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CREATING VALUE THROUGH MANAGING CORPORATE RISK: INSURANCE, FINANCIAL PRODUCTS AND FINANCIAL STRATEGIES

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Résumé de l'article

La gestion des risques dans les entreprises s'est développée de diverses façons au cours des deux dernières décennies. D'abord orientée vers les risques d'assurances jusqu'aux risques financiers et aux autres risques d'entreprise, elle s'est ensuite tournée vers un large éventail de produits financiers lui permettant aujourd'hui d'adopter des stratégies intégrées. Autre aspect moins évident, quoique probablement plus important, son développement a permis de reconnaître que la gestion des risques et les stratégies de financement corporatif convergent vers les mêmes problèmes. Le choix du levier de couverture, du levier contingent, du financement des sinistres après leur réalisation, de l'équité contingente, de la responsabilité limitée et des approches similaires peuvent constituer des substituts ou des compléments dans plusieurs stratégies de gestion des risques traditionnels. Dans cet article, l'auteur présente les résultats de la littérature récente, notamment sur l'explication du coût des risques encouru par les entreprises et il expose à grands traits les stratégies de couverture et de financement corporatif concernant ces divers coûts.

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CREATING VALUE THROUGH MANAGING CORPORATE RISK: INSURANCE, FINANCIAL PRODUCTS AND FINANCIAL STRATEGIES

by Neil A. Doherty

ABSTRACT

Corporate risk management has evolved in several ways over the past two decades. It has evolved from addressing insurance risk to financial and other business risks, it has expanded to embrace a wide variety of hedging products and integrated strategies are now often adopted. Another less conspicuous, though probably more important, development has been the recognition that risk management and corporate finance strategies can address the same problems. The choice of leverage, contingent leverage, postloss financing, contingent equity, limited liability and similar approaches can substitute or complement more traditional risk management strategies. Here the author will present results of recent literature on why risk is costly to firms and outline both the hedging and corporate finance strategies for addressing these various costs.

Keywords: Risk management, financial risks, integrated strategies, leverage of coverage, contingent leverage, results of recent literature.

RÉSUMÉ

La gestion des risques dans les entreprises s'est développée de diverses façons au cours des deux dernières décennies. D'abord orientée vers les risques d'assurances jusqu'aux risques financiers et aux autres risques d'entreprise, elle s'est ensuite tournée vers un large éventail de produits financiers lui permettant aujourd'hui d'adopter des stratégies intégrées. Autre aspect moins évident, quoique probablement plus important, son développement a permis de reconnaître que la gestion des risques et les stratégies de financement corporatif convergent vers les mêmes problèmes. Le choix du levier de couverture, du levier contingent, du financement des sinistres après leur réalisation, de l'équité contingente, de la responsabilité limitée et des approches similaires peuvent constituer des substituts ou des compléments dans plusieurs stratégies de gestion des risques traditionnels. Dans cet article, l'auteur présente les résultats de la littérature récente, notamment sur l'explication du coût des risques encouru par les entreprises et il

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Mots clés : *Gestion des risques, risques financiers, stratégies intégrées, levier de couverture, levier contingent, résultats de la littérature récente.*

INTRODUCTION

Risk management is about hedging. If a firm is exposed to volatile cash flows and there are a set of costs associated with volatility, then an obvious way to control those costs is to reduce volatility; i.e. to hedge the risk. The financial risk management literature has developed to reflect the two prongs of this proposition. On the one hand, researchers have asked why is risk costly to the firm; simultaneously they have sought to analyze and price existing hedging instruments and to derive new or derivative instruments to hedge new and exotic sources of risk.

But hedging is not the only way a firm can offset the cost of risk. If one understands the structural features of the firm that cause risk to be a problem, then value can be created by keeping risk and adapting the structure of the firm so that it is more robust to risk. For example, one reason risk is costly is that volatility increases the chance that any given firm will become bankrupt which will in turn trigger a set of bankruptcy costs. A firm is bankrupt when it is unable to meet its debt obligations. So the problem can be addressed by reducing the volatility (which reduces the probability of falling below a fixed debt obligation) or reducing the debt obligation. Thus, hedging and capital structure choices are addressing the same corporate problem. As we progress through all other reasons why risk is costly, we will see that the cost can be reduced by either reducing the risk or making the firm more resilient to a given level of risk.

This way of thinking about risk management cuts across discipline boundaries. In the previous paragraph I suggested management of capital structure (a corporate finance function) overlaps with hedging risk (traditionally a risk management function) and many recent writers have joined these two concepts.[1] Indeed, one is increasingly strained to think of risk management apart from corporate finance and the vice versa. Accordingly, this paper will not attempt to catagorize strategies according to discipline. Rather, it will follow a simple model of risk and corporate value to identify appropriate strategies for preserving value.

A SIMPLE VALUATION MODEL OF THE FIRM

The starting point for identifying how risk management can create value is a simple valuation model of the firm. Table 1 shows how the value of equity depends on component cash flows. This will be used to illustrate the various theories as to how risk affects value and then to show how its management can restore value. The value of equity of a firm is the present expected value of future cash flows from existing assets and the anticipated net present value of future investments minus prior claims of debt repayment and taxes. Specifically;

$$E = V_0 + L - K + \Delta V - T - D - X - H \qquad (1)$$

This says that the value of equity is the sum of the expected present value of earnings from existing operations, V_0, and liquid assets, L, plus the value added from new investment, $-K + \Delta V$ (the first term here, K, is the present value of capital investments and the second term, ΔV, is the expected present value of earnings generated by these investments), minus the value of existing debt, D, minus the transaction costs of any new issues required to fund new investments, T and minus the expected value of taxes, X. To allow for the prospect of future risk, the firm also can buy a hedge product, such as an insurance policy, and we net out the cost of this hedge, H.

