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Why Firms Use Currency Derivatives

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Abstract

We examine firms' use of currency derivatives to in order to differentiate among existing theories of hedging behavior. Firms with greater growth opportunities and tighter financial constraints are more likely to use currency derivatives. This result suggests that firms might use derivatives to reduce cash flow variation that might otherwise preclude firms from investing in valuable growth opportunities. Firms with extensive foreign exchange-rate exposure and economies of scale in hedging activities are also more likely to use currency derivatives. Finally, the source of foreign exchange-rate exposure is an important factor in the choice among types of currency derivatives.

Why Firms Use Currency Derivatives

Large U.S. corporations increasingly turn to derivatives to reduce their exposures to a variety of risks. The motives for this behavior are not well understood, and the empirical evidence on the characteristics of derivatives users is limited. However, theoretical research provides several explanations for optimal hedging that result from different types of capital market imperfections. To distinguish among these explanations, we examine the use of currency derivatives for a sample of firms that have *ex ante* exposure to foreign exchange-rate risk. We also consider how the magnitude of this exposure affects the level of benefits that can be realized from reducing risk and the costs associated with risk reduction.

Our sample represents 372 of the *Fortune 500* nonfinancial firms in 1990. All of our sample firms have potential exposure to foreign currency risk from foreign operations, foreign-denominated debt, or a high concentration of foreign competitors in their industries. Approximately 41 percent of these firms use currency swaps, forwards, futures, options, or combinations of these instruments. We find that firms with greater growth opportunities and tighter financial constraints are more likely to use currency derivatives. This result is consistent with the notion that firms use derivatives to reduce the variation in cash flows or earnings that might otherwise preclude firms from investing in valuable growth opportunities (Shapiro and Titman (1986), Lessard (1990), Stulz (1990) and Froot, Scharfstein, and Stein (1993)). The underinvestment cost explanation for optimal hedging suggests that, contrary to recent media hyperbole, derivatives may provide a valuable benefit to firms that use them rationally.

We also examine currency derivatives use for naturally-hedged firms, those with foreign operations *and* foreign-denominated debt. For this sample, research and development (R&D) expenses and short-term liquidity are not significant determinants of currency derivatives use. However, these variables are still significant determinants of derivatives use for firms with foreign operations but no foreign-denominated debt. These results suggest that foreign-denominated debt and currency derivatives act as substitutes for hedging foreign operations.

The likelihood of using currency derivatives also is positively related to foreign pretax income and sales, and foreign-denominated debt. These results are consistent with our argument that the benefits of hedging are greatest and the costs lowest for firms with extensive foreign exchange-rate exposure. Finally, larger firms and firms that use other types of derivative instruments, including interest-rate-based and commodity-based derivatives, are more likely to use currency derivative instruments, which suggests that economies of scale in costs are important determinants of currency derivatives use.

Because we observe derivatives use, not "hedging," our dependent variable might measure speculation rather than hedging. Therefore, we consider firms' motives in using currency derivatives to speculate and the implications of speculation for our results. Although we find that some of our proxy variables are important determinants of both optimal speculation and optimal hedging (such as firm size), other firm characteristics (such as those associated with underinvestment costs) are unrelated to optimal speculative motives. Therefore, although currency derivatives use is not a direct measure of hedging, our results suggest that on average, our sample firms are not speculating with currency derivative instruments.

The paper proceeds as follows. Section I summarizes this paper's contribution to the existing literature on derivatives use. Section II reviews the incentives for derivatives use and discusses the effects of underlying exposure and costs of risk management on a firm's ultimate hedging decision. Section III describes our sample and the collection of derivatives data. Section IV reports univariate and logit tests of the determinants of the use of currency derivatives as well as the results of robustness checks on those tests. We test the determinants of the choices among types of derivative instruments in Section V. Section VI concludes.

I. Overview of Derivatives Use Studies

Our paper is one of the first cross-sectional studies to examine the determinants of corporate derivatives use by employing new annual report disclosures required by the Financial Accounting Standards Board, rather than survey data. We contribute to the empirical literature

through our sample construction and empirical methodology. Our sample of *Fortune 500* firms with *ex ante* foreign exchange-rate exposure reduces noise in our empirical tests by excluding firms that may have incentives to reduce variance, but do not have *ex ante* exposure. At the same time, our sample retains cross-sectional variation in the firm characteristics that are predicted to be associated with optimal hedging. Thus, our results are applicable to a broad range of firms. Other empirical studies have either used broad but unrestricted samples (Dolde (1993, 1995), Nance, Smith and Smithson (1993), Mian (1996), and Francis and Stephan (1990)) or industry-specific samples (Schrand and Unal (1996), and Tufano (1996)). By construction, industry-specific studies diminish cross-sectional variation in firms' risk exposures, but they do so at the expense of cross-sectional variation in the potential incentives to hedge.

