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The Determinants of Firms' Hedging Policies

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Abstract

We develop a positive theory of the hedging behavior of value-maximizing corporations. We treat hedging by corporations simply as one part of the firm's financing decisions. We examine (1) taxes, (2) contracting costs, and (3) the impact of hedging policy on the firm's investment decisions as explanations of the observed wide diversity of hedging practices among large, widely-held corporations. Our theory provides answers to the questions: (1) why some firms hedge and others do not; (2) why firms hedge some risks but not others; and (3) why some firms hedge their accounting risk exposure while others hedge their economic value.

I. Introduction

There is a considerable literature on the hedging practices of firms;[1] however, the focus is generally on risk-averse producers who use forward or futures markets to reduce the variability of their income.[2] Although this literature provides a useful basis for the analysis of hedging in closely-held corporations, partnerships, or individual proprietorships, it is not as applicable to large, widely-held corporations whose owners, the stockholders and bondholders, have the ability to hold diversified portfolios of securities.[3] In this paper, we develop a positive theory of hedging by value-maximizing corporations in which hedging is part of overall corporate financing policy.

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[1] A recent review of papers on hedging foreign exchange risks by Jacques [15] contains 80 references.

[2] References that consider the hedging problems for risk-averse agents include [1], [2], [10], [12], [13], [19], and [24].

[3] Notice that the literature on the demand for insurance addresses a problem that is similar to the problem discussed by the literature on hedging. However, for corporations, the determinants of the demand for insurance differ crucially from the determinants of hedging policies. For a corporation, the purchase of insurance provides real services due to the expertise of insurance companies in evaluating some types of risks and administering claims settlement procedures (for an analysis of these services, see [20]), while forward or futures contracts provide no apparent real services.

Modigliani/Miller [21] show that, with fixed investment policy and with no contracting costs or taxes, corporate financing policy is irrelevant. Their argument implies that if a firm chooses to change its hedging policy, investors who hold claims issued by the firm can change their holdings of risky assets to offset any change in the firm's hedging policy, leaving the distribution of their future wealth unaffected.[4] Thus, if the hedging policy affects the value of the firm, it must do so through (1) taxes, (2) contracting costs, or (3) the impact of hedging policy on the firm's investment decisions. We examine each of these potential explanations of the observed diversity of hedging practices among large widely-held corporations.[5] Our analysis provides answers to the following questions: (1) Why do some firms hedge while others do not? (2) Why do firms hedge some risks, but not others? (3) Why do some firms hedge accounting exposure, while others hedge economic values?

A definition of hedging. A firm can hedge by trading in a particular futures, forward, or option market even though it has no identifiable cash position in the underlying commodity. Furthermore, a firm can hedge by altering real operating decisions; for instance, a merger can produce effects similar to those of hedging through financial contracts. Thus, we adopt a fairly general definition of hedging in terms of the market value of the firm. Let $V(\underline{S})$ be the value of a firm if it does not hedge, where $\underline{S}$ is a vector of state variables. Consider two firms, a and b, that differ from the firm with value $V(\underline{S})$ only in their hedging policies. We say that firm a hedges more with respect to state variable i than firm b if the absolute value of the covariance of the value of firm a with state variable i is less than or equal to that of firm b. Therefore, hedging reduces the dependence of firm value on changes in the state variable. Alternatively, we say that firm a hedges more than firm b if the absolute value of the covariance of the value of firm a with the value of an unhedged firm with the same production policy and capital structure is less than or equal to that of firm b.

II. Taxes and Hedging

The structure of the tax code can make it advantageous for firms to take positions in futures, forward, or options markets. If effective marginal tax rates on corporations are an increasing function of the corporation's pre-tax value, then the after-tax value of the firm is a concave function of its pre-tax value. If hedging reduces the variability of pre-tax firm values, then the expected corporate tax liability is reduced and the expected post-tax value of the firm is increased, as long as the cost of the hedge is not too large. See Figure 1.