Now, add in the possibility of default on the debt. Limited liability protects the equity value from becoming negative and thereby affords the possibility for the shareholders to default on the debt when the firm value falls sufficiently. We represent this in the usual form of the default put option. The shareholders have the option to default on the debt when the firm value falls below the face value of the debt. So the underlying asset in this put option, $P\{\ .\ \}$, is the firm value, $V(F)$ which has a standard deviation of $\sigma(F)$ and the striking price is the debt face, D. Since default is now considered, bankruptcy costs also are relevant. Although bankruptcy costs are borne *ex post* by creditors, the anticipation of this cost will be reflected in the issue price of new debt and the expected cost, B, will be borne *ex ante* by holders of equity

$$E = V(F) - D + P\{V(F); \sigma(F); D\} \qquad (2)$$

$$\text{where } V(F) = (V_0 + L - K + \Delta V - T - X - H - B)$$

The default put has been shown with three arguments $V(F)$, $\sigma(F)$ and D. The option value decreases with $V(F)$, but increases with $\sigma(F)$ and D.[2]

Now suppose some event occurs, such as a fire, liability loss or a change in currency rates or commodity prices. The loss itself causes a direct loss (or gain) of wealth to the firm of an amount S. However, the event can have a series of repercussions which affect other values. For example, a product liability claim might result in a settlement (including legal fees) of S, but can affect consumer demand for future sales which would affect both future earnings from existing projects, V_0, and from new investments, ΔV. A rise in commodity prices could cause a direct loss of S, which would affect the value of equity which in turn changes the capital structure and affects the cost of financing new investments. The hedge vehicle pays an amount $H(S)$ conditional on the occurrence of S.

Define a set of conditional values for the above variables conditional on the occurrence of loss with superscript S. The notation is varied in the case of debt which is written as $D(S)$ since I later wish to consider the case where the debt is arranged to be contractually related to S.

$$E^S = V(F^S) - D(S) - X^S + P\{V(F^S); \sigma(F^S); D(S)\} \qquad (3)$$

$$\text{where } V(F^S) = V_0^S + L - K^S + V^S - S - T^S + H(S) - B^S$$

The conditional values can provide a focus for explaining several risk management models. However, we can first pause to note that the value of equity is the probability weighted average of equity over different event states. We will use the superscript to denote values of variables if the event S does not occur; i.e.

$$\begin{aligned} E &= V(F) - D - X + P\{V(F); \sigma(F); D\} \\ &= \Sigma_s \left\{ V(F^S) - D(S) - X^S + P\{V(F^S); \sigma(F^S); D(S)\} \right\} \end{aligned} \qquad (4)$$

The relationships just described are reproduced in Table 1. Scanning the table reveals quickly the points at which risk affects value. First, it is well known that the value of options is heavily influenced by risk. So if the firm becomes more risky, the value of the default put option increases. This has a direct effect on the value of debt and thereby affects the cost of debt capital. A less direct effect of increasing the value of the default put, as we shall see, is that it causes distortions in investment decisions. Thus, man-

aging risk and lowering the value of the default put will create incentive for improved investment decision making. We will also see that the firm's tax liability also has option characteristics and is sensitive to risk. Thus reducing risk will reduce taxes. Another way in which risk enters into value lies in the shift in the values before and after a loss (i.e., the different values in columns 1 and 2). But all in all, Table 1 shows where value comes from and will now be used to show how value can be preserved by managing risk.

■ MATCHING PROBLEMS AND SOLUTIONS

□ Principal agent problems: underinvestment and asset substitution

Asset substitution[3]

Both the underinvestment and asset substitution problem arises because the debt contract is not conditioned on the firm's

TABLE 1
CURRENT VALUE OF EQUITY AND VALUE AFTER LOSS EVENT "S"

	Current Value		Value Condition on Event "S"	
Value of existing operation		V_0		V^S_0
cash and liquid assets	+	L	+	L
Capital cost for future investment projects	–	K	–	K^S
Value added from new investments	+	ΔV	+	ΔV^S
Transaction costs for new issues	–	T	–	T^S
Existing Debt	–	D	–	D(S)
Tax liability (option)	–	X	–	X^S
Default put option	+	P	+	P^S
Loss from event			–	S
Cost of hedge	–	H		
Payout on hedge			+	H(S)
Bankruptcy cost	–	B	–	B^S

selection of investment projects. The asset substitution problem is a standard *ex post* moral hazard problem. The firm chooses a new investment project after debt has been issued. Given limited liability, the firm will choose the projects which maximize the value of existing equity holdings. This value includes not only the net present value of the projects but any change in the default put option. Accordingly, firms will have a disproportionate tendency to select high risk projects since shareholders benefit from the upside, but pass additional downside risk to creditors (i.e. the value of the default put increases). Naturally, investors anticipate this bias for the firm to favor high risk projects and this is discounted in the price of the debt. This incentive problem thus raises the cost of debt funding.

The asset substitution problem can be seen by contrasting the capital budgeting rule for maximizing firm value with the selection criterion which will maximize the value of equity.