Our empirical tests also include a set of hypotheses that are more comprehensive than those of empirical studies that use large cross-sectional samples. We organize the various theories into a single framework by discussing the incentives for derivatives use from the perspectives of managers, bondholders, and equityholders. With this added structure, we are able to identify firm characteristics that have not been previously considered, and we are able to define our variables to match the testable implications of the theories. In addition, by estimating alternative specifications of our empirical models, we address issues of endogeneity related to a firm's derivatives use, capital structure, and management compensation. While we cannot completely eliminate the problem of endogeneity, all our results are nevertheless robust to these alternative specifications.

Finally, unlike other empirical studies, we extend the testable implications of extant theories on derivatives use by considering how the cost of using derivatives affects the decision to use them. We find that firms with the greatest economies of scale in implementing and maintaining a risk management program are more likely to use currency derivatives. Moreover, we find that the source of underlying exposure to foreign exchange-rate risk affects not only the choice to use these derivatives, but also the choice among different types of instruments. For example, foreign exchange-rate exposure resulting from foreign operations generally represents

frequent short-term transactions in which the payment amount varies across transactions and is not determined until the transaction is finalized. We find that firms with currency exposure resulting from foreign operations or import competition are more likely to use forwards only, or forwards in combination with futures or options, than currency swaps. This finding is consistent with the notion that forward contracts and options provide a relatively low-cost method for matching the payoffs of frequent and uncertain transactions.

In contrast, the foreign exchange-rate exposure associated with a foreign debt contract is known at the inception of the contract. Thus, the exposure represents a relatively smaller number of transactions with multiple, but certain, subsequent payments. Consequently, a firm can implement a single long-term risk management strategy at the initiation of the debt contract. Consistent with this argument, we find that firms that use currency swaps or combinations of swaps have relatively higher levels of foreign-denominated debt than firms that use no currency derivatives. These results related to the choice of derivative instrument are consistent with managers rationally hedging foreign exchange-rate exposure. This behavior, however, is often questioned in the current debate over regulation of corporate derivatives use.

II. Theories of Derivatives Use

Theories of optimal hedging demonstrate that capital market imperfections create incentives for firms to use derivative instruments. While these imperfections might be necessary for optimal derivatives use, they are not sufficient conditions. We argue that given these incentives, a firm's ultimate decision to use derivatives also depends on the level of its exposure to foreign exchange-rate risk. In addition, a firm's choice to use currency derivatives depends on the costs of managing foreign exchange-rate risk. In this section, we propose proxies for the three factors affecting a firm's derivatives decision: the incentives to use derivatives, the exposure to foreign exchange-rate risk, and the costs of implementing a derivatives strategy.

A. Incentives for derivatives use

Managers: Smith and Stulz (1985) demonstrate that when a risk-averse manager owns a large number of the firm's shares, his expected utility of wealth is significantly affected by the variance of the firm's expected profits. The manager will direct the firm to hedge when he believes that it is less costly for the firm to hedge the share price risk than it is for him to hedge the risk on his own account. Consequently, Smith and Stulz predict a positive relation between managerial wealth invested in the firm and the use of derivatives.

We measure the managerial wealth derived from shares by the log of the market value of common shares beneficially owned (excluding options) by officers and directors as a group (MGRWLTH). Ideally, we would like a proxy which measures the *percentage* of total managerial wealth invested in the firm; however, total managerial wealth is not observed. Using MGRWLTH assumes that total managerial wealth is constant across managers in all firms and that the size of the management team is constant across all firms. Table I presents the predicted signs of the coefficient estimates for each proxy variable. The Appendix contains detailed definitions and data sources for each variable.

[Insert Table I here]

The expected utility of managerial wealth can be a convex function of the firm's expected profits when managers own unexercised options. In this case, managers can choose to increase the risk of the firm in order to increase the value of their options. Assuming derivatives are used for hedging, Smith and Stulz predict a negative relation between option holdings and derivatives use.

We measure managerial ownership of options (OPTS) by the log of the market value of the shares obtainable by using outstanding options. These options are exercisable within 60 days of the date for which managerial share ownership is reported in proxy statements. This represents a crude proxy for convexity of the compensation function created by employee stock options.

However, because we are unable to obtain information about the total number of options outstanding, their exercise prices and expiration dates, we cannot determine if the options are in- or out-of-the-money, or the amount of money at risk. The disincentives related to hedging are greatest when the options are out-of-the-money[1].

Bondholders: Smith and Stulz (1985) also show that exogenous bankruptcy costs create incentives for bondholders to support optimal hedging. By reducing the variance of a firm's cash flows (or accounting profits), hedging decreases the probability, and thus the expected costs, of financial distress. These exogenous bankruptcy costs can include, for example, the costs related to the deterioration or loss of long-term relationships with suppliers and customers (Shapiro and Titman, 1986). We use two measures of borrowing capacity as proxies for a firm's pre-hedging probability of financial distress: the interest coverage ratio (COV_AV) and the long-term debt ratio (DE_AV). The lower a firm's coverage ratio and the higher its long-term debt ratio, the greater the probability of financial distress. Consequently, the *expected* costs of financial distress for those firms are greater, assuming that exogenous bankruptcy costs are constant across firms. Therefore, the lower a firm's coverage ratio and the higher its long-term debt ratio, the more likely the firm is to use derivatives, *ceteris paribus*[2].

