the Cdn.$226,000 realized on sale of the assets of the firm.

[38]In the *Fleet Factors* case in the United States, the lender was deemed to have had the ability to influence the lender's environmental policies and therefore was deemed a potentially responsible party under *CERCLA* and therefore jointly and severally liable. See Footnotes 12-14 above for references to *Fleet Factors* and *CERCLA*.

To summarize, Figure 13 shows that the market value of the secured debt which ranks ahead of the environmental liability (case i) is a straight line and is unaffected by the size of the environmental liability. This line represents the value of secured debt as modelled by prior researchers who did not distinguish between secured bank debt and secured public debt and who did not consider removing the limited liability of the lender by introducing lender environmental liability. Figure 13 shows how bringing lender environmental liability into the picture reduces the value of secured bank debt. BSRlel(1) trends to zero as the environmental liability gets very large, representing the floor provided by the limited liability. BSRlel(2), however, has no such floor and the value of the senior debt becomes negative. In both case ii and case iii, the existence of lender environmental liability is shown to change the nature and the value of the lending contract and cause secured debt with lender environmental liability to be worth less than secured debt without lender environmental liability.

VI. Testable Hypotheses And Conclusions

The options model demonstrates that the existence of lender environmental liability changes the nature of the secured lending contract. For a lender, secured debt becomes riskier than unsecured debt because the limited liability inherent in the contract has been removed in a process which can be modelled as a transfer of liability from the government to the lender.

While the lender has had the limited liability of the lending contract removed, the borrower's position has not changed. However, the borrower will see changes in the type of loans that financial institutions will make available, and therefore a borrower exposed to environmental hazards should show a change in type of debt and therefore its capital structure over time.

In addition to the comparative statics conducted on the mathematical model in Section V.2, there are several hypotheses about borrower and lender behaviour which can be tested empirically. Empirical testing would provide further support for the model and extend our understanding of the impact of lender environmental liability.

VI.1   Testable Hypotheses For Empirical Study

If it is assumed that lender environmental liability may be found by the courts subsequent to the bankruptcy of the borrower and this liability may be extended to both the security

and the lender's assets, as discussed in Chapter V, cases ii and iii, then the following can be proposed:

Hypothesis 1: Firms with exposure to environmental hazards will have smaller amounts of secured debt in their capital structures than firms without exposure to environmental hazards and the amount of secured debt used by these firms will decrease over time.

Rationale: With lender environmental liability, lenders are less willing to provide secured debt to those firms with significant exposure to environmental hazards. As noted above, the secured creditors purchase an option on a specific asset when they secure a loan. The shareholders sell an option which is not useful to them since it cannot be exercised, but they do give up an option to use that asset to gain financing in the future. The transfer of environmental liability to a lender is unlikely to be a valuable option for a borrower since the borrower becomes judgement-proof prior to any liability of the lender. When lender environmental liability exists, the value of the put on the security decreases and a put on the lender's assets may be created.

If the lender views the option on the secured assets as likely to be "in the money", then it would not extend secured debt, or would reduce the amount of debt available and also require that the security be large enough to cover any additional environmental costs. A higher level of equity in the firm may also be required. Thus, a set of firms with environmental liability should show lower usage of secured debt than a set of firms without

exposure to environmental hazards. Given the development of lender environmental liability in the United States and Canada, there should be a trend showing decreased use of secured debt over time for companies with potentially large environmental exposures as banks become aware of the potential for liability and adjust their lending policies.

Hypothesis 2: Firms with exposure to environmental risks will have a lower debt to equity ratio than firms without such exposure and there should be a decreasing trend in secured debt/equity ratios over time.

Rationale: The limited liability of the shareholders is the "insurance" provided by lenders[39] since the borrower must be judgement-proof before lender environmental liability is found by the courts. The lower the floor on the shareholders' risk profile, the later is the exercise of the limited liability option through the bankruptcy of the shareholders. Lenders thus try to ensure that the put on their assets is out of the money by requiring additional equity to support environmental hazards, resulting in a lower debt to equity ratio. The higher required equity is likely to be enforced through loan covenants. Lenders will adjust their lending practices to refuse to provide secured loans to firms exposed to environmental hazards. Since lenders generally require secured debt from firms viewed as too risky to lend to on an unsecured basis, the result should be a decrease in the total bank debt to equity ratio over time for firms with environmental exposure.

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[39]Halpern, Trebilcock, and Turnbull (1980:140) describe limited liability as "bankruptcy insurance provided by creditors"

<u>Hypothesis 3</u>: As a corollary to Hypothesis 2, firms with significant exposure to environmental costs should show a smaller amount of shareholder's equity than firms without such exposure.

<u>Rationale</u>: Firms which have significant environmental exposure will try to limit the amount of assets which they have at risk and also the amount of shareholder's funds which are at risk. This should result in environmentally-exposed firms being smaller in size than firms without such exposure. This trend may be seen as a diminishment in size over time as environmental laws become stricter.

<u>Hypothesis 4</u>: Firms with environmental exposure should have smaller relative amounts of private bank debt as compared with public debt than firms without environmental exposure and the trend should show a decrease in the use of bank debt over time.

<u>Rationale</u>: Private secured bank debt for environmentally-risky companies should be seen to decline over time while public secured debt should remain the same, or increase. Since public debt has not yet been subject to lender environmental liability, to the extent that private debt is of restricted availability, public debt should increase.

Firms which have environmental exposure should also show slower growth as they are required to use higher cost forms of financing. The projects which they undertake must be more profitable to justify the capital expenditure. The process over time is one of

internalization of the environmental costs: a redressing of the externalization of costs which has occurred during the past as consumers, shareholders and lenders have benefited as the full costs of the environmental hazards were paid by society through the unwritten government guarantee rather than by the parties who received the economic benefits.

Hypothesis 5: Secured debt should be priced higher relative to unsecured debt because of the added risk of liability for the financial institution when environmental risk is present.

Rationale: For firms with environmental risk who are able to obtain secured bank financing, the interest rate charged on secured debt should be higher than the rate on secured debt for comparable firms without environmental risk.

With the existence of lender environmental liability, the option on the lender's assets created as a result of the liability reduces the value of the option the lender holds on the borrower's assets. Thus, while normal secured debt should reduce the interest rate because it is less risky for the lender, secured debt with lender liability is riskier and a higher rate should be charged.

Hypothesis 6: Firms with significant exposure to environmental hazards should be smaller than firms without such an exposure.

Rationale: There are two trends at work here. Shareholders will attempt to raise the floor

on their risk profile and therefore will limit the amount of equity which they retain in the firm. This minimizes their risk. In addition, bank funding will be removed for environmentally risky firms. These two trends will tend to limit the size of firms with high exposure to environmental hazards. In addition, the market could view the provision of secured bank debt to a firm with significant environmental exposure as good news. An event study would demonstrate whether this is true by showing abnormal returns at the announcement of new secured bank debt to environmentally exposed firms.

VI.2   Conclusions

Limited liability is a legal mechanism used to transfer risk. The legal system establishes the types of contracts which will be formed to allocate risk. Lender environmental liability has the potential to change the risk allocation inherent in existing contracts, and to create new incentives for the formation of contracts in the future. The hypotheses presented in Section VI.1 represent an opportunity to conduct empirical tests on the options model developed in Chapters II to V, and to extend our knowledge about how changes in the legal system affect capital markets through secured debt and corporate financing.

As demonstrated in Chapter V, when shareholders have limited liability, the government can be viewed as a guarantor of environmental liability in the event of the bankruptcy of a firm. This results in the environmental risk being transferred from the firm to the

government. When lender environmental liability is found by the court, the existing lending contract is changed to pass the guarantee of the environmental costs from the government to the lender.

Shareholders may be indifferent as to whether the government takes on the environmental liability or whether it rests with the lender in the event of bankruptcy, but the existence of liability for lenders has the potential to change the nature of the financing options that are made available to a firm. When lender environmental liability exists, the firm will be affected through the types of lending contracts offered to it. It is possible that some borrowers may be eliminated from participation in the secured debt market with the presence of lender environmental liability.

For lenders, the existence of lender environmental liability means that secured debt provided to firms with environmental exposure can be riskier than an unsecured loan to the same firm. As part of the capital allocation process, with lender environmental liability, lenders are required to act as gatekeepers or quasi-regulators in order to ensure that all environmental regulations are met and thus keep the environmental liability from transferring to them through the lending process. At the same time, given the existing legal status of lender environmental liability, the act of monitoring a borrower, a lender's traditional function and a necessity in order to ensure compliance with environmental regulations, could be a condition for triggering lender environmental liability.

From the government's point of view, regulators wish to ensure that costs of economic activities are internalized thus increasing the economic efficiency of the markets. Lender environmental liability has been shown to be one method of passing environmental costs back to the market through the lender. However, rather than providing a direct incentive to the polluter, the incentive is for the intermediary, the lender, to avoid lending to environmentally risky firms. Over time, there is potential for the need for environmental precaution to be met through the curtailment of economic activities. This will occur through a market mechanism as lenders allocate funds away from environmentally risky firms. The present uncertainty regarding the lender's liability for environmental costs will only be resolved as legislation is carefully written with a view towards addressing all of the interconnections with market behaviour, and as the legislation is tested by the courts.

Along with economic efficiency, the goals of environmental legislation should ensure precaution and that the polluter pays. If we return to Hawken's (1993:106) argument that limited liability is a "gift from the state, a grant, a covenant, a form of permission that citizens, through their government, delegate to the corporation and its shareholders", then the existence of limited liability for shareholders constructs a barrier between the creators of the pollution and responsibility for the pollution. Lender environmental liability is one method of lodging the responsibility for environmental costs with the market participants. However, the role of limited liability as a policy for shareholders represents an area for further research and possible extensions of the options model.

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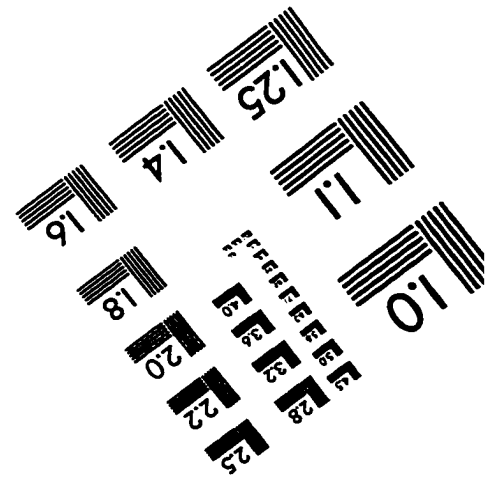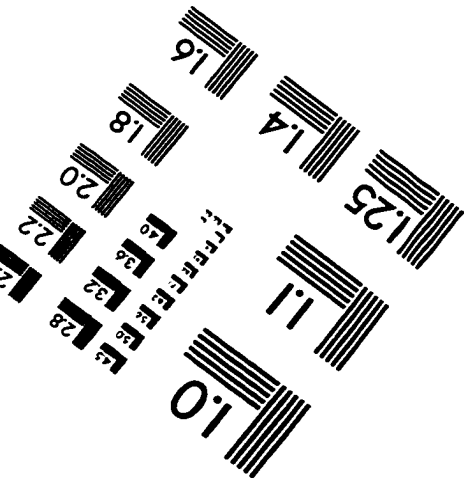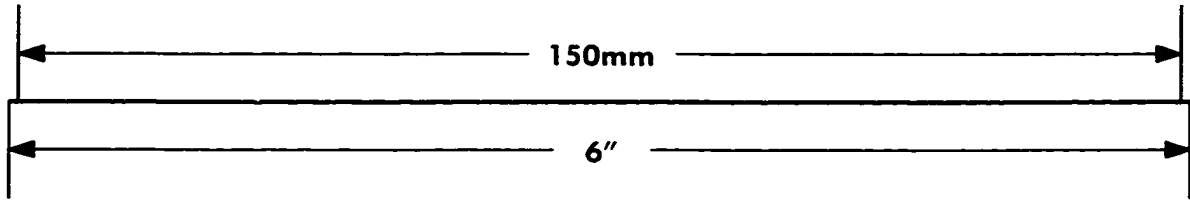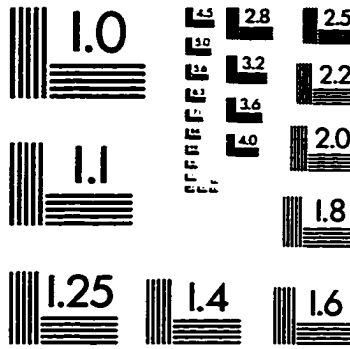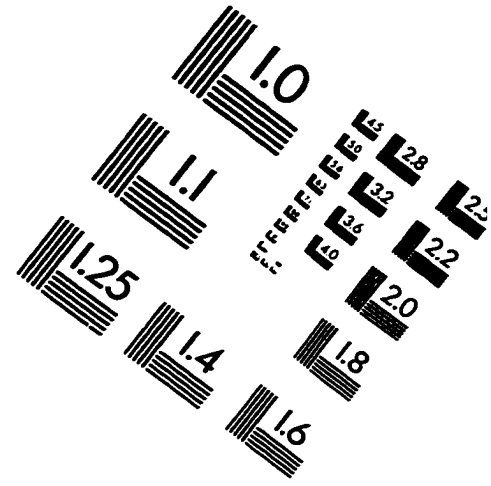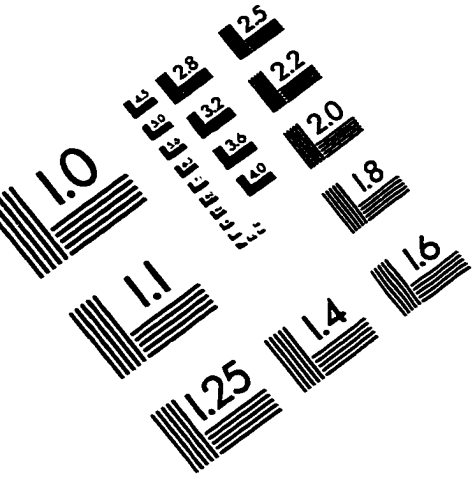
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IMAGE EVALUATION
TEST TARGET (QA-3)

1.0

1.1

1.25

2.8   2.5
3.2   2.2
3.6   2.0
4.0

1.8

1.4   1.6

150mm

6"