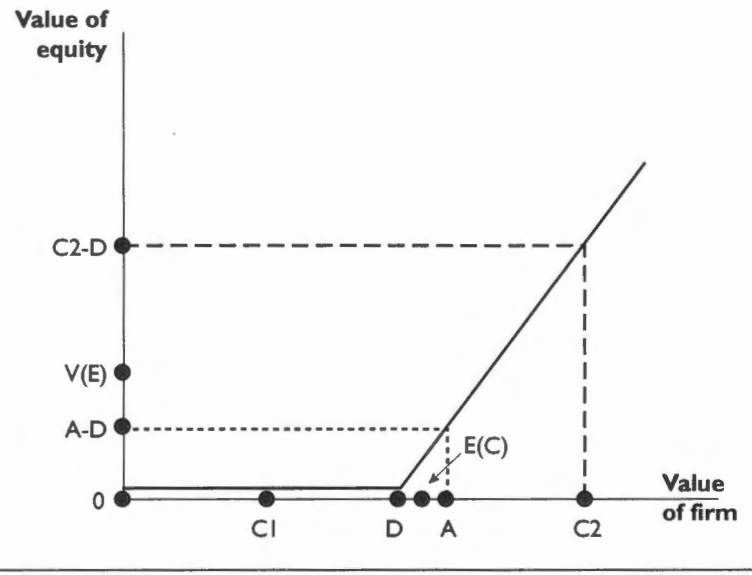
Capital budgeting rule:
Choose project to maximize $\Delta V - K - T$

Maximize equity value:
Choose project to maximize $\Delta V - K - T + \Delta P(.)$

The inclusion of the default put in the equity maximization criterion reveals the distortion. Recall that the value of the default put will increase as the risk of the firm increases or as the striking price of the option, the face value of debt, increases. Thus, there is a bias towards high risk projects and this bias is higher the greater the leverage of the firm. The put option also shows how risk management strategies can be selected to neutralize this disincentive.

The idea of asset substitution (and underinvestment which is considered below) can be seen in Figure 1. The graph shows the value of equity conditional on the value of the firm. Equity shows the classic call option profile with the striking price equal to the face value of debt *D*. Now imagine a choice between two investments. Choice *A* will give the firm a certain value shown on the horizontal axis. The value of equity is the difference between *A* and *D* shown on the vertical axis as *A-D*. Investment *C* is risky and can result in firm value of either *C1* or *C2* each with a 0.5 chance. Notice the expected firm value, *E(C)* is somewhat lower than *A* indicating that the expected NPV of *C* is lower. With strategy *C*, the value of equity is either *0* or *C2-D* so the value of equity, *V(E)*, weights these outcomes by the 0.5 probabilities. So even though *C* has a lower NPV it leads to a higher equity value.

FIGURE I
ASSET SUBSTITUTION AND UNDERINVESTMENT



Solving the asset substitution problem involves finding ways to minimize the distorting effect of the default put option. The first and most direct strategy is to commit to hedge the project risk (if such commitment is feasible). For example, the bond might include a condition that project assets be insured or otherwise hedged. But even without such a condition, the firm that anticipates frequent need to access debt markets might voluntarily choose to hedge project risk in order to signal investors that it will seek no advantage from exploiting the default put. In this way, the firm establishes a reputation for selecting projects that do not impose undue risk on creditors and thus the firm lowers its cost of debt capital.

The second type of risk management strategy works through the default put striking price, i.e., the face value of debt. Simply lowering the level of debt (i.e., using more equity financing) will have this effect. A more subtle way of achieving this goal is to change the structure of debt. Implicitly we have thought of the face value of the debt as fixed. Consider an alternative form in which the face value is conditional on the loss event; i.e., $D = D(S)$ where $D' \leq 0$. In other words, the face value of the debt declines as the size of the loss increases. If such were the case, then the advantage from selecting high risk projects to exploit the default put is mitigated. If the risk comes out on the downside, there will be no default, but

simply a reduction in the amount owed. Shareholders no longer keep the upside risk but default on the downside, rather they face both the upside and downside realizations.

There are various types of contingent debt that have the property $D = D(S)$ where $D' \leq 0$. The first is debt with principal (interest) at risk in which the principal (interest) is forgiven in full or part if certain defined events occur. For example, forgivable debt has been linked to oil prices or to the occurrence of natural hazards such as earthquakes and hurricanes. A second vehicle is debt that converts into equity when the value of the firm falls. This is not convertible debt in the normal sense in which the bondholders hold the option to convert. For regular convertible debt, the option is exercised when the firm value increases. But with the option to convert held by the firm (not the creditors), the firm will choose exercise when the firm value falls to a sufficient level that it is cheaper to convert than to repay the face. Such is reverse convertible debt.[4] The effect of this conversion option is that the shareholders no longer simply walk away from downside risk; instead they share it with the bondholders who now become the joint holders of the firm's equity. Since shareholders now retain a stake in the downside, the incentives to select high risk projects are reduced and the asset substitution problem is partly mitigated.