The use of the long-term debt ratio as a proxy for expected financial distress costs is not without controversy. In the interpretation above, we assume that a greater probability of financial distress leads to greater expected costs. We ignore the possibility that exogenous financial distress costs might be an important determinant of a firm's debt choice. For example, a firm with high exogenous distress costs might choose a low long-term debt ratio. However, we address this issue through extensive robustness checks. For example, we use a firm's Standard & Poor's credit rating in place of its long-term debt ratio as a measure of expected distress costs. In another robustness check, we assume that firms within specific industries have a common exposure to distress and replace long-term debt ratios with industry-adjusted ratios. We also model the derivatives choice and debt choice simultaneously. The debt choice equation includes firm characteristics that control for cross-sectional variation in exogenous financial distress costs.

A hedging strategy will only reduce expected bankruptcy costs to the extent that the firm can commit *ex ante* to following a hedging strategy after debt proceeds are received. Such a commitment may be achieved directly through bond covenants. Alternatively, bondholders may be able to infer that hedging is an optimal firm strategy in equilibrium for reasons unrelated to reducing the costs of external financing. At least four of our sample firms disclosed in 1991 that bond covenants or credit agreements require them to hedge some portion of their interest rate exposure.

Froot, Scharfstein, and Stein (1993) formalize the Smith and Stulz financial distress explanation for optimal hedging by endogenizing bankruptcy costs. Like Shapiro and Titman (1986), Lessard (1990), and Stulz (1990), Froot et al. argue that without hedging, firms are more likely to pursue suboptimal investment projects (Myers, 1977). Hedging mitigates this underinvestment problem by reducing not only the costs of obtaining external funds, but also a firm's dependence on external financing. Therefore, we predict a positive association between potential underinvestment costs and the benefits of hedging.

We use three variables as proxies for the growth opportunities available to a firm: RD is the ratio of a firm's research and development expenditures to its sales; PPE is the ratio of a firm's capital expenditures for property, plant, and equipment to firm size (SIZE), measured as the book values of the firm's debt and outstanding preferred stock plus the market value of the firm's equity; and BM is the book value of a firm's common equity scaled by its market value. The underinvestment cost hypothesis, however, predicts that these costs result from the interaction of *both* potential growth opportunities *and* costly external financing. Thus, we create three additional variables to measure underinvestment costs by interacting a firm's long-term debt ratio multiplicatively with the three proxies for growth opportunities: RD, 1/BM, and PPE. We use the inverse of a firm's book-to-market ratio (BM) so that there is a positive predicted relation between each of these variables and derivatives activity.

Nance, Smith, and Smithson (1993) argue that firms can control the agency and expected financial distress costs associated with long-term financing not only by hedging, but also by

issuing convertible debt (CONV) or preferred stock (PS). Because CONV and PS are possible substitutes for hedging, Nance et al. predict negative relations between derivatives use and these debt instruments. In contrast to this prediction, we (indirectly) predict a positive relation between derivatives use and both CONV and PS. We base our prediction on the Froot et al. argument that firms that are more financially constrained are exposed to greater underinvestment costs. This prediction assumes that preferred stock and convertible debt reflect additional leverage, which constrains a firm's access to external funds.

Nance et al. also argue that firms can reduce the expected financial distress and agency costs associated with long-term debt by maintaining greater short-term liquidity. We use two variables as proxies for a firm's short-term liquidity: the quick ratio, which is cash and short-term investments divided by current liabilities (QUICK_AV); and the dividend payout ratio (DIV_AV). The quick ratio, a variant of the current ratio, measures a firm's ability to repay short-term operating liabilities with readily available cash. The numerator of the quick ratio differs from that of the current ratio by including only cash and marketable securities, rather than all short-term assets. Because converting certain short-term assets, such as inventories or accounts receivable, to cash can create information costs similar to those related to debt financing, the quick ratio can capture the concept of internal wealth used in Froot et al. better than the current ratio. The greater a firm's quick ratio and the lower its dividend payout ratio, the lower its need to hedge to reduce the expected financial distress and agency costs of straight debt. Froot et al. also predict a negative association between liquidity and hedging. This prediction results from interpreting liquidity not as a substitute for long-term debt, but as a measure of the availability of internal funds.

Equityholders: Smith and Stulz (1985) demonstrate that hedging increases the expected value of an equityholder's ownership claim when a progressive statutory corporate tax schedule creates concavities in a firm's expected profit function. Tax preference items such as tax credits, which are subtracted from pretax income, indirectly create convexity in the tax liability (concavity in firm value), because the present value of unused preference items decreases as they are carried

forward to future periods. Reducing variance through hedging increases the expected value of tax benefits because the probability of using preference items increases with the level of a firm's taxable income. We measure the availability of tax preference items using the book value of net operating losscarryforwards outstanding scaled by total assets (NOL[3]).