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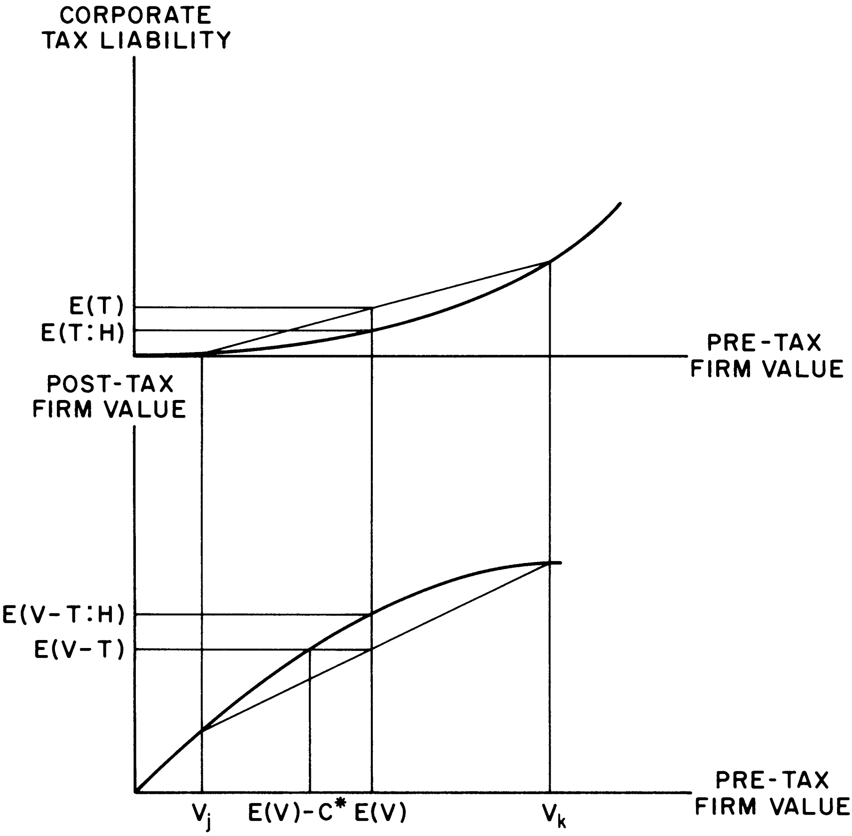
[4] If markets are perfect and complete, the value of the firm is independent of its hedging policy for other reasons, as well. For example, if a firm hedges the value of an input by purchasing forward contracts and that input price rises, the firm's pricing and production policies should not be affected by the existence of the hedge. The opportunity cost of the input is its current price, not the (sunk) cost of the forward contract.

[5] This diversity has been well documented in the case of foreign exchange risks. See, for instance, [23].



$V_j[V_k]$:	pre-tax value of the firm without hedging if state j [k] occurs.
$E(V)$:	expected pre-tax value of firm without hedging.
$E(T)$:	expected corporate tax liability without hedging.
$E(T{:}H)$:	corporate tax liability with a costless, perfect hedge.
$E(V-T)$:	expected post-tax firm value without hedging.
$E(V-T{:}H)$:	post-tax firm value with a costless, perfect hedge.
C^*:	maximum cost of hedging where hedging is profitable.

FIGURE 1

Corporate Tax Liability and Post-Tax Firm Value as a Function of Pre-Tax Firm Value
(If costless hedging reduces the variability of pre-tax firm value, then the firm's expected tax liability falls and its expected post-tax value rises.)

A. Hedging and Corporate Tax Liabilities

To analyze the effect of hedging on the present value of the firm's after-tax cash flow, we employ a state-preference model of firm value. We assume that there are s states of the world, with V_i defined as the pre-tax value of the firm in state of the world i. States of the world are numbered so that $V_i \leqslant V_j$, if $i < j$. Let

P_i be the price today of one dollar to be delivered in state of the world i, and $T(V_i)$ be the tax rate if the before-tax value of the firm is V_i. In the absence of leverage, the value of the firm after taxes, $V(0)$, is given by

$$V(0) = \sum_{i=1}^{S} P_i\left(V_i - T\left(V_i\right)V_i\right) . \tag{1}$$

Hedging can increase the value of the firm if there are two states of the world, j and k, such that $T(V_j) < T(V_k)$. To demonstrate this, suppose that the firm holds a hedge portfolio such that $V_j + H_j = V_k + H_k$, and that the hedge portfolio is self-financing in the sense that $P_jH_j + P_kH_k = 0$. (Such a portfolio is feasible if it is possible to create a portfolio that pays one dollar in state j and a portfolio that pays one dollar in state k.) Let $V^H(0)$ be the value of the hedged firm. It follows that

$$\begin{aligned} V^H(0) - V(0) &= P_j\left(T\left(V_j\right)V_j - T\left(V_j + H_j\right)\left(V_j + H_j\right)\right) \\ &\quad + P_k\left(T\left(V_k\right)V_k - T\left(V_k + H_k\right)\left(V_k + H_k\right)\right) > 0 . \end{aligned} \tag{2}$$

(The inequality is implied by the definition of a concave function.) Therefore, costless hedging increases the value of the firm. This analysis also implies that incomplete hedging (i.e., hedging that does not eliminate all uncertainty in future cash flows) also raises firm value.