For regular convertible debt, the firm does not convert at low firm values, but for higher values the conversion option kicks in. Since the firm value is negatively related to S, then $D' \geq 0$ (the opposite sign to debt which interest and principle at risk and to reverse convertible debt). Despite this feature, Green 1984 has shown that convertible debt can mitigate the asset substitution problem. The holding of the option by bondholders increases the value of the bond and permits the firm to raise a similar amount as with a non convertible issue at a lower face value. Moreover, the firm then agrees to share upside risk with equityholders. This has the effect of reducing the concavity of the payoff profile to bondholders. The effect is to reduce the attractiveness of high risk investments to shareholders. While they can still divest themselves of downside risk, shareholders now have to forsake part of the upside gain. Thus conventional convertible debt also can reduce the asset substitution problem.

☐ Underinvestment[5]

The underinvestment problem has a similar structure but relates to investment choices made after the loss event has

occurred. This can be seen immediately by imagining that an adverse event S has just occurred and the firm faces a similar investment decision.

Capital budgeting rule:
Choose project to maximize $\Delta V^S - K^S - T^S$

Maximize equity value:
Choose project to maximize $\Delta V^S - K^S - T^S + \Delta P(.)$

The problem is similar to asset substitution. When making investment decisions, the owners will incorporate the effect of the project on the value of the default put. This will cause the same bias towards high risk investment. But there is a twist. The parameters of the investment decision can shift as a result of the loss as indicated by the superscript S. Most importantly, the leverage of the firm will increase as a result of the loss and this will bring the put option "closer to the money". Accordingly, the distortions in project selection can be even more pronounced than before the loss. Thus, the underinvestment problem is essentially the intensification of the asset substitution problem caused by the loss.

To see the effect of the loss on the default put option, compare the value of the default put in equations (2) and (3). Apart from any effects the loss has on future cash flows and on the cost of funding, the value of the firm (the underlying asset on which the put option is written) is reduced by the amount of the loss and this increases the value of the put. This is seen by the subtraction of S in the put formula in equation (3) but not in (2). The striking price for the default put is the face value of the debt $D(S)$. If the debt value is unaffected by the loss, $D(S)=D$, then the value of the underlying asset has fallen with no change in striking price; thus the value of the put option will rise. Thus, after the loss the asset substitution problem will be enhanced. The name "underinvestment" comes from the extreme version of this problem that occurs when the default put is shifted so far into the money that it is better for shareholders to reject a positive NPV project and bankrupt the firm than to accept the project.

I have so far ignored the effects of the loss of future costs of funding, etc. These effects are picked up by the inclusion of subscripts in the postloss valuation equation 3. If one supposes that these indirect effects of the loss are negative, then the underinvestment problem is enhanced.

The strategies for dealing with underinvestment are apparent when one considers that the issue arises from the effects of loss on

the default put option. Recall the value of the default put is $P\{V(F^S);\sigma(F^S):D(S)\}$, these effects can be negated by acting on each of the three arguments of the option value $V(F^S)$,$\sigma(F^S)$ and D(S).

1. The first approach is to negate the effects of the loss on the value of the option's underlying asset. Since *V(F)* falls by the value of the loss, this can be offset by hedging *S*.

2. The second approach is to offset the effects of *S* on *V(F)* by conditioning the risk of the firm, $\sigma(F^S)$, on the size of the loss. This instrument has been seen and is a *second risk insurance* or a *event conditional insurance future.* The idea is the need for hedging is determined by the size of the principal agent problem. And since the agency problem increases with the a large loss, then the need for a hedge will increase when the loss occurs. Thus one arranges for an insurance coverage to be triggered by the occurrence of the loss. This instrument is a prepaid conditional insurance coverage.[6]

3. The third approach is to offset the change in the value of the underlying asset with a conditional change in the striking price, *D(S)* with $D'<0$. This can be achieved by the two forms of debt instrument described for asset substitution, i.e. forgivable debt and reverse convertible debt.

□ Bankruptcy costs[7]

The possibility of future bankruptcy, and the costs of bankruptcy, represent a deadweight loss to the firm's stakeholders. Under the absolute priority rule of bankruptcy, the *ex post* costs are borne by creditors. *Ex ante,* new debt will tend to reflect the expected costs of bankruptcy and the cost will therefore fall on shareholders who must accept a price for new debt which differs from its face by the expected bankruptcy costs. There is, therefore, a gain to shareholder from signaling to potential creditors a reduction in the expected value of bankruptcy costs.

To derive risk management strategies, consider first the probability of bankruptcy (and expected bankruptcy costs) from the existing operations of the firm. A visible hedging strategy should reassure existing creditors that the probability of bankruptcy is reduced. If debt is already issued, then shareholders will get no direct benefit since the price at issue will have reflected expected bankruptcy costs at the time of issue. However, the hedging program will be a positive signal to investors who might subscribe to new debt issues. A normal hedge against any future event will reduce the probability that the event will result directly in bank-

ruptcy. But a second event hedge described above also will help since it is often the combination of misfortunes that bankrupts a firm.

A second way of reducing expected bankruptcy costs is simply to change the firm's capital structure. The probability of bankruptcy increases as the leverage of the firm increases. Thus, choosing a higher ratio of equity to debt financing will reduce the expected bankruptcy cost.

A second way of approaching the bankruptcy cost problem is to contract up front with creditors for the disposition of the firm in the event that its value falls. Forgivable debt and reverse convertible debt do this and thereby avoid the legal and related costs associated with actual bankruptcy. Consider forgivable debt. If a severe event happens that might bankrupt the firm, the debt forgiveness is automatically triggered and there is no need to go through a costly legal bankruptcy process. Similarly, reverse convertible debt, automatically redistributes claims on the firm (debt is converted to equity) when otherwise the bankruptcy court or a workout would have been necessary. Notice that with regular debt, the outcome of a workout or bankruptcy proceeding is to forgive part of the debt or to convert the debt into equity. So forgivable debt or reverse convertible debt can be viewed as a prior contractual agreement to redistribute the claims on a failing firm in much the same way, but avoiding the costs of an *ex post* settlement.