Two additional proxies for tax incentives were considered by Nance, Smith, and Smithson (1993). However, these proxies are not used in this paper because our sample period follows the Tax Reform Act (TRA) of 1986. Their first proxy measures a firm's probability of facing progressive tax rates. Because rate changes regulated by TRA induce volatility in the time series of tax expense, the Nance et al. metric might overstate management's expectations of the firm's probability of operating in the progressive tax region.[4] Their second proxy measures the availability of tax preference items by using available investment tax credits (ITCs). TRA generally repealed ITCs (Code Section 49). Consequently, we use only net operating loss carryforwards as a proxy for tax incentives.

DeMarzo and Duffie (1991) argue that equityholders can benefit from hedging when managers have private information about an unobservable risk that affects the firm's payoffs. In their model, hedging gives uninformed equityholders reduced noise in their information sets concerning the variability of a firm's payoffs because hedging reduces their variance. Equityholders support hedging because they can make better optimal *portfolio* optimization decisions. DeMarzo and Duffie's model suggests that equityholders of firms with greater informational asymmetry will derive greater benefits if the firm hedges.

We use two proxy variables to measure information asymmetry: the percentage of institutional ownership of the sample firm (IO), and the number of investment firms with analysts following the sample firm (ANLST). We assume that a larger analyst following and a greater number of institutional investors are positively related to the availability of information, and thus negatively related to the probability of hedging.

B. Variation and Exposure

Firms with greater variation in cash flows or accounting earnings resulting from exposure to foreign exchange-rate risk have greater potential benefits of using currency derivatives. We measure this variation related to operating activities using the absolute value of the ratio of pretax foreign net income to total sales (FORINC).[5] The higher a firm's foreign pretax income, the greater the benefits from hedging. Income represents the net of foreign-denominated revenues, and also the direct and indirect expenses, which may be foreign-denominated, related to foreign operations. To the extent that costs are a natural hedge of foreign revenues, net profit represents the underlying exposure to foreign currency risk. But because this measure can also include allocated domestic expenses, we additionally measure exposure to foreign exchange-rate risk by using the ratio of foreign sales to total sales (FORSALES) and the ratio of foreign assets to total assets (FORASSETS).[6]

Foreign-denominated debt can also act as a natural hedge of foreign revenues, thereby decreasing a firm's foreign exchange-rate exposure. On the other hand, foreign debt can increase a firm's exposure to foreign exchange-rate risk if debt-related cash outflows and net foreign-denominated cash inflows are negatively correlated. Because this correlation cannot be determined from publicly available data, we cannot predict the relation between foreign debt and derivatives use. We measure the exposure of a firm's debt to foreign exchange-rate risk by the dollar equivalent amount of foreign-denominated long- and short-term debt (LTFRDT and STFRDT). We also use an indicator variable equal to one (FORDEBT) if the firm has quantifiable foreign-denominated long- or short-term debt, or makes a qualitative, but not quantitative, disclosure about the existence of foreign-denominated debt.

Finally, variation in a firm's short-term cash flows is related to changes in exchange rates when foreign competitors can affect market prices, and thus demand for domestic output. We measure this competitive exposure by using the percentage of imports in a firm's four-digit SIC industry relative to total industry output (IMPORTS). As the percentage of imports increases,

changes in the value of the dollar versus other currencies become a more significant factor in demand for domestic output.

C. Costs

Costs also play a role in a firm's decision to use currency derivatives and in its choice among derivatives strategies. We consider two major components of these costs: those associated with initiating and maintaining a risk management program in general, and those associated with choosing a particular currency derivative instrument. If the costs are high enough, a firm will not use any derivatives. If the costs are low enough, they can still affect a firm's choice among instruments.

Costs associated with implementing and maintaining a risk management program, including those related to the acquisition of expertise, exhibit economies of scale related to the amount of risk managed. Two variables previously introduced to measure variation, pretax foreign income (FORINC) and foreign-denominated debt (FORDEBT), are also proxies for economies of scale. Because these proxies are negatively correlated with the *costs* of implementing a derivative strategy and positively related to the *benefits*, we predict a positive association with derivatives use for both of these variables.

Another measure of economies of scale is an indicator variable equal to one if a firm uses other types of derivatives (OTHDERIV) in addition to currency-based derivatives. Firms that use other types of derivatives can have greater expertise and lower transaction costs associated with derivatives trading. Therefore, we predict a positive association between OTHDERIV and the use of currency derivatives.

Finally, firm size (SIZE) is a proxy for economies of scale in the costs of hedging. As discussed in Nance et al., there are alternative arguments for either a positive or negative relation between firm size and hedging activity. For example, smaller firms should hedge more, *ceteris paribus,* because of the inverse relation between firm size and bankruptcy costs (Warner, 1977). We might also expect a negative relation between firm size and the use of derivatives if smaller

firms have greater information asymmetries. O'Brien and Bhushan (1990) document that analyst following and institutional ownership, which proxy for information asymmetry, are positively and negatively related to firm size, respectively, in a multivariate setting. Ultimately, the predicted sign of the estimated coefficient on SIZE is ambiguous.

If a firm chooses to implement a risk management program, it also must consider the costs associated with particular instrument choices. These costs include liquidity costs, transactions costs of customization, and basis risk. Liquidity and transaction costs are greater for customized and long-term contracts, but customization reduces basis risk. We ignore costs associated with counterparty default risk, because almost all of our sample firms use over-the-counter currency derivatives.

Operating exposures generally represent a series of transactions with a subsequent single payment, for example, sales or payments on credit. In contrast, debt exposures generally represent a single or small number of transactions with multiple but certain subsequent payments. Therefore, foreign-debt exposure over the life of the debt contract is known at the inception of the contract. Thus, firms can implement a long-term risk-management strategy with low basis risk at the inception of the debt contract. Operating exposure, however, needs to be managed dynamically to minimize costs associated with basis risk.

Forward contracts provide a relatively low-cost method for matching the payoffs of frequent and uncertain transactions. The downside to using forwards is the basis risk associated with differences between characteristics of the underlying transaction and the forward contract, such as the maturity or payoff date. Basis risk for operating transactions is relatively small, however, because each individual transaction is of a short-term nature.

Over-the-counter swap contracts are more cost-effective for the risks associated with longer-term debt contracts because these instruments can be customized to reduce basis risk associated with generic forward contracts. In addition, because there are fixed costs associated with each contract, the cost of customization is relatively lower for a single long-term contract than for a portfolio of short-term contracts with comparable maturity.

III. Sample Companies and Derivative Instrument Activity

We construct our sample of industrial firms from *Fortune's* 1991 list of the 500 U.S. industrial corporations with the highest sales for fiscal year 1990. Of the *Fortune 500* firms, we eliminate cooperatives (13), subsidiaries of foreign owned corporations (13), private companies (44), firms acquired during fiscal year 1991 (8), firms operating under Chapter 11 during the sample period (8), and firms not included on the Compustat tapes (3). Four hundred eleven firms remain.

We further restrict the sample to those firms with foreign exchange-rate exposure at year-end 1990. By eliminating firms with no exposure, we are able to concentrate on the major cross-sectional differences that affect the incentives for hedging. Measuring foreign exchange-rate exposure, however, is difficult. We consider that all of the following are indications of foreign exchange-rate exposure: reporting pretax foreign income (311 firms), foreign sales (282 firms), non-zero long- or short-term foreign-denominated debt (120 and 57 firms, respectively), or non-zero foreign tax expense (342 firms); discussing (qualitatively) foreign operations in the annual report footnotes (67 firms); or belonging to a four-digit SIC industry in the upper quartile of the 411 sample firms with respect to IMPORTS (103[7]).

Our final sample contains 372 firms that have *at least one* source of foreign exchange-rate exposure. None of the 39 firms eliminated by our restrictions use currency derivatives. We also examine partitions of this sample based on exposures to various sources of exchange-rate risk. The results are only reported in the cases where significant differences exist.

We obtain data about the use of currency swaps, forwards, futures, and options by reading accounting footnotes to annual reports and/or 10-K filings for fiscal year-end 1991. We use a dichotomous measure of derivatives use because the reported information about the magnitude of off-balance sheet activities is either inconsistent or missing. Although notional amounts are available for some firms, our sample size would be greatly reduced if we were to restrict our sample to only those firms with a continuous measure of derivatives activity. More importantly,

we do not use notional amounts as a measure of exposure because the annual report disclosures are noisy, often because of aggregation and netting.

[Insert Table II here]

Table II presents a summary of currency derivatives use by the sample firms, partitioned on the basis of firm size and industry. The frequency of currency derivatives use increases across the last three size quartiles. It nearly doubles from the third to fourth quartiles (see Table II, Panel A). Because we restrict our sample to firms with foreign exchange-rate exposure, the reported frequencies are higher than those reported in surveys of random firms (Wharton/Chase Survey, 1994). As Panel B shows, firms in the consumer goods and electronics industries are the most frequent users of foreign currency derivatives. The differences in derivatives use across industries may reflect industry-specific characteristics associated with either increased overseas foreign exchange-rate exposure or incentives for optimal risk reduction. Because of the observed differences across industries, we include industry indicator variables in our analysis.

IV. Determinants of Corporate Users of Currency Derivatives

A. Univariate Tests

Table III presents summary statistics for the proxy variables described in the previous sections, and tests of differences between the means of these variables for users and non-users of currency derivatives. User firms are statistically different from non-user firms with respect to variables that are proxies for investment growth opportunities. User firms have significantly greater ratios of research and development expenditures to sales, and smaller book-to-market ratios (BM), than do non-users of derivatives. In addition, currency derivatives users' quick ratios (QUICK_AV) are statistically lower than those of non-users. This suggests that these two groups differ with respect to proxies for short-term liquidity. Currency derivatives users also have larger managerial option holdings than do non-users. Finally, non-users exhibit less

informational asymmetry than do users, as measured by institutional ownership or analyst following.

[Insert Table III here]

The univariate tests suggest that users of currency derivatives are not statistically different from non-users with respect to managerial wealth, substitutes for hedging, or tax preference items. The univariate results related to the proxies for financial distress are mixed. Although the long-term debt ratios of users of currency derivatives are statistically lower than those of non-users, the interest coverage ratios of the two groups are not statistically different. When we analyze firms that have foreign operations but no foreign denominated debt (results not presented), users have larger managerial shareholdings. This result is consistent with the industry-specific hedging studies in which much of the cross-sectional variation in underlying exposure is eliminated by construction (Schrand and Unal, 1996, and Tufano, 1996). However, as we note in the next section, managerial wealth is not statistically significant in logit regressions for this sample.

In addition to cross-sectional differences in hedging incentives, currency derivatives users and non-users also differ on the costs of implementing a derivatives strategy. On average, user firms are significantly larger than non-user firms, with mean (logged) capitalizations of $8.24 million and $7.13 million, respectively. User firms also have greater exposure to foreign exchange-rate risk, as measured by foreign pretax income, foreign sales, foreign-denominated debt, and IMPORTS. Finally, the ratio of foreign to total assets (FORASSETS) is not significantly different across users and non-users. This observation is consistent with the results of the Wharton/Chase survey (1995) of derivatives users in which only 4.7 percent of the respondents indicate that their firms hedge balance sheet ratios. The remainder of the respondents indicate that their firms hedge cash flows or accounting earnings that are associated with foreign income, sales, or debt.

B. Logit Results

We estimate logit regressions to distinguish among the possible explanations for derivatives use. Table IV presents the results of logit regressions of a dichotomous variable representing derivatives use on the explanatory variables and industry indicator variables. The dependent variable is equal to one for currency derivatives users and zero for non-users. Because multiple proxies are available to measure some firm characteristics (such as the coverage and the long-term debt ratios as measures of financial distress) we estimate separate logit regressions, using all possible combinations of variables representing each predicted construct. The results are qualitatively similar.

[Insert Table IV here]

Table IV reports marginal changes in the probability of using derivative instruments, implied by the logit coefficient estimates, that result from a unit change in the explanatory variables. These marginal sensitivities are labeled $\Delta Prob$. In the discussion below, we focus on these marginal effects.

We present the results for two sets of logit regressions. The first regression uses book-to-market ratios (BM) as proxies for growth opportunities. Of the 372 sample firms, there are 282 firms with available data (full sample). The second regression substitutes research and development expenditures for BM. These data are available for 220 firms (partial sample). For the full sample, the estimated model predicts 75 percent of the observations correctly, with 29 percent and 21 percent of derivatives users and non-users, respectively, misclassified. In the sample that includes RD, 78 percent of the observations are predicted correctly, with 21 percent and 24 percent of derivatives users and non-users, respectively, misclassified.

As Table IV reports, financing constraints provide incentives for hedging. Specifically, higher quick ratios, which indicate more internally available funds, imply a significantly lower

probability of using currency derivative instruments. This result is consistent with the Froot et al. prediction that hedging activity is useful to secure the availability of internal funds. It also supports the Nance et al. prediction that using substitutes for straight debt can reduce a firm's relative need to hedge because the agency costs of straight debt are lower.

The results also suggest that potential underinvestment costs provide incentives for hedging. A one percent increase in the ratio of R&D expenditures to sales yields a statistically significant increase of 6.98 percent in the probability that a firm uses currency derivatives. One possible explanation for the significance of RD is given by Lewent and Kearney (1990), who note that long-term R&D projects force firms to seek overseas revenues because domestic R&D financing can be costly. Because R&D is usually centralized, the firm faces a mismatch between domestic costs and foreign revenues. According to Lewent and Kearney, it is this mismatch that motivates the hedging activity to insure that internal funds are available for continued investment. Additionally, the interaction of the inverse of BM and a firm's long-term debt ratio (DE_AV*1/BM) is statistically significant and positive. This result suggests that the incentive to use derivatives to reduce underinvestment costs is greater when a firm's external financial flexibility is lower.

The results related to underinvestment costs depend to some extent on the source of foreign exchange-rate risk. In particular, for firms with foreign operations *and* foreign-denominated debt (naturally-hedged firms), R&D expenses and short-term liquidity are not significant determinants of currency derivatives use (logit results are not presented). In contrast, R&D expenses and short-term liquidity are still significant in logit regressions for firms with only foreign operations but no foreign-denominated debt. These results suggest that foreign-denominated debt and currency derivatives may act as substitutes for hedging foreign operations.[8]

Exposure to foreign exchange-rate risk is also an important factor in the decision to use derivatives. As predicted in Section II, derivatives use is positively associated with a firm's level of foreign pretax income, its use of foreign-denominated debt, and the percentage of imports

relative to total industry sales. These results are significant even after we control for firm size and other potential measures of multinationality[9].

Finally, the costs associated with implementing a derivatives strategy also play a role in a firm's decision to use currency derivatives. Assuming that the use of other types of derivatives (OTHDERIV) and (the log of) firm size (SIZE) are proxies for economies of scale, the observed positive coefficients suggest the presence of cost-driven motives for hedging.

The logit results do not support DeMarzo and Duffie's (1991) information asymmetry explanation for hedging, as evidenced by the positive coefficient on the standardized number of analyst firms.[10] An explanation consistent with this result is that managers of firms with a larger analyst following could face more pressure on their quarterly performance, and thus prefer fewer earnings surprises. If this is true, we would expect these firms to hedge more than firms with lower analyst following. But the causality could go the other way. Analysts could choose to follow firms with more stable cash flows and fewer earnings surprises[11].

[Insert Table V here]

In addition, the results do not support Smith and Stulz' (1985) tax or managerial contracting cost explanations for corporate hedging. The coefficient estimates of our proxies for managerial contracting costs in the logit regressions (MGRWLTH and standardized OPTS), are not statistically significant.

C. Robustness

Our logit tests can be criticized because some of the independent variables that measure potential incentives for derivatives use are, themselves, choice variables. The long-term debt ratio and the management compensation variables create the most concern because choices about capital structure and managerial compensation can be made simultaneously with the decision to use derivative instruments.[12] Moreover, the endogeneity of the managerial compensation choice

and the derivatives decision can depend on the firm's level of financial distress.[13] Although we recognize that it is almost impossible to eliminate these endogeneity issues, we have investigated several alternative variable specifications to mitigate this problem, and have provided robustness checks of our empirical results[14]. In all the cases discussed below, our conclusions are unaffected by the alternative specifications and procedures.

To control for possible endogeneity in any of our independent variables, we measure all of them as of fiscal year-end 1990 but measure the choice of derivatives use as of fiscal year-end 1991. In the results presented in Table IV, the stock variables, such as the book-to-market and long-term debt ratios, are measured as of fiscal year-end 1990. The flow variables, such as research and development expenditures and foreign income, are measured contemporaneously with the sample year. Measuring all variables as of fiscal year-end 1990 does not affect the results. This robustness check, however, is not completely satisfactory if serial dependence exists in these variables.

To further control for the simultaneity of the capital structure and currency derivatives use decisions, we estimate the determinants of these decisions simultaneously with a two-stage estimation technique (Maddala, 1983). There is no theoretical model explaining a firm's joint choice of its capital structure and currency derivatives use. Therefore, we specify the model of the capital structure decision following Titman and Wessels (1988) and Opler and Titman (1996).[15] Because the capital structure decision equation includes RD, the model of the currency derivatives use decision follows the specification shown in Table IV that includes RD. The structural equations are:

Capital structure decision:

$$DE\_AV = \delta_0 + \delta_1 CURDERIV^{*} + \delta_2 RD + \delta_3 LOG(SALES) + \delta_4 SGA + \delta_5 TANGS + \sum_{I=1}^{78} \delta_I IND_I + \varepsilon \quad (1)$$

Currency derivatives use decision:

$$CURDERIV = \lambda_1 NOL + \lambda_2 DE\_AV^* + \lambda_3 RD + \lambda_4 RD^*(DE\_AV^*) + \lambda_5 QUICK + \lambda_6 ANLST - STAND + \lambda_7 SIZE + \lambda_8 FORINC + \lambda_9 FORDEBT + \lambda_{10} IMPORTS + \lambda_{11} OTHDERIV + \sum_{I=1}^{7} \lambda_I INDCLASS_I + \omega \quad (2)$$

In equation (1), CURDERIV* is the predicted value of currency derivatives use obtained from the first-stage estimation of the currency derivatives use decision equation; LOG(SALES) is the natural logarithm of sales during the sample year; SGA is the ratio of selling, general and administrative expenses to sales; TANGS is the three-year average of the ratio of tangible assets (total assets less intangible assets from Compustat) to total assets; and IND1 through IND77 are indicator variables representing 4-digit SIC classifications. In equation (2), DE_AV* is the predicted value of the long-term debt ratio obtained from the first-stage estimation of the capital structure decision equation, and INDCLASS represents the seven industry classifications that were used in the Table IV regressions. As in the logit regressions, OPTS and ANLST are standardized.

The parameter estimates and their significance levels for the capital structure decision equation are similar to those presented in Opler and Titman (1996). The results of these regressions (not reported) show that the coefficient estimate on the predicted probability of using currency derivatives is not statistically different from zero. This result suggests that there is no clear association between the decision to use currency derivatives and capital structure choice. More importantly, the predicted long-term debt ratio is not a statistically significant determinant of the decision to use currency derivatives. However, the interaction variable of RD and DE_AV* is statistically significant, similar to the results presented in Table IV. Additionally, the coefficient estimates for the other explanatory variables in equation (2) are similar to those reported in Table IV. The parameter estimates for the capital structure decision equation are robust to exclusion of the industry indicator variables.

In addition to this simultaneous equations approach, we also estimate several variants of the Table IV logit regressions to address the problem of endogeneity of a firm's capital structure,

represented by the long-term debt ratio. First, we reestimate the logit regressions, excluding the long-term debt ratio but including the interaction variable that measures the combination of both financial distress and growth opportunities. The results for this logit specification are virtually unchanged from those presented in Table IV. Therefore, the long-term debt ratio is not driving the results.

Second, we use Standard & Poor's credit ratings as a proxy for financial distress instead of firms' long-term debt ratios. An advantage of doing this is that credit ratings are less of a managerial choice variable than capital structure because they are assigned by a third party. A disadvantage of using credit ratings is that they are ordinal measures, and therefore less informative than a continuous variable. S&P credit ratings are obtained from Compustat and the *S&P Bond Guides,* and are assigned values from three to 22 for AAA+ to D-rated firms, respectively. Ratings are available for 258 of the 372 sample firms. The ratings series has a correlation of 57.7 percent with long-term debt ratios and -24.7 percent with interest coverage ratios. We reestimate the Table IV logit regressions, substituting for the long-term debt ratio three indicator variables that represent firms rated AA- or better (56 firms), A- to A+ (83 firms), and BBB- to BBB+ (72 firms). Firms below investment grade (47 firms) serve as the control group. None of the coefficients on these indicator variables are significant. The estimates of the other coefficients in the regressions do not change for either the full or partial sample.

Next, we include an industry-adjusted long-term debt ratio as a proxy for financial distress instead of the actual long-term debt ratio. We calculate the industry-adjusted ratio as the difference between the firm's long-term debt ratio and the median long-term debt ratio for the firm's four-digit SIC industry. By doing this, we assume that the industry median is the firm's target long-term debt ratio, and that any excess or shortfall relative to this median represents a measure of financial distress. As with the use of S&P credit ratings, our logit results are unchanged by this substitution, and the coefficient estimate for the industry-adjusted variable is insignificant.

To control for the potential endogeneity of the managerial compensation structure, we industry-adjust the managerial wealth and managerial option ownership variables. Just as we industry-adjusted the long-term debt ratio, we calculate the difference between the log of managerial wealth and the median for the industry, and the log of the market value of shares obtainable with options and its industry median. We define the industries for these variables based on the eight industry groupings presented in Table II, which are derived from the *Fortune* industry codes. Using the industry-adjusted compensation variables instead of MGRWLTH and standardized OPTS in the regressions shown in Table IV does not change the results for the existing variables. The coefficients are insignificant for both of these industry-adjusted compensation variables.

Finally, we examine the incremental impact of financial distress on derivatives choice for firms whose managers have high levels of wealth. To do this, we interact the long-term debt ratio with an indicator variable equal to one for those firms with managerial wealth in the upper quartile of the sample. We include this interaction variable as well as the long-term debt ratio in the logit regressions presented in Table IV. The marginal probability of the interaction variable measures whether, conditional on the firm's level of financial distress, managerial wealth affects the derivatives decision. We separately measure a similar interaction variable for option ownership. The coefficient estimates for these interaction variables are insignificant for both samples, and their inclusion in the models does not change the existing results.

D. Hedging versus Speculating

The consistency of our results with models of optimal hedging behavior suggests that firms, on average, are not speculating with currency derivatives. If the motives for optimal hedging and speculation are correlated, however, our results might not distinguish between these two activities. In this section, we consider firms' motives for speculation and their implications for our results.

Equityholders are likely to support the use of currency derivatives for speculation if speculation is a profit-making activity, if equity shares are viewed as options on the value of a levered firm, or if managers of low-output firms want to create noise to mimic high-output firms (Ljungqvist, 1994). For speculation to be a profit-making activity in rational markets, either a firm must have an information advantage related to the prices of the instruments underlying the derivatives, or it must have economies of scale in transactions costs allowing for profitable arbitrage opportunities. This suggests that firm size (SIZE) and the use of other derivatives (OTHDERIV) are possible determinants of the use of currency derivatives for speculation.

If equityholders view their shares as options on the value of a levered firm, we would expect them to support any speculation that increases firm volatility when the firm is close to (or in) financial distress so that the option is near-the-money (or out-of-the-money). Managerial option holdings similarly provide incentives for speculation. Therