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The Journal of Finance, Vol. 48, No. 1 (Mar., 1993), 267-284.

Stable URL:
http://links.jstor.org/sici?sici=0022-1082%28199303%2948%3A1%3C267%3AOTDOCH%3E2.0.CO%3B2-0

The Journal of Finance is currently published by American Finance Association.

THE JOURNAL OF FINANCE • VOL. XLVIII, NO. 1 • MARCH 1993

On the Determinants of Corporate Hedging

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ABSTRACT

Finance theory indicates that hedging increases firm value by reducing expected taxes, expected costs of financial distress, or other agency costs. This paper provides evidence on these hypotheses using survey data on firms' use of forwards, futures, swaps, and options combined with COMPUTSTAT data on firm characteristics. Of 169 firms in the sample, 104 firms use hedging instruments in 1986. The data suggest that firms which hedge face more convex tax functions, have less coverage of fixed claims, are larger, have more growth options in their investment opportunity set, and employ fewer hedging substitutes.

CORPORATE HEDGING REFERS TO the use of off-balance-sheet instruments—forwards, futures, swaps, and options—to reduce the volatility of firm value. Hence, if the value of an American manufacturing firm that faces competition in its U.S. markets from foreign manufacturers is inversely related to the value of the dollar, it could employ off-balance-sheet instruments to hedge that exposure. This exchange rate-induced volatility can be hedged by (1) selling a forward contract on the foreign currency, (2) selling foreign exchange futures on the foreign currency, (3) entering into a currency swap in which it receives cash flows in dollars and pays cash flows in the foreign currency, (4) buying a put option on the foreign currency, or (5) writing a call option on the foreign currency. Alternatively, the firm could hedge through an on-balance-sheet strategy; it might relocate production facilities abroad or fund itself in the foreign currency. In this paper we take the firm's investment and on-balance-sheet financing strategies as predetermined and focus on off-balance-sheet financial hedging.

The use of off-balance-sheet hedging instruments has grown dramatically over the past two decades. For example: treasury bond futures volume on the Chicago Board of Trade grew from 32 thousand contracts in 1977 to 75 million contracts in 1990; outstanding U.S. dollar interest rate swap notional

* Nance is from Lousiana Tech University, Smith is from The University of Rochester, and Smithson is from Chase Manhattan Bank. We wish to thank J. Binder, M. Flannery, R. Lease, W. Marr, K. Mitchel, J. Pringle, L. Wall, D. Mayers (the editor), and two anonymous referees for their comments and suggestions. The research was partially supported by the John M. Olin Foundation, the Lynde and Harry Bradley Foundation, and the Managerial Economics Research Center at the Simon School.

principal rose from $5 billion, when the market began in 1982, to $1 trillion in 1989; and the total number of nonequity option contracts traded grew from 2.6 million in 1983 to 64 million in 1990.[1]

These markets are dominated by corporations and institutions, not by individuals trading for their personal accounts. Thus, risk aversion provides an unsatisfactory explanation for the observed volume—portfolio theory implies that, given well-diversified investors, corporate hedging does not benefit shareholders by reducing the firm's cost of capital. Financial economics offers several hypotheses to explain the corporate purchase of hedging instruments. It suggests that hedging can increase firm value by reducing expected taxes, by reducing the expected costs of financial distress, or by reducing other agency costs. In this paper, we test these hypotheses explaining corporate hedging policy and offer empirical evidence on the relative importance of these corporate hedging motives.

In Section I, we review existing theory, identify economic incentives for a firm to hedge, and summarize the testable implications. We describe our data in Section II and in Section III employ a logistic regression to analyze the differences between the firms that use the hedging instruments and those that do not. Our conclusions are presented in Section IV. That section also contains a comparison of our results with those from other studies.

I. Hedging Determinants

A. Benefits of Hedging

A.1. Reduction in Expected Taxes

Jensen's inequality implies that, if a firm's effective tax schedule is convex, expected taxes are reduced by hedging (Mayers and Smith (1982) and Smith and Stulz (1985)). And, the more convex the effective tax schedule, the greater the reduction in expected taxes.