Now consider the change in the probability of bankruptcy and expected bankruptcy costs that stem from changes in investment and financing strategies. The asset substitution problem outlined an incentive for the shareholders to play a bait and switch game after new debt is issued. Underinvestment revealed the tendency for firms to forgo positive NPV projects after a severe loss event. Insofar as the risk management strategies already considered in this section also address these principal agent problems they provide a secondary benefit, i.e., these strategies reduce the incentives for dysfunctional behavior that can lead to future bankruptcy and thereby reduce expected bankruptcy costs.

☐ The "Pecking Order" Theory of Risk Management[8]

The next explanation about why risk is costly relies on the differential costs of internal and external sources of funding. Various transaction costs are associated with external funding, notably the principal agent costs considered here. Since internal funds are less costly, these are usually the preferred source of funding for new

investments. This is the "pecking order hypothesis" of Myers and Majluf 1984. Firms will typically manage their cash to provide orderly funding of new investments. However, a sudden loss can absorb cash and leave the firm unable to finance new investment except with more costly external funds. Because of the increased costs some new projects will fail to meet capital budgeting criterion and their value will be lost. This has been used as an explanation for hedging behavior, so called "cash flow hedging". The idea is that hedges such as insurance protect the firm's cash from these sudden shocks and ensure that the firm's ongoing investment program is properly funded. But other risk management strategies are available.

The transaction costs of financing new projects was shown as T^S in equation 3. Now the pecking order hypothesis asserts that internal funds are used first since their transaction costs are lower. This implies that the projected transaction costs will be higher the lower the firm's liquidity. Postloss liquidity is initial cash, *L*, minus the cost of the loss event, S, plus any recovery under a hedge instrument, *H(S)*. Thus

$$T^S = T^S(L - S + H(S))$$

Now cash flow hedging resolves this problem by providing the postloss cash injection *H(S)* which neutralizes the loss *S*. The other set of strategies for dealing with this issue involve changing the functional relationship $T^S(.)$ conditional on the loss. To see this recall that the transaction costs arise mainly from the information asymmetry between insiders and outside investors, notably the agency costs we have considered. But these agency costs increase as the leverage increases. If a reduction in leverage is triggered by the occurrence of *S*, the firm will be able to secure new external funding at fairly low cost. Thus conditional hedge strategies such as forgivable debt or reverse convertible debt which have the feature $D' < 0$ will achieve this shift in the transaction cost function.

Risk Management and Non Linear Taxes[9]

The tax reason for hedging corporate risk arises because the typical firm's tax schedule is non linear. Ignoring for the moment carry forwards, corporate tax can be modeled as an option on the firm's earnings where the striking price is the value of the deductions the firm can take against current earnings. If the earnings are *N*, the marginal tax rate is *t*, and the firm can take *d* in deductions, then the actual tax will be

$$TAX = t\left\{MAX\left((N - d); 0\right)\right\}$$

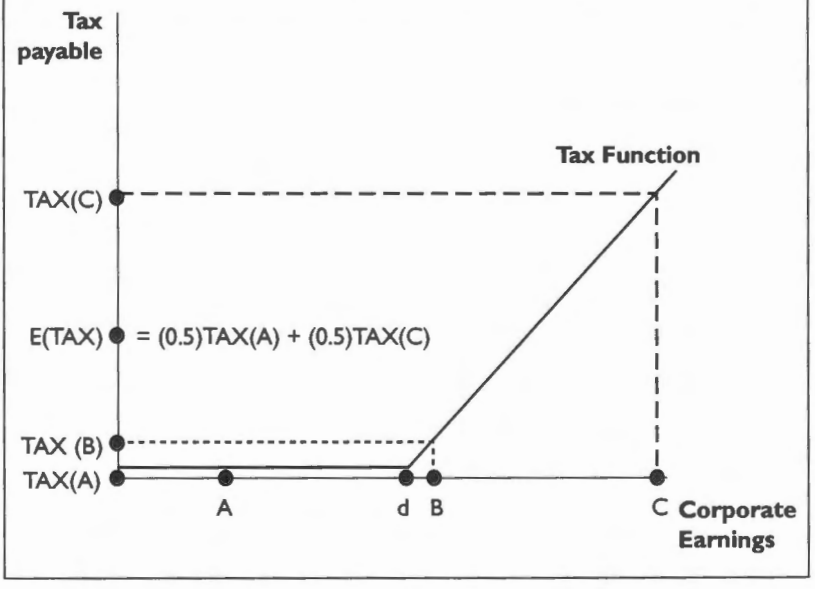
This describes the payoff to a call option. The value of the firm's contingent tax liability, *V(TAX)*, can be shown as *t* times a call option, C(.), as follows:

$$V(TAX) = t\left\{C(N, \sigma(N), d)\right\}$$

It is immediately apparent that, like other call options, the higher the risk of the underlying asset, in this case earnings, the higher the value of the call and therefore the higher the firm's expected tax liability. It follows that reducing the risk of the underlying asset will reduce the value of the option and thereby reduce expected taxes. The story has a nice intuition. Risk involves the possibility that earnings will be higher than expected or lower than expected. If higher, then as long as the firm is earning over its deduction *d*, each dollar of additional earnings will be taxed at *t*. But if earnings are less than expected, the firm will not get full tax relief since the earnings will fall below the tax shield and the tax deductibility will be wasted. By hedging, the firm avoids the additional tax on upside swings in earnings, but does incur much additional tax by avoiding the downside because of the deduction. This asymmetry, reduces taxes.

The tax effect is illustrated in Figure 2. The firm has a tax schedule represented by the kinked line which has a tax deduction

FIGURE 2
NON LINEAR TAXES AND RISK



of *d*. Earnings are risky; they can be either *A* or *C* each with a 0.5 probability. The expected earnings is the mid point *B*. With earnings of A the tax due, *TAX(A)*, is zero. With earnings of *C* the tax is *TAX(C)*. Given the 50-50 chance of either level of earnings, the expected tax is the halfway point shown as $E(TAX) = (0.5)\ TAX(A) + (0.5)\ TAX(C)$. If the firm hedges its earnings to the expected value of *B*, the tax payable for certain is now *TAX(B)*. Notice that this is less than the expected tax with volatile earnings even though the expected earnings has not changed.

The tax story so far is oversimplified, the tax code is more complex. A detailed treatment is beyond us here, but an illustration will show that there is still scope for adding value by managing risk. Carry forward provisions enable a firm to use unused deductions against future income. Thus unused tax deductions are not lost. However, the present value of a dollar carried forward is not equal to a dollar of deduction today. Firms cannot carry forward with interest, and there is a chance that the firm might not have sufficient future earnings to use a carry forward. Thus, the present expected value of a dollar carried forward is less than a dollar of current deduction. This means that the effective tax schedule is still non linear and the firm can still reduce expected taxes by hedging although carry forwards do limit the value of the gain.

The obvious strategy for reducing the value of the tax option is to change the risk of the underlying asset, i.e earnings. A hedge on earnings will accomplish this. However a less obvious way to do this is to change the striking price. The firm can deduct *d* from its earnings in the current year. An important source of earnings is often depreciation. Instead of buying the asset and depreciating it, the firm could lease the asset. To see this, first note that the problem is that the firm may lose part of its depreciation deduction because fluctuations in earnings can result in earnings below the value of the tax shield. Whether this occurs or not depends on the average level of earnings for the firm, degree of volatility around that average and the size of the tax shield. Thus a firm with low expected earnings, high volatility and high tax risks leaving a large part of its depreciation deduction unused. But a second firm with high expected earnings, low volatility and small tax shield is unlikely to have its earnings fall below its tax shield and can make full use of the depreciation deduction. Now consider the following transaction. Instead of buying an asset that it needs for production, the first firm (that cannot fully use its depreciation deduction) asks the second firm (that can fully use the deduction) to purchase the asset and lease it back to the first firm. With this lease, the overall

tax of the two firms is minimized and the price of the lease can be arranged so that the firms share this gain. Reinsurance is another transaction that can achieve the same result, i.e., the primary insurer transfers income to a reinsurer whose expected marginal tax rate is likely to be lower.[10]

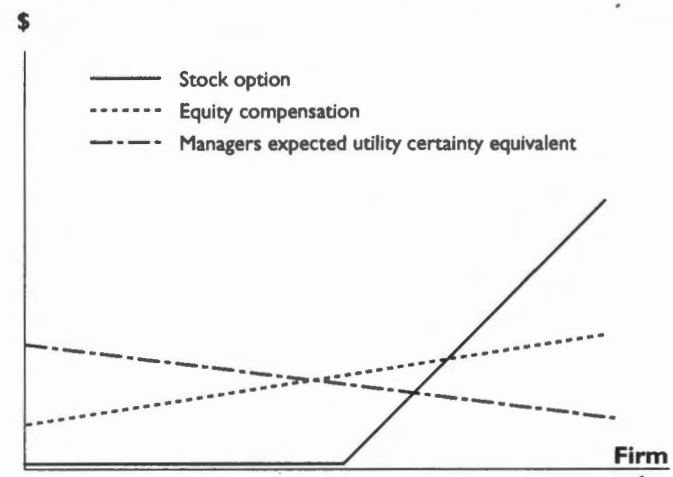
Managerial Utility Maximization[11]

Managers are paid agents of the firm's owners, the shareholders, and this principal agent relationship has been the subject of similar attention to that between owners and creditors. The basic problem is that, from a risk sharing viewpoint, it makes more sense to allocate risk to shareholders than to managers since the former can diversify firm risk more effectively. This theory suggests that managers be paid a flat salary and all residual risk accrue to the firm's owners. But to motivate performance, it is useful to align the interests of the managers and shareholders by means of incentive pay such as a bonus related to profit or by means of stock ownership. Incentive compatible pay exposes the manager to risk since profits and firm value reflect exogenous risk as well as managerial inputs. An extreme version of incentive pay is a stock option where the manager receives (usually out of the money) call options usually with a fairly long exercise date. Thus, incentive pay involves the familiar trade-off between risk bearing and efficiency.

The principal agent problem arises because the managers' interests are not naturally aligned with those of the shareholders. For example, if firm value is positively related to manager effort and managers exhibit disutility of effort then manager's expected utility will decline with firm value. Figure 3 shows the certainty equivalent of the manager's expected utility declining with value. Accordingly, with a flat salary, manager effort will tend to decline. This can be offset by relating salary to firm value by means of a profit bonus or share ownership plan. This will encounter some resistance from managers since risk is imposed on them. Accordingly a risk premium will need to be included in the compensation plan. The benefit of risk management is that it avoids the risk premium and lowers management resistance to incentive compensation. Thus one would expect to find that firms that have hedged risk will pay less on average in compensation and/or have a higher proportion of compensation in the form of incentive bonus.

To understand how risk management can add value, consider two different roles of risk management. First, risk management can add value as mentioned in the previous paragraph by achieving a

FIGURE 3
MANAGERIAL UTILITY AND COMPENSATION



preferred trade off between risk sharing and efficiency. If the risk is hedged with a specialized risk bearer (an insurer, investment fund, etc,) then the risk premium paid to that risk bearer should be lower than that paid to the manager. And with a hedge in place, the firm can load up its compensation to managers in favor of performance bonuses since these now entail little risk to managers. Thus, there should be an efficiency gain from enhanced performance.

The second type of risk management issue arises from differences between the owners' and managers' risk preferences. Owners may wish to hedge (or otherwise manage risk) for all the reasons given above. However, managers can have different interest in risk. Absent any compensation issues, managers may wish to hedge to protect their jobs. So far there seems to be a common interest in risk reduction. But the trade off may be very different. For example, imagine a large firm with many business divisions where the risks facing the separate divisions have a low correlation. Since risk can be diversified, the overall risk to the firm is less than the sum of the risk of the individual divisions, i.e. there is some risk spreading within the firm. In the aggregate, the risk to the firm is fairly low, the agency costs, bankruptcy costs, risk/tax effects are small and this would call for only a modest amount of insurance to be purchased. But divisional managers might be tempted to hedge the divisional risk. If every divisional manager were to act alone, too much costly insurance is likely to be purchased.

Thus, the second risk management problem becomes how to motivate managers to choose the risk management decisions that make sense for the firm as a whole. In the divisional firm just outlined, a plausible answer is a combination of linear compensation, profit centers and phantom and real hedges. Divisional managers are compensated as a linear function of divisional profits and are allowed to insure from a captive insurer. Divisional profit will reflect a premium for insuring divisional risk and will also reflect a payment of compensation or insurance for that loss. This ensures proper costing of risk at the divisional level. The insurance may be real or notional. The firm as a whole may not need to transfer all risk channeled through the captive insurer to an external counterparty or reinsurer. The amount of risk reinsured can be determined by the overall agency costs, bankruptcy costs, tax effects, etc.

Signaling Theories of Risk Management[12]

Various signaling theories have been developed to explain why firms may wish to control risk. Signaling theories are based on the idea that a party with private information may have an incentive to send a credible signal to other uninformed parties. The signal here is the hedging strategy chosen by the firm. Imagine insiders have favorable information about their own firms and its future performance potential but this information is not shared by outsiders such as investors. Furthermore, insiders in other firms privately know that they do not look so good. The private information could be about management quality, investment opportunities or about external factors that impact on the firm. The firms with the favorable information would like to be rewarded by the market for being better than the common herd. How can the firms with favorable private information transmit that information to outsiders without the other firms being able to replicate the signal?

Consider one such model. Each quarter investors have expectations about the firm's earnings. However earnings can be randomly up or down and therefore investors can be surprised either pleasantly or unpleasantly. These earnings shocks can be transient events that carry no information about future earnings potential, or persistent events which, though they occurred this quarter, have carry over implications for the future. For example a transient shock might be accidental fire damage to a facility that was expensive to repair but involved little disruption of production. A persistent shock could be a product liability claim that revealed ongoing quality control problems which could recur in the future. Now insiders know more about the composition of earnings and will

have a greater understanding about whether deviations from expected earnings are transient or permanent.

If a negative transient shock occurred and quarterly earnings were down, and it were known, investors would not be worried that the firms earnings were lower than expected and the stock price should not be unduly impacted. But if the earnings were down due to a persistent shock, investors would be worried for the future and the stock price would fall. But investors in fact cannot perfectly discern the reason that earnings were down. The danger is that the firm with a transient shock will be undervalued by the market since investors fail to realize that its misfortunes are quickly passing. These firms become targets for takeover by a raider that is able to successfully invest in inside information.

The problem here is that earnings fluctuations are a noisy signal of the future earnings potential and therefore of the firm's underlying value. Thus, a firm wishing to protect itself from potential mis-valuation by the market and possible takeover might wish to purge its earnings of any transient shocks. The appropriate strategy is therefore selective hedging; i.e. hedging only the transient events that can shock the firm's cash flows. Thus, one would expect a firm to insure property loss but not the risk in the marketing and performance of a new product. The hedge can be a conventional hedge (such as insurance) or be built into the debt as a forgiveness provision linked to specified non core risk (such as a catastrophe bond). This strategy will mean that all remaining shocks to earnings are persistent and are meaningful indicators of underlying firm value.

While hedging transient risk is an appropriate strategy for signaling underlying value, how can the firm's owners (who are largely uninformed in this theory) ensure that the managers (who are better informed) have an incentive to adopt this strategy? The obvious control is the managerial compensation structure. Without going into too much detail here, an appropriate strategy might be to pay the managers stock options. This result is quite surprising. Arguments given earlier suggest that options will induce managers to assume risk rather than hedge. But the issue is a little more subtle. What is initially volatile in this theory is the firm's *cash flows*. But options assume value according to the volatility of the firm's *share price*. Thus, we need to know how volatility of earnings translates into volatility of the share price and how this relationship is affected by the hedging of transient or persistent risk. Doherty and Sinclair, 2000 show that hedging transient risk only will partly

stabilize earnings (since some risk is removed) but it will maximize the volatility of stock prices since remaining shocks are pure signal. Thus, paying managers with stock options will lead them to select the desired hedging strategy (transient risk only).

A SUMMARY OF RISK MANAGEMENT STRATEGIES

The various explanations for costly risk bearing (tax, agency and related costs), and corresponding strategies (hedging, leverage, etc.), are summarized in Table 2. The messages that leap out of this table are

– that there is an arsenal of remaining strategies for coping with risk and

– that risk management is inseparable from capital structure decisions, from tax management and from compensation design.

In addition to the obvious strategy of hedging risk, changes in the level of leverage or more complex debt management such as forgivable or reverse convertible debt also can address many of the problems associated with risk.

The one strategy that addresses all explanations why risk is costly is hedging. If risk is causing a problem, then that problem can be caused by reducing the risk. But it must not be assumed that hedging is the magic pill and that all other strategies are redundant. Hedging can be costly. For example, insurance encounters moral hazard and adverse selection problems which will raise the *ex ante* price of coverage. In buying insurance, one is swapping the transactions costs associated with corporate risk bearing (bankruptcy costs, asset substitution, underinverstment, etc) with the transaction costs of the insurance policy. Insurance only adds value to the extent that the latter costs are lower.

There is a second potential problem with hedging that rests on a distinction between *core* and *non core* risk. Corporate hedging has largely focused on certain specific risk types, interest rate risk, foreign exchange risk and insurable risks such as property and liability losses. For many firms, these risks are incidental to its main operations and they have no comparative advantage in retaining the risk. These are the non core risks. For example, insurers can price

TABLE 2
MATCHING THE COSTS OF RISK WITH STRATEGIES

	bankruptcy cost	asset substitution	under-investment	crowding out	managerial optimization	signaling	non-linear taxes
hedge	•	•	•	•	•	• non core	•
leverage	•	•					
convertible debt		•					
R/convertible debt	•	•	•	•			
forgivable debt	•	•	•	•		• non core	
contingent equity	•		•	•			
second event hedge	•		•				
linear compensation					•		
non linear compensation						•	
leasing, reinsurance							•

and control property and liability risk better than most other firms and this risk is often insured. Interest rate risk, foreign exchange risk and commodity risk are largely exogenous to most firms and are often hedged in a competitive market. In contrast, firms have not typically hedged the risk that earnings depart from expectations due to the success of its business strategy, marketing or to product design. These latter risks are so called core risks. An entrepreneurial firm should have a comparative advantage in bearing these risks over alternative risk bearers and will earn economic rent for its success. Hedging such core risk would involve throwing out the baby with the bath water, i.e. giving up all profit that came with risk bearing.

An alternative strategy to hedging is to use one (or more) of the other strategies in Table 2 such as leverage, contingent leverage, etc. These strategies do not attach to specific types of risk, so it is "enterprise risk management" in its impact. Nor is the benefit dependent on whether the risk addressed is core or non core. If one chooses the hedging approach one is left with the core risk and its

dysfunctional effects. If one chooses the second approach one can mitigate the effects of all types of risk, but rarely are these effects completely removed. Other factors must be balanced against the risk management benefit when choosing the level and structure of debt, or the design of executive compensation. For example, in choosing leverage, one must consider not only the agency and risk effects but tax considerations. In choosing executive compensation, one must look beyond risk effects to the effects on managerial performance.

But hedging and alternative strategies in Table 2 are not mutually exclusive. The optimal level of hedging and insurance will be influenced not only by transaction costs but also by the firm's capital structure, compensation design and the value of the tax option. On the other hand capital structure and related decisions will need to be made in light of the available hedging opportunities. Thus the boundaries between risk management and other financial functions will disappear.

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☐ Notes

1. For example, Doherty 1985 ch.9, Froot and Stein 1998, Leland 1998, Smith and Stultz 1984, etc.

2. The other arguments for a put option, the interest rate and term to maturity, are not of direct concern and have been omitted.

3. See Campbell and Krakaw 1990, Jensen and Meckling, 1976, Leland 1998, Myers, 1977, Caillaud, Dionne and B. Julien, 2000.

4. Frierman and Viswanath, 1994, Doherty 1996, Doherty and Harrington 1997.

5. See Mayers and Smith 1987, Myers 1977.

6. One can object that it would be simpler to wait till the loss occurs then solicit insurance coverage if and when a loss occurs. This misses the whole point. Since the firm must seek and pay for the insurance after the loss, then this can be viewed as a project choice made after the loss. But the very issue we are examining suggests that the firm will prefer the high risk alternative (no insurance) since that increases the value of the default put.

7. See Mayers and Smith 1983, Smith and Stultz 1984, Shapiro and Titman 1985.

8. Doherty 1985, Froot, Scharfstein and Stein 1993.

9. Main, 1983b, Smith and Stultz 1984.

10. See Lew 1990.

11. Smith and Stultz 1984, Stultz 1984.

12. See Breedon and Viswanathan 1996, DeMarzo and Duffie 1995, Doherty and Sinclair 2000.