The previous analysis must be modified if hedging is costly. If transactions costs of hedging do not exceed the benefits identified in (2), i.e., $V^H(0) - V(0)$, hedging increases firm value. The amount of hedging undertaken by the firm depends on the transactions cost structure of hedging. If transactions costs exhibit scale economies, then the firm either hedges completely, if the cost is low enough, or hedges nothing.

Hedging can be costly because the firm purchases before-tax cash flows from investors who receive after-tax cash flows. If the marginal investor's tax function is linear in the payoffs of the hedging instruments, our analysis still holds; the self-financing hedge portfolio analysis is still valid. However, if investors' tax functions are nonlinear and investors face different tax rates across states, the analysis is more complex. It could be the case that the decrease in the firm's expected tax liability from hedging is offset by an increase in the expected tax liability of the investors who enable the firm to hedge. Thus, there may be no impact on expected taxes. Hedging instruments would be priced accordingly and there would be no benefit from hedging. However, in this case, it would pay firms that expect to face a constant tax rate to offer hedging instruments to firms that expect their tax rate to be an increasing function of their cash flow. This mechanism tends to produce hedging instrument prices as if the marginal investor faces a linear tax function.[6]

[6] Cornell [6] offers some supporting evidence for this conjecture.

B. Empirical Implications

The basic provisions of the corporate tax code (a zero tax rate on negative taxable income, moderate progressivity for taxable income under \$100,000 and a constant rate thereafter) yield a convex statutory tax function. The convex region is extended by tax preference items like the investment tax credit that offset a stated maximum fraction, x, of a corporation's tax liability.[7] The effective marginal tax rate is constant only if taxable income exceeds $1/x$ times the corporation's accumulated investment tax credits, a number that can substantially exceed \$100,000. DeAngelo and Masulis [7] report that over the period 1964-1973, in any year an average of 27 percent of the firms filing tax returns paid no taxes; for the largest corporations, the average was between 10 percent and 20 percent.

The tax-reducing benefits of hedging increase if the function that yields after-tax income becomes more concave. Thus, if excess-profits taxes or investment-tax credits increase the convexity of the tax function, then such a tax will induce firms to hedge more. Conversely, allowing trading in tax credits reduces the convexity of the tax function and reduces the tax benefits of hedging.[8]

The three-year carry-back, fifteen-year carry-forward provision and the progressivity provisions of the tax code produce local concavities in the tax function.[9] A firm that faces concavities in the tax function finds it profitable to "reverse hedge," increasing the variability of its taxable income over that range of outcomes.

III. Debt and Hedging Policies

A. Transactions Costs of Bankruptcy

Transactions costs of bankruptcy can induce widely-held corporations to hedge.[10] Consider a levered firm that pays taxes on its cash flows net of interest payments to the bondholders. Let F be the face value of debt. If the value of the firm is below F at maturity, the bondholders receive F minus the transactions costs of bankruptcy. Otherwise, the shareholders receive firm value minus both taxes paid and the bondholders' payment, F. The lower are expected bankruptcy

[7] For tax years 1983 and 1984, the maximum tax offset by the investment tax credit is 85 percent. It was 50 percent in 1978, and increased by 10 percent per year until it reached 90 percent in 1982.

[8] Regulations are equivalent to in-kind taxes. For example, if unexpectedly large changes in firm value lead politicians to impose additional constraints on the firm, then these additional regulatory costs are like taxes even though they do not result from the filing of a tax form. Note also that if regulations typically impose contraints on firms expressed in terms of accounting numbers, then this establishes incentives for firms to hedge accounting rather than economic values.

[9] The fifteen-year carry forward provision applies only for operating losses. Notice that the existence of a minimum tax introduces further complications. However, the minimum tax tends to make after-tax income more of a concave function of before-tax income, as it implies that some taxes will be paid on positive cash flows. Cordes and Sheffrin [5] present evidence on the use of these provisions.

[10] Diamond [8] also argues that bankruptcy costs lead to hedging. In his model of financial intermediaries, financial intermediaries hedge all systematic risks, i.e., all risks that have no incentive effects. His inclusions are stronger than ours because in his model there are no cases in which it does not pay to hedge, either because of transaction costs or for other reasons discussed in this paper.

costs, the higher the expected payoffs to the firm's claimholders. By reducing the variability of the future value of the firm, hedging lowers the probability of incurring bankruptcy costs. This decrease in expected bankruptcy costs benefits shareholders. Figure 2 illustrates this point. If transactions costs of bankruptcy are a decreasing function of firm value, and the tax rate is either constant or an increasing function of firm value, expected after-tax firm value net of bankruptcy costs is higher if the firm can costlessly hedge.

To extend our analysis, we consider a simple model in which a firm issues debt to create a tax shield. Again, let P_i be the price today of one dollar delivered in state i and $T(V_i)$ be the tax rate, if the before-tax value of the firm is V_i. In the absence of leverage, the after-tax value of the firm is $V(0)$. We assume a levered firm issues pure discount bonds with face value F, and pays taxes on its before-tax value net of its payment to the bondholders. The after-tax value of a levered firm with the same investment policy as the unlevered firm is $V(F)$. For simplicity, it is assumed that $V_j < F < V_k$. If $V_i < F$, bankruptcy costs are given by $C(V_i) \leq V_i$. The difference in the value of the levered firm and the unlevered firm is given by

$$(3) \qquad V(F) - V(0) = \sum_{i=1}^{j} P_i\left(T\left(V_i\right)V_i - C\left(V_i\right)\right) + \sum_{i=k}^{S} P_i T\left(V_i\right)F,$$

where F corresponds to the payment to the bondholders in the absence of bankruptcy. By inspection, the value of the levered firm equals the value of the unlevered firm minus the present value of bankruptcy costs plus the present value of the tax shield from interest payments.[11] From equation (3), the value of the levered firm increases with decreases in the present value of expected bankruptcy costs.[12]

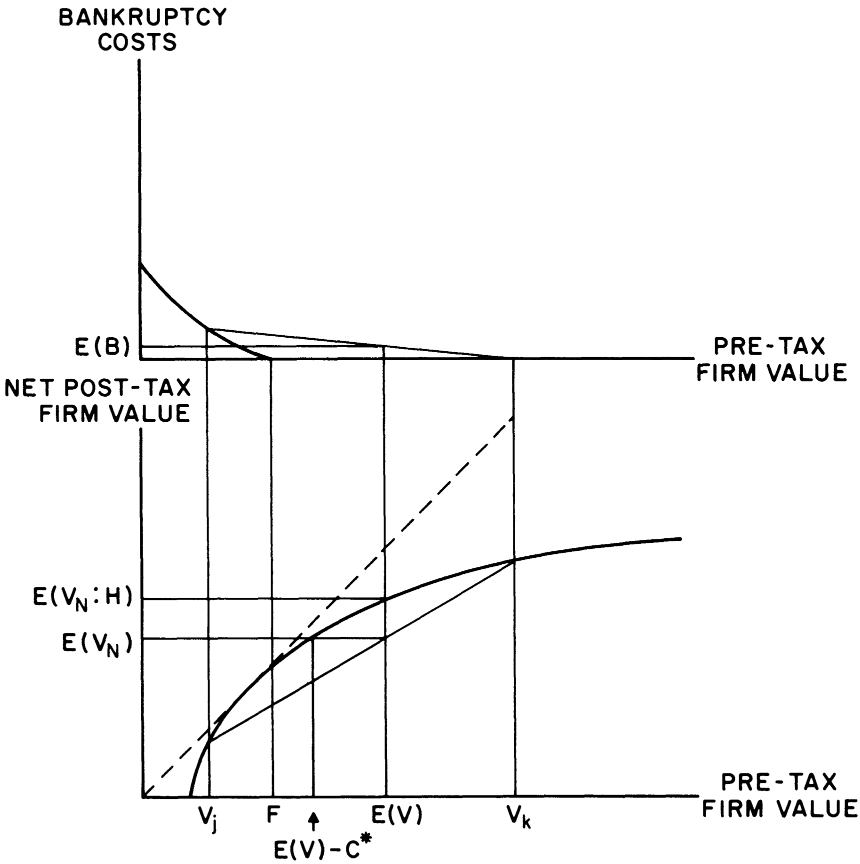
To analyze the effects of hedging on expected bankruptcy costs, we examine an unlevered firm whose shareholders plan to issue debt. Since potential bondholders have no market power, shareholders capture any increase in firm value from bond issuance. We assume that investment policy is fixed, ($V_i(0)$ is given for all is), and that any proceeds of a debt issue are distributed to the shareholders as a dividend.

The firm can reduce bankruptcy costs by holding a hedge portfolio that pays positive amounts when the firm would be bankrupt without hedging. To analyze the benefits of hedging, consider a hedge that pays $H_g < 0$ in state g and $H_m > 0$ in state m. We assume the hedge portfolio involves no current cash flows (i.e., $P_g H_g + P_m H_m = 0$) and that $V_g + H_g > F$ and $V_m + H_m > F$. By construction, $V_g < F$. Let $V^H(F)$ be the value of the leveraged firm if the firm hedges. Then, assuming a constant tax rate T, we have

$$(4) \qquad V^H(F) - V(F) = P_g C\left(V_g\right) + P_g T\left(F - V_g\right).$$

[11] The model we employ is similar to those developed by Kraus and Litzenberger [17] and Brennan and Schwartz [4]. While our treatment of taxes is not very sophisticated, it is important to understand that the role played by taxes in this analysis is simply to justify the existence of debt. A more realistic treatment of taxes would not add important insights to our analysis.

[12] Note that with a more sophisticated treatment of taxes the analysis becomes more complex. As the probability of bankruptcy decreases, the promised yield of the debt decreases and so does its tax shield.



$V_j[V_k]$: pre-tax value of the firm without hedging if state $j\,[k]$ occurs.
F: face value of the debt.
$E(V)$: expected pre-tax value of the firm without hedging.
$E(V_N)$: net expected post-tax value of the firm without hedging.
$E(V_N{:}H)$: net expected post-tax value of the firm with a perfect, costless hedge.
$E(B)$: expected bankruptcy cost without hedging.
$E(B{:}H)$: expected bankruptcy cost with perfect hedging will be zero in this case.
C^*: maximum cost of hedging where hedging is profitable.

FIGURE 2

Post-Tax Firm Value as a Function of Pre-Tax Firm Value in the Presence of Bankruptcy Costs
(If costless hedging reduces the variability of pre-tax firm value, then the firm's expected bankruptcy costs fall and its net (of bankruptcy costs) expected post-tax value of the firm increases.)

Since $C(V_g) > 0$ and $V_g < F$, $V^H(F) - V(F)$ is always positive. Thus, the hedge decreases the present value of bankruptcy costs and increases the present value of the tax shield of debt. (With a constant tax rate, expected tax payments from the hedge are zero unless the firm is bankrupt when the hedge pays off.) Shareholders benefit from hedging only because bankruptcy involves real costs to stockholders and bondholders—the direct bankruptcy costs and the loss of debt tax shields.

Again, with costly hedging it is still generally profitable to hedge. However, shareholders must account for hedging costs when they decide among alternative hedging strategies.

B. Bond Covenants and Costs of Financial Distress

For hedging to increase shareholder wealth, the firm must convince potential bondholders that it will hedge after the bond sale and, hence, that expected bankruptcy costs are not as high as the firm's investment policy would otherwise suggest. But potential bondholders recognize that hedging after the sale of the debt is not in the stockholders' best interests. Although hedging increases the value of the firm, it also redistributes wealth from shareholders to bondholders in a way that makes shareholders worse off.[13] Without an incentive to hedge, despite promising to do so, it will be difficult for the firm to make a credible announcement that it will hedge.[14]

There are at least two ways that market forces create incentives for shareholders to pursue a hedging policy. First, if the firm borrows frequently, it benefits from a reputation for hedging since that reputation increases the price for its new debt. Yet, such a reputation is not likely to be sufficient to insure that the firm will hedge when the probability of bankruptcy is large. Then, the gain from no longer hedging is likely to outweigh the cost of lost reputation, since the reputation is valuable only if the firm successfully avoids bankruptcy. Second, hedging provides a means whereby the firm can reduce the costs of financial distress imposed by bond covenants that constrain the shareholders to take actions they would otherwise avoid. For instance, binding bond covenants can force the firm to alter its investment policy; hedging can reduce the likelihood that covenants become binding.

C. Empirical Implications

Warner [28] suggests that transactions costs of bankruptcy are a small fraction of large firms' assets. Yet, small bankruptcy costs can be sufficient to induce large firms to hedge, if the reduction in expected bankruptcy costs exceeds the costs of hedging. Warner also indicates that the bankruptcy costs are less than proportional to firm size. If hedging costs are proportional, the reduction in expected bankruptcy costs is greater for the small corporation, and, hence, small firms are more likely to hedge.

A firm can hedge to reduce the expected costs of financial distress. Because bond covenants use accounting numbers to define states where the firm's activi-

[13] In this context, the decision not to hedge after debt has been sold has the same effect on the shareholders' wealth as a decision by the firm to substitute a more risky asset for a less risky asset. See [25].

[14] Note that this is an example of a time-inconsistent optimal policy. See [18].

ties are restricted,[15] a firm that wants to decrease the probability of financial distress must manage its accounting numbers so that bond covenants do not become binding. It is thus possible for a value-maximizing firm to choose to reduce the variance of its accounting earnings, even if this increases the variance of economic earnings.[16]

IV. Managerial Compensation, Risk Aversion, and Hedging

The corporation's managers, employees, suppliers, and customers are frequently unable to diversify risks specific to their claims on the corporation. Because they are risk averse, these individuals require extra compensation to bear the nondiversifiable risk of the claims.[17] With limited liability, the amount of risk that can be allocated to the stockholders is restricted by the company's capital stock. But the firm can reduce the risk imposed on other claimholders by hedging. Thus, as long as the reduction in compensation of managers and employees and other suppliers plus the increased revenues from customers exceed the costs of hedging, hedging increases the value of the firm.

A. Managerial Risk Aversion and Hedging

Shareholders hire managers because they have specialized resources that increase the value of the firm. Managers cannot use their expertise unless they have some discretion in the choice of their actions. Yet, unless faced with proper incentives, managers will not maximize shareholder wealth. The managerial compensation contract must be designed so that when managers increase the value of the firm, they also increase their expected utility. Frequently observed provisions of managerial compensation contracts make the manager's total current compensation an increasing function of firm value.[18]

The managers' expected utility depends on the distribution of the firm's payoffs. Hedging changes the distribution of the firm's payoffs and, therefore, changes the managers' expected utility. To analyze the managers' hedging choices, we define hedging as the acquisition of financial assets that reduce the variance of the firm's payoffs. The firm is assumed to acquire a hedge portfolio

[15] See [25] for a description and analysis of bond covenants.

[16] One also would expect firms to hedge more if accounting rules are changed to increase the variance of accounting earnings. Thus, firms will hedge less under FASB 52 than under FASB 8, as translation gains and losses are not recognized in earnings when they occur under FASB 52 while they were under FASB 8.

[17] Employees demand higher wages if the probability of layoff is greater. Managers demand higher salaries (or perhaps even an equity stake in the company) if the risks of failure, insolvency, and financial embarrassment are great. Suppliers set more unfavorable terms in long-term contracts with companies whose prospects are more uncertain. And customers, concerned about a company's ability to service their products in the future or fulfill warranty obligations, will be reluctant to buy its products. Reagan and Stulz [22] provide an analysis of risk-sharing when one party of the contract has a comparative advantage in using capital markets to diversify risks away.

[18] See [26] for a description and analysis of the provisions of management compensation contracts and see [11] for a discussion of the specification of bonus plans. Note also that we assume the manager's marginal tax rate is constant. Progressive tax rates only make managerial wealth a more concave function of firm value and thus reinforce our results based on risk aversion alone.

that creates neither a cash inflow nor outflow at acquisition. Let H_i be the payoff of the hedge portfolio in state of the world i so that

(5) $$H_i = \sum_j N_j \cdot Q_{ij},$$

where N_j is the number of shares of asset j purchased, and Q_{ij} is the payoff of one share of asset j in state of the world i.

To derive the optional hedge portfolio, we assume a two-period world in which the manager's end-of-period wealth equals the sum of his pecuniary compensation plus the payoff of his nontradeable investment in the firm. This implies that the manager's indirect utility function in state i is a function only of his end-of-period wealth in state i, written W_i; and his wealth is an increasing function of the total value of the firm in state i, i.e., $V_i + H_i$,

(6) $$U_i = U\left(W\left(V_i + H_i\right)\right); \quad i = 1, \ldots, S.$$

The indirect utility function of wealth is assumed to be strictly concave; thus, the manager is risk averse. With these assumptions, the manager maximizes expected utility

(7) $$U = \sum_i P_i \cdot U\left(W\left(V_i + H_i\right)\right),$$

where p_i is the probability of state i occurring, subject to the budget condition that

(8) $$\Sigma_j N_j \cdot Q_{0j} = 0,$$

where Q_{0j} is the price at the beginning of the period of a share of asset j. To obtain the optimal number of shares of each security, N_j, the first-order conditions are

(9) $$\sum_i P_i \frac{\partial U}{\partial W} W' \frac{Q_{ij}}{Q_{0j}} = \sum_j P_i \frac{\partial U}{\partial W} W' \frac{Q_{ik}}{Q_{0k}}, \quad \text{for all } j \text{ and } k,$$

where W' is the first derivative of function $W(\cdot)$. The first-order conditions state that the marginal increase in expected utility per dollar of security j purchased must equal the marginal increase in expected utility per dollar of security k purchased. To simplify, we assume that all financial assets have equal expected rates of return and that the firm incurs no transactions costs when it purchases or sells financial assets.

The solution to the hedging problem has several interesting properties. First, if the manager's end-of-period wealth is a concave function of the end-of-period firm value, the optimal hedging strategy is to hedge the firm completely, if this is feasible. The expected income of the manager is maximized if the firm is completely hedged, because the expected value of a concave function of a random variable is smaller than the value of the function evaluated at the expected value of the random variable (Jensen's Inequality). As the manager is risk averse, he will choose to bear risk only if he is rewarded for doing so by higher expected income. Since his expected income is maximized when the firm is completely hedged, the manager will choose to bear no risk.[19]

Second, if the manager's end-of-period wealth is a convex functon of the end-of-period firm value, but the manager's expected utility is still a concave function of the end-of-period value of the firm, the optimal strategy generally will be to eliminate some, but not all, uncertainty through hedging. In this case, the expected income of the manager is higher if the firm does not hedge, since his income is a convex function of the value of the firm. However, because the manager is risk averse, he will want to give up some expected income to reduce risk. Faced with a trade off between expected income and risk of income, the manager will not, in general, choose a policy that makes his income riskless.

Third, if the manager's end-of-period utility is a convex function of the end-of-period firm value, Jensen's Inequality implies that the manager's end-of-period utility has a higher expected value if the firm is not hedged at all. Bonus or stock option provisions of compensation plans can make the manager's expected utility a convex function of the value of the firm. If the manager's expected utility is a convex function of the value of the firm, the manager will behave like a risk-seeker even though his expected utility function is a concave function of his end-of-period wealth.

An example of a situation in which a firm does not hedge even though the manager is risk averse can make this point clearer. We assume that the compensation contract promises a payment equal to $\mathcal{T} + \text{Max}(V_i - K_i, 0)$. The option-like feature of this contract can be found in many compensation contracts. For simplicity, we assume that $S = 2$ and $V_2 > K > V_1 > \mathcal{T}$. The manager is assumed to maximize an expected utility function of the form

$$U = P_1 \frac{1}{d} W_1^d + P_2 \frac{1}{d} W_2^d ; \quad d < 1 . \tag{10}$$

The firm hedges if it purchases financial assets that pay a positive amount in state 1 and a negative amount in state 2. Given our assumptions, the expected payoff of the hedge portfolio must equal zero, which implies that $H_2 = (-p_1/p_2)H_1$. By eliminating H_2 in equation (7) and taking the partial derivative of the manager's expected utility with respect to H_1, one can easily verify that U is a decreasing function of H_1 for positive values of H_1 equal to or smaller than the value of H_1 required to hedge the value of the firm completely. Thus, the structure of the manager's compensation package can induce him not to hedge the firm at all.

Frequently, compensation packages make the manager's end-of-period wealth a concave function of the firm value in some regions and a convex function in others. This suggests that hedging will take place for some values of the firm and not others. Furthermore, for values of the firm that make the manager's end-of-period wealth a convex function of firm value, the manager may choose

[19] This result is equivalent to Arrow's [3] proposition that a risk-averse individual offered fairly priced insurance fully insures. See also [14].

to "reverse-hedge" (make the value of the firm even more dependent on the realization of some state variable).

We have assumed that the expected rates of return on all financial assets are equal and that transactions costs are negligible.[20] If expected returns to financial assets vary, the manager faces a trade off between expected income and risk of income. In such cases, he will hedge less if hedging involves going short in a portfolio with a high expected return. If transactions costs increase, the firm will hedge less, as hedging decreases the manager's expected end-of-period wealth. We also must assume that the firm has a comparative advantage in hedging over the manager. In other words, it should not pay for the manager to hedge his end-of-period wealth on his personal account. The combination of transactions costs, economies of scale, and the large number of managers within any firm make this comparative advantage likely.[21]

B. Managerial Compensation and Hedging

Our analysis has, thus far, taken as given the form of the management compensation contract. This analysis is interesting in itself since it produces positive statements about the firm's hedging policies. In reality, however, shareholders choose the management compensation package and, thereby, affect the hedging managers undertake. Making managerial wealth a concave function of firm value bonds the firm to a hedging policy. This should be important for a firm with debt or other fixed claims, as it offers greater assurance that the firm will hedge as long as that compensation policy is followed.

Managers whose compensation is a concave (or not too convex) function of firm value have incentives to reduce firm cash flow variability. Hence, such managers might reject variance-increasing positive net present value (NPV) projects. If hedging costs are negligible, it pays to let managers hedge as this increases incentives to take variance-increasing positive NPV projects. If shareholders instead try to prohibit hedging, managers will focus more on nonpriced risks. Still, as long as their compensation depends on firm value, managers have incentives to consider market valuation in evaluating projects.

With costly hedging, shareholders have incentives to devise a compensation plan that discourages managers from devoting excessive resources to hedging. This can be accomplished when computing the manager's compensation by filtering out those changes in firm value that are not under the manager's control and by making the manager's compensation a more convex function of firm value. However, it will generally not be efficient to eliminate all incentives to hedge. Earlier sections have demonstrated that hedging can be profitable. Moreover, a compensation plan that eliminates all hedging incentives would be costly to negotiate and implement.[22]

[20] Stulz [27] derives optimal hedging strategies in a continuous-time framework when holding costs for forward contracts are positive and when expected rates of return differ across assets for the case of foreign exchange exposure.

[21] If there is a single manager, scale economies can still induce the manager to hedge through the firm. Note that the size of most futures contracts is too large to make them useful to hedge a manager's income.

[22] The Diamond/Verrecchia [9] analysis suggests that bonus schemes would filter out the effect

C. Empirical Implications

A manager's compensation often includes a payment whose value depends on accounting earnings. It follows that the manager's expected utility depends on both the firm's market value and its accounting earnings. If the manager's expected utility depends heavily on accounting earnings and is a concave function of accounting earnings, one would expect the firm to principally hedge accounting earnings even if doing so increases the variance of the firm's economic value.

Managers' risk aversion can lead them to hedge, but it does not necessarily do so. If the compensation package of the manager is such that his income is a convex function of the value of the firm, it can be the case that the manager is better off if the firm does not hedge. Hence, the more option-like features in a firm's compensation plan, the less the firm is expected to hedge. For instance, bonus plans that make a payment to managers only if accounting earnings exceed some target number will induce managers to hedge less since this payment is a convex function of accounting earnings.

If the manager owns a significant fraction of the firm, one would expect the firm to hedge more, as the manager's end-of-period wealth is more a linear function of the value of the firm. This reinforces the incentive for closely-held firms to hedge since the owners are unlikely to hold well-diversified portfolios and, thus, have incentives to induce managers to reduce the variance of the firm's returns.

V. Summary and Conclusions

This paper presents an analysis of the hedging behavior of firms that differs fundamentally from the existing literature. Rather than assuming that the firm is risk averse, we follow modern finance theory and assume that incentives exist within the contracting process to maximize the market value of the firm. We then show that a value-maximizing firm can hedge for three reasons: (1) taxes, (2) costs of financial distress, and (3) managerial risk aversion. Our analysis offers a framework within which the wide diversity of hedging practices among firms can be understood.

Further research should focus on empirical tests of the implications of our analysis. To implement the tests, however, more detailed data are required than are available from sources such as *Compustat,* in which firms' hedging activities are aggregated with other contingent outcomes such as insurance contracts and outstanding lawsuits. Transactions, such as mergers, also accomplish some of the same results as hedging, although it is likely to be difficult to appropriately control for other changes in investment and financing policy to focus on these hedging characteristics.

of variables over which management has no control. However, the difficulty in administering such a scheme must explain why they are rarely observed.

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