Statutory progressivity causes the tax schedule to be convex. Although the range of statutory progressivity specified in the U.S. corporate profit tax is relatively small, firms with more of the range of their pretax income in the progressive region of the tax schedule have greater tax-based incentives to hedge. In addition to statutory progressivity, tax preference items (for example, tax loss carry forwards, foreign tax credits, and investment tax credits) also make the effective tax schedule convex (see Zimmerman (1988)). The tax code generally specifies that if the firm's pretax income falls below some level, the value of tax preference items is reduced by either the loss of the tax shield or postponement of its use (see DeAngelo and Masulis (1980) and

[1] Data on volumes of futures and options contracts is taken from "Volume of Futures Trading," Futures Industry Association, Washington, D.C. Data on swap volumes are obtained from the International Swap Dealers' Association.

Gurel and Pyle (1984)). Hence, the tax benefit of hedging is greater if the firm has more tax preference items.

A.2. Reduction in Expected Transactions Costs of Financial Distress

Mayers and Smith (1982) and Smith and Stulz (1985) argue that hedging reduces the probability that the firm encounters financial distress by reducing the variance of firm value, and thereby reduces the expected costs of financial distress.[2] The magnitude of this cost reduction is a positive function of (1) the probability that the firm will encounter financial distress if it does not hedge, and (2) the costs the firm incurs if it does encounter financial distress.

The probability of the firm encountering financial distress is directly related to the size of the firm's fixed claims relative to the value of its assets. Hence, hedging becomes more valuable as the firm's fixed claims rise.

Firm size affects firms' incentives to hedge for several reasons:[3] (1) Financial distress can lead to bankruptcy and reorganization or liquidation, situations in which the firm faces direct legal costs. Warner (1977) finds that these direct costs of financial distress are less than proportional to firm size, implying that small firms are more likely to hedge. (2) Smaller firms are more likely to have taxable income in the progressive region of the tax schedule, again implying small firms are more likely to hedge. (3) Block and Gallagher (1986) and Booth, Smith, and Stolz (1984) argue that hedging programs exhibit informational scale economies and that larger firms are more likely to employ managers with the specialized information to manage a hedging program employing these instruments. This argument implies that large firms are more likely to hedge. (4) Finally, the swap, forward, and over-the-counter options markets exhibit significant scale economies in the structure of transactions costs, implying that large firms are more likely to hedge with these instruments. Thus, the relation between hedging and firm size is an empirical question.

A.3. Reductions in Agency Costs

Realizing that shareholders can behave opportunistically, potential bondholders protect themselves by lowering their offer price. To induce bondhold-

[2] This analysis presumes that the firm is solvent, an appropriate assumption for our sample of Fortune 500/S&P 400 firms. For firms in financial distress, hedging could increase the expected transacation costs of financial distress (see Binder (1989)).

[3] Strictly, firm size is a function of scale economies in organization and production; thus firm size is endogenous. However, given our limited understanding of the determinants of size, we include firm size itself as an explanatory variable.

ers to pay more, the firm must assure the bondholders that wealth transfers will not take place, either via restrictive covenants (see Smith and Warner (1979)) or hedging (see Mayers and Smith (1987) and Bessembinder (1991)). The nature of the firm's investment opportunity set affects the conflict between the firm's fixed and residual claimholders. Myers (1977) characterizes firms' potential investment opportunities as options and demonstrates that, with fixed claims in the firm's capital structure, taking a positive net present value project can reduce shareholders' wealth if the gains accrue primarily to the debtholders. Consequently, the shareholders can have incentives to forego positive NPV projects. Myers calls this the *underinvestment problem*. By restricting the states in which the firm would default on bond payments, hedging can control this problem. Hence, firms with more growth options in their investment opportunity set are more likely to undertake a hedging program aimed at reducing the variance in firm value. Since the underinvestment problem is more pronounced with more debt in the firm's capital structure, firms with higher leverage are more likely to hedge.

B. Substitutes for Hedging

A firm's use of off-balance-sheet hedging instruments is also influenced by its decisions with respect to other financial policies. For example, instead of off-balance-sheet hedging, a firm could manage financial price risk on its balance sheet by structuring its assets and liabilities to reduce its exposure to movements in financial prices. Hence, an alternative means of reducing the conflict between shareholders and bondholders is for the firm to reduce the debt in the capital structure. However, reducing the debt-equity ratio can be unattractive because it also reduces debt-related tax shields and increases the firm's tax liability.

The firm could control agency problems by using convertible debt or preferred stock rather than straight debt. Convertible debt helps control conflicts of interest among stockholders and bondholders and thereby reduces incentives to hedge. Instead of reducing the variability of the firm's equity by reducing the variance of the firm's net cash flows as the hedging instruments do, convertible debt includes an embedded option on the firm's assets which makes this liability more sensitive to firm-value changes and thereby reduces the sensitivity of equity value to firm-value changes. Preferred stock reduces the probability of financial distress. Although similar to debt, preferred stock pays periodic dividends rather than interest. Thus, while preferred shares do not produce tax shields, firms can omit a preferred dividend payment without being forced into bankruptcy. In contrast, a bankruptcy filing is virtually inevitable if an interest payment on debt is not met.[4]

[4] This argument also suggests that since private debt is less costly to renegotiate than public debt, the costs associated with financial distress are lower; so firms with more private debt would be less likely to hedge. However, covenants pre-commiting the firm to hedge its financial exposures have yet to evolve a standard form. The absence of standard covenant implies additional legal uncertainty that is more readily handled in private than public debt issues.

Firms also could reduce the probability of default by investing in more liquid or less risky assets or by imposing dividend restrictions. More liquid assets or lower dividend-payout ratios help to assure bondholders that funds will be available to pay fixed claims—the more times these fixed claims are covered, the lower are the expected costs due to financial distress and agency costs (see Smith and Warner (1979)). Finally, Kalay (1982) shows that a divided restriction is another means of controlling the underinvestment problem.

C. Summary of Empirical Predictions

Off-balance-sheet hedging can increase the value of the firm by reducing expected taxes, the costs associated with financial distress, or agency costs. The tax hypothesis suggests that the benefits of hedging should be greater (1) the higher the probability the firm's pretax income is in the progressive region of the tax schedule, (2) the greater the firm's tax loss carry forwards, and (3) the greater the firm's (investment) tax credits. The argument of reducing the transaction costs of financial distress implies that the benefits of hedging should be greater (1) the larger the fraction of fixed claims in the firm's capital structure and (2) the smaller the firm. However the informational and transactional scale economies argument implies that larger firms will be more likely to hedge; so the predicted impact of size is indeterminate. Agency cost arguments imply that the benefits of hedging should be greater (1) the higher is the firm's leverage and (2) the more growth options in the firm's investment opportunity set. Finally, other financial policies of the firm are substitutes for hedging because they reduce expected taxes, transaction costs, or agency costs. The substitutes for hedging imply the likelihood of the firm employing off-balance-sheet hedging instruments is lower (1) the more convertible debt the firm issues, (2) the more preferred stock the firm issues, (3) the more liquid are the firm's assets, and (4) the smaller is the firm's dividend payout.

II. Data

Since public data are not available on the corporate use of off-balance-sheet hedging instruments, we employ a survey to determine if specific firms used forward contracts, futures, swaps, and/or options in fiscal year 1986. We mailed our questionnaire (with a postage-paid return envelope) to the Chief Executive Officers of the union of the Fortune 500 and the S&P 400—535 firms in all. Firms which had not responded within a month were sent a followup letter and duplicate questionnaire. Completed questionnaires were received from 194 firms (36.3%); however 11 questionnaires were incompletely answered and the COMPUSTAT data was incomplete for 14 firms. Thus our sample contains 169 (31.6%) useable responses. Of the 169 firms in our sample, 104 firms use hedging instruments in fiscal year 1986, while 65 do not.

To check for response bias, we compare our 169 sample firms to a random sample of the 341 nonrespondents with respect to 12 characteristics which deal with the firm's effective tax rate, debt coverage, size, investment opportunities, and financial policies. This comparison of means indicates no statistically significant differences.

To examine the tax hypothesis, we use COMPUSTAT data to measure three aspects of the firm's effective tax function: (1) tax loss carry forwards available in 1985 to offset taxes payable in subsequent years; (2) investment tax credits used to offset federal corporate income tax payable in 1986; and (3) the range of the firm's pretax income in the progressive region of the tax schedule. To measure the range of income in the progressive region, we create a binary variable: A 95% confidence interval is formed around the 1986 pretax operating income using the standard deviation calculated from 1977 to 1986 income data. If any of the confidence interval falls within the progressive region (0–$100K), the tax progressivity variable is coded as one, otherwise it is coded as zero.

The comparison of the means for hedgers and nonhedgers in Table I indicates that the firms in our sample which use the off-balance-sheet hedging instruments have significantly more investment tax credits and more of the range of their pretax income in the progressive region of the tax schedule. However, there is no significant difference in tax loss carry forwards.

In Table I, we do not scale the tax preference variables. The hedging-induced reduction in expected taxes results from convexity of the effective tax function; so, the appropriate factor for scaling tax preference items is the firm's expected taxable income. Evidence in the accounting literature suggests that earnings are nonstationary; thus earnings changes are permanent and average earnings are undefined. Variables which could proxy for expected taxable income (for example, EBIT) take on negative values. Thus, tax preference items scaled by such a proxy are not monotonic with respect to the tax preference item. As the proxy goes from positive to negative, the ratio switches from a large positive number to a large negative number, thereby introducing bias.

A potential solution is to view the value of the firm's equity as the present value of the firm's expected future aftertax income stream. If the variation in effective tax rates and discount rates are small relative to the cross-sectional variation in expected taxable income, then we can deflate the tax preference items by the market value of the firm's equity. If we scale TLCF and ITC by the value of the firm's equity, the difference in ITCs between hedgers and nonhedgers is not statistically significant.

The range of the firm's income in the progressive region potentially incorporates effects other than simply the tax effect—i.e., firms with more of the range of their income in the progressive region are more likely to experience financial distress and are smaller. Similarly, the investment tax credit variable may proxy for an aspect of the investment opportunity set since only certain types of assets give rise to ITCs. These empirical problems make

Table I

Differences Between Hedgers and Nonhedgers

Expected relations among the variables and a comparison of the mean values for 169 Fortune 500/S & P 400 industrial firms in 1986.

Variable	Hypothesized Relation Between Hedgers & Nonhedgers	Means		Differences in Means	
		Hedgers (n = 104)	Nonhedgers (n = 65)	H − NH	t-Statistic
(1) Tax loss carry forwards	H > NH	38.950	40.770	−1.820	0.06
(2) Investment tax credits	H > NH	7.715	1.536	6.179	3.53
(3) Income in progressive region of tax schedule	H > NH	0.404	0.262	0.142	1.90
(4) EBIT/Interest expense	H < NH	7.951	15.017	−7.066	1.14
(5) Debt/Value	H > NH	0.218	0.228	−0.010	0.37
(6) Firm value	Indeterminant	4.112	1.837	2.275	4.16
(7) R&D/Value	H > NH	0.029	0.015	0.014	2.03
(8) Book/Market	H < NH	0.730	0.705	0.025	0.75
(9) Convertible debt/Value	H < NH	0.013	0.015	−0.002	0.31
(10) Preferred stock/Value	H < NH	0.016	0.057	−0.041	1.22
(11) Liquidity	H < NH	1.939	2.175	−0.236	1.90
(12) Dividend yield	H > NH	2.988	2.053	0.935	4.07

interpretation of our univariate results more difficult and tests of specific hypotheses less powerful.

To examine the hypotheses regarding the reduction in the transaction costs of financial distress, we use COMPUSTAT data on (1) the size of the firm and (2) the firm's leverage. Firm size is measured by the sum of the book value of its debt plus the market value of its equity. We employ two variables to measure leverage: the firm's debt-size ratio (the three-year average (1984 to 1986) of the ratio of book value of long-term debt from COMPUSTAT to our size measure) and the coverage of fixed claims (the ratio of the three-year average (1984 to 1986) of earnings before interest and taxes (EBIT) to the three-year average of total interest expense).

Two types of data are used to examine the agency cost hypotheses: (1) To examine the impact of fixed claims in the capital structure, we use our two leverage measures. (2) Growth options in the firm's investment opportunity set are proxied both by the firm's research and development expenditures (defined as 1986 R&D expenditures from COMPUSTAT deflated by our firm size variable) and by the ratio of the book value of the firms assets to the market value (our size variable).

The comparison of the means for hedgers and nonhedgers reported in Table I indicates that hedgers are significantly larger and have significantly larger R&D expenditures. However, the means reflect no significant difference between hedgers and nonhedgers with respect to leverage or the ratio of book to market. The hypothesis that firms with more leverage have a greater incentive to hedge assumes that the firm's investment opportunities are fixed. But, Smith and Watts (1992) document that firms with more investment options employ lower leverage. And, firms with more investment options have a greater incentive to hedge. Hence, the unconditional impact of leverage on hedging activity is indeterminate: Greater leverage implies more hedging to control the underinvestment problem; but, since greater leverage is associated with fewer investment options, greater leverage implies less hedging.

To examine hypotheses about the substitutes for hedging, we use COMPUSTAT data on (1) the firm's use of convertible debt (the 1986 book value of convertible debt divided by our firm size measure), (2) the firm's use of preferred stock (the 1986 book value of preferred stock divided by firm size), (3) the liquidity of the firm's assets (the 1984 to 1986 average of the firm's current ratio, i.e., current assets divided by current liabilities), and (4) the firm's dividend behavior (the 1984 to 1986 average of the firm's dividend-price ratio). Table I indicates that firms that use the hedging instruments have significantly less liquid assets and higher dividend yields; however, there is no significant difference in the use of convertible debt or preferred stock.

Since the probability of encountering financial distress is directly related to the firm's cash flow volatility, the firm would be more likely to hedge the more volatile its income. However, as a firm hedges, volatility is reduced; so, ex post, the volatilities could be indistinguishable. In fact, this is what our data indicate: the mean volatility of pretax income is 0.717 for nonhedgers

and 0.719 for hedgers. Moreover, a nonparametric sign test indicates no difference between the volatilities of the hedgers and those of the nonhedgers.

III. Empirical Evidence

To provide evidence on conditional relations, we employ a logistic (LOGIT) regression analysis; our dependent variable is binary. Maximum likelihood estimates of a logit regression are reported in column 1 of Table II. The dependent variable is coded as a "1" for those firms which use forwards, futures, swaps and/or options and "0" otherwise. The investment tax credit and dividend yield variables are statistically significant at traditional confidence levels; of the remaining variables, income in the progressive region of the tax schedule and R&D/value have chi-square values which are statistically significant at the 20% level.

It is not surprising that the power of this logit regression is low. The sample size is small relative to the number of parameters estimated: we use 12 right-hand side variables, while there are only 65 observations in the smaller group. Moreover, correlations exist among the variables; of the 66 Pearson correlation coefficients reported in Table III, 29 are statistically significantly different from zero. To increase the power of the tests, we consider restricted specifications for the logit regression. (Of course, this benefit is offset by any bias introduced by omitting relevant correlated independent variables.) We group the 12 right-hand side variables into 5 classes:

1. Three variables reflect aspects of the firm's effective tax function: Tax Loss Carry Forwards, Investment Tax Credits, and Range of the Firm's Pretax Income in the Progressive Region.
2. Two variables measure leverage: EBIT/Interest and Debt/Value.
3. One variable measures firm size: Firm Value.
4. Two variables proxy growth options in the investment opportunity set: R&D/Value and Book/Market.
5. Four variables reflect alternatives to hedging: Convertible Debt/Value, Preferred Stock/Value, Liquidity, and Dividend Yield.

Our restricted logit regression equations include as right-hand side variables only one variable from each of these five classes of variables—48 alternative logit regression equations. In Table II, we report the results of eight of these restricted logit-regressions (columns 2 through 9).

As indicated by the chi-square values, the restricted logit regressions increase the power of the tests of the hypothesized relations. The results of the restricted logit regressions suggest that a firm is more likely to hedge if it has more investment tax credits (5–7% probability value), if more of the range of the firm's income is in the progessive region of the tax schedule (11–16% probability value), if the firm is larger ($<$ 1–31% probability value), if the firm has more growth options (i.e., if the firm has higher R&D

Table II

Alternate Specifications of LOGIT Regressions Explaining Use of Forwards, Futures, Options, and Swaps by 169 of Fortune 500/S&P 400 Firms for 1986.

Entries in the body of the table are: Parameter Estimate/Standard Error/Chi Square/Probability Value.

	Predicted Sign of Parameter Estimate	Including All Right-Hand-Side Variables	Restricted Specifications							
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Tax loss carry fwds	+	0.0002 0.0010 0.05 0.83								
Investment tax credits	+	0.0911 0.0531 2.95 0.09	0.0931 0.0489 3.62 0.06	0.0925 0.0509 3.31 0.07	0.0971 0.0498 3.80 0.05	0.0971 0.0521 3.48 0.06				
Income in progressive tax region	+	0.6733 0.4792 1.97 0.16					0.5400 0.3831 1.99 0.16	0.5962 0.3941 2.29 0.13	0.6713 0.4272 2.47 0.12	0.7001 0.4364 2.57 0.11
EBIT/Interest	−	−0.0057 0.0080 0.51 0.48	−0.0056 0.0069 0.65 0.42	−0.0059 0.0073 0.66 0.42			−0.0040 0.0062 0.41 0.52	−0.0040 0.0065 0.38 0.54		
Debt/Value	+	−0.0194 1.9322 0.00 0.99			0.5592 1.0619 0.28 0.60	0.7113 1.0579 0.45 0.50			−0.4599 1.2198 0.14 0.71	−0.2840 1.2123 0.05 0.81

Table II—*Continued*

	Predicted Sign of Parameter Estimate	Including All Right-Hand-Side Variables (1)	Restricted Specifications (2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		0.0652	0.1156	0.0772	0.1174	0.0798	0.1991	0.1630	0.2067	0.1692
Firm value	?	0.0824	0.0713	0.0767	0.0719	0.0774	0.0717	0.0765	0.0725	0.0767
		0.63	2.63	1.01	2.67	1.06	7.70	4.54	8.14	4.87
		0.43	0.10	0.31	0.10	0.30	0.01	0.03	< 0.01	0.03
		9.1706	9.8809	10.5073	11.1409	11.9580	9.3725	10.3313	8.4579	9.7935
R&D/Value	+	6.7929	6.0470	5.7903	6.3727	6.1420	6.2579	6.1033	6.7031	6.4862
		1.82	2.67	3.29	3.06	3.79	2.24	2.95	1.59	2.28
		0.18	0.10	0.07	0.08	0.05	0.13	0.09	0.21	0.13
		−0.9361								
Book/Market	−	1.3691								
		0.47								
		0.49								
		3.498								
ConvDebt/Value	−	5.585								
		0.39								
		0.53								
		−0.8159	−1.1712		−1.2550		−1.4112		−1.1794	
PrefStock/Value	−	1.5276	1.3158		1.4286		1.4775		1.4593	
		0.29	0.79		0.77		0.91		0.65	
		0.59	0.37		0.38		0.34		0.42	
		−0.0384								
Liquidity	−	0.2488								
		0.02								
		0.88								
		0.3573		0.3156		0.3227		0.3454		0.3380
Dividend yield	+	0.1401		0.1257		0.1272		0.1272		0.1284
		6.50		6.31		6.43		7.37		6.93
		0.01		0.01		0.01		0.01		0.01

Table III

Pearson Correlation of Coefficients for 169 Fortune 500 / S & P 400 Using 1986 Data

	Tax Loss Carry Forwards	Investment Tax Credits	Income in Prog Region	EBIT/ Interest Exp	Debt/ Value	Firm Value	R&D/ Value	Book/ Market	Conv Debt/ Value	Pref Stock/ Value	Liquidity
Investment tax credits	−0.047										
Income in progressive reg	0.253	−0.019									
EBIT/Interest expense	−0.067	−0.056	−0.202								
Debt/Value	0.272	0.006	0.401	−0.299							
Firm value	−0.047	0.576	0.020	−0.081	0.039						
R&D/Value	0.128	0.066	0.230	−0.079	−0.258	0.067					
Book/Market	0.139	0.067	0.538	−0.355	0.624	0.018	0.099				
Convertible debt/Value	0.011	−0.095	0.121	−0.095	0.367	−0.128	−0.057	0.075			
Preferred stock/Value	0.204	−0.049	0.021	−0.074	0.196	−0.103	−0.034	0.069	0.060		
Liquidity	−0.111	−0.207	−0.198	0.262	−0.300	−0.317	0.027	−0.129	0.016	−0.038	
Dividend yield	−0.186	0.300	0.010	−0.014	−0.018	0.470	−0.074	0.149	−0.217	−0.199	−0.167

Correlation coefficients larger than 0.125 (0.150) are statistically significant at 90% (95%) confidence level.

expenditures (6–21% probability value)), and if the firm has higher dividend payout (1% probability value).[5]

We do not observe the expected significant positive association between hedging and leverage. In the case of our flow measure of leverage, the estimated coefficient on EBIT/Interest Expense is consistently negative as expected, but the highest significance level attained is 42%. In the case of our stock measure of leverage, the highest significance attained by the coefficient for Debt/Value is 50%. (Although not reported in Table II, if we use income in the progressive region of the tax schedule as the tax variable and the book-market ratio as the investment opportunity set variable, the estimated coefficient on Debt/Value is negative rather than positive.) This suggests that, if we do not include in our logistic regression an effective control for the firm's investment opportunity set, leverage can proxy for the firm's investment opportunities (as in the unconditional comparison of means in Table I). Without effective control, the coefficient on leverage will reflect not only the substitution effect we are trying to isolate (firms with more leverage have stronger incentives to hedge) but also this proxying effect (firms with more growth option use less leverage and have stronger incentives to hedge).

The empirical problems associated with scaling the tax preference variables that we note in Section II are again troublesome here. If we employ equity value as a scaling variable we find no significant relation between hedging and investment tax credits or tax loss carry forwards. These results reduce our confidence in the hypothesis that tax preference items are important determinants of hedging policy.

[5] Space constraints precludes reporting the estimated parameters of all 48 regressions in Table II. We exclude those regressions which use Tax Loss Carry Forwards as the tax variable, Book/Market as the growth options variable, and Convertible Debt/Value or Liquidity as the alternatives to hedging because these variables were generally less significant than those reported. Comparing the probability values for the variables in the eight regressions reported in Table II with those in the other 40 regressions,

	Probability Values	
	Reported In Table II (%)	In Unreported Estimations (%)
Tax Loss Carry Forwards	n/a	56–97
Investment Tax Credits	5–7	4–7
Income in Progressive Region	11–16	3–17
EBIT/Interest Expense	42–54	39–63
Debt/Value	50–60	61–94
Firm/Value	< 1–31	< 1–31
R&D/Value	5–21	4–24
Book/Market	n/a	39–78
Convertible Debt/Value	n/a	44–99
Preferred Stock/Value	34–42	32–49
Liquidity	n/a	36–94
Dividend Yield	1	1–4

A complete set of estimates is available from the authors.

IV. Conclusions and Comparison With Other Research

As we have noted, constraints in our data reduce the power of our tests; nevertheless we believe that our evidence provides a basis for a consistent view of hedging as a component of corporate financial policy. The accumulated evidence suggests that the firm's hedging decision is made the same way other financial decisions are made: firms hedge to reduce expected tax liabilities, to lower expected transactions costs, and to control agency problems.

Our study complements other examinations of corporate hedging policy. Booth, Smith, and Stolz (1984) survey 238 banks and savings and loan associations in the western United States regarding their use of interest-rate futures. Block and Gallagher (1986) survey 193 Fortune 500 firms regarding their use of interest rate futures and options. Houston and Mueller (1988) survey 48 firms regarding their hedging of foreign exchange exposures (accounting exposures). Wall and Pringle (1989) examine a group of 250 swap users obtained via a search of footnotes to annual reports. Mayers and Smith (1989) examine another form of hedging—the purchase of reinsurance by 1276 property-casualty insurance companies. Since the samples differ, more powerful inferences can be drawn from aggregating the evidence across the studies. We summarize the results of the six studies in Table IV.[6]

Our results are consistent with the proposition that firms with more convex tax schedules hedge more. Firms that use the hedging instruments have significantly more tax credits and more of their income in the progressive region of the tax schedule. (Since we do not scale the tax preference items, these results could be due to firm size—our evidence does not allow us to distinguish between the two hypotheses.)

Several papers examine issues concerning the probability of default and the costs of financial distress. Booth, Smith, and Stolz find that S&Ls use interest rate future more than do banks; Houston and Mueller find that firms with more foreign operations (firms with greater foreign exchange exposures) hedge more; Wall and Pringle find that firms with lower credit ratings are more likely to use swaps; Mayers and Smith find that firms with lower Best's ratings reinsure more.

Each study examines firm size but the collective evidence does not suggest that a single dominant motive explains the relation between firm size and hedging. Studies examining hedging via forwards, futures, options, and swaps generally conclude that large firms hedge more. This result is consistent with

[6] Of the six studies summarized in Table IV, only two—Mayers and Smith and this study—employ regression analyses, the other four employ comparisons of means. To provide a comparison of these studies which recognizes this methodological difference, we use the following conventions: "Yes" ("No") indicates that the sign of the relations between hedgers and non-hedgers reflected the means (or by the regression coefficient if estimated) is as predicted (opposite of that predicted), while dash (–) indicates that the hypothesis was not examined. A single asterisk (*) indicates that the difference in the means is statistically significant at the 0.05 probability/significance level.

significant information and transaction cost scale economies. Moreover, since futures trading does not exhibit the substantial transaction costs scale economies that are evident for forwards, options, and swaps, the Booth, Smith, and Stolz and Block and Gallagher results specifically suggest important informational scale economies. Yet Mayers and Smith's examination of insurance companies, where these scale economies should be less pronounced, indicates that small insurers hedge (reinsure) more. This result is consistent with size-related tax and financial distress incentives being relatively more important hedging decisions in this industry. However, in an insurance company, management should be familiar with reinsurance since it is a normal component of their business. Such managerial familiarity is less likely for the financial hedging instruments.

Block and Gallagher find a positive but statistically insignificant relation between the debt-equity ratio and hedging. Our results (1) that firms that use the hedging instruments have significantly higher R&D expenditures and (2) that firms with more investment options have both lower leverage and more hedging suggest that firms that use the hedging instruments have more growth options in their investment opportunity set. Additional anecdotal support for this finding is provided by Lewent and Kearney (1990) in their explanation of the way Merck decided to hedge their foreign exchange exposure. Merck noted that R&D expenditures represent a substantial portion of a pharmaceutical firm's total expense. Moreover, they note that R&D expenditures "furnish the basis for future growth;" indeed, "success in the pharmaceutical industry requires a continuous, long-term commitment to a steadily increasing level of research funding." However, the managers of the firm discovered, for Merck, that "earnings uncertainty caused by exchange rate volatility leads to a reduction of growth in research spending." They document that Merck implemented a hedging program using foreign exchange options specifically so that volatility in foreign exchange rates would not lead to underinvestment in R&D.

Our results are consistent with the proposition that hedging and other financial policies are substitutes. The comparison of means reported in Table I suggests that the firms that use the hedging instruments have less liquid assets and higher dividends; Table II indicates that the hedgers have significantly higher dividends.

Table IV contains a thirteenth determinant of hedging in addition to the 12 we examine in this paper. If the firm is owned by ill-diversified investors, risk aversion will provide incentive for the firm to hedge. In contrast to the other studies that deal only with publicly held firms, Mayers and Smith include Lloyds associations and closely held common stock companies and find that these firms hedge (reinsure) more than do firms with more diverse ownership.

Subsequent work might increase power of our tests by: (1) use of more data (note that SFAS 105—effective for financial statements for fiscal years ending after June 15, 1990—requires that firms disclose their use of certain off-balance-sheet financial instruments); (2) use of a continuous measure of

Table IV

Comparison of Results Across Six Empirical Analyses of Corporate Hedging Policies

"Yes" ("No") indicates that the sign of the relation between hedgers and nonhedgers reflected the means (or by the regression coefficient if estimated) is as predicted (opposite of that predicted), while a dash (—) indicates that the hypothesis was not examined. A Single asterisk (*) indicates that the difference in the means is statistically significant at the 0.05 probability/significance level.

Received Theory Suggests That a Firm is More Likely to Hedge	Booth, Smith, & Stolz (1984) Use of interest rate futures by 238 financial institutions in western US	Block & Gallagher (1986) Use of interest rate futures by 193 of Fortune 500	Houston & Mueller (1988) Hedging via financial instruments by 48 firms	Wall&Pringle (1989) Examination of 250 swap users	Mayers & Smith (1990) Use of reinsurance by 1276 insurance companies	Nance, Smith, & Smithson (1991) Use of hedging instruments by 169 of Fortune 500 firms
To reduce expected tax liabilities if...						
...the firm has more tax loss carry forwards	—	—	—	—	—	No
...the firm has more (investment) tax credits	—	—	—	—	—	Yes*
...more of the range of the firm's pretax income is in the convex region of the tax schedule	—	—	—	—	—	Yes
To reduce expected costs associated with financial distress if...						

Table IV—*Continued*

... the probability that the firm will encounter financial distress is higher	Yes*	Yes	Yes*	Yes	Yes*	Yes
... the costs of financial distress are high—i.e., if the firm is small	—	—	—	—	Yes*	
Due to information scale economies if...						
... the firm is large	Yes*	Yes*	Yes	Yes	—	Yes*
To reduce agency costs if the firm...						
... has more growth options in its investment opportunity set	—	—	—	—	—	Yes*
If the firm is not currently using alternatives to hedging—i.e., if the firm...						
... issues less convertible debt	—	—	—	—	—	No
... issues less preferred stock	—	—	—	—	—	Yes
... has less liquid assets	—	—	—	—	—	Yes*
... has higher dividends	—	—	—	—	—	Yes*
Due to risk aversion if the firm...						
... is owned by ill-diversified investors.	—	—	—	—	Yes*	—

hedging activity; (3) more effective separation of exogenous and endogenous variables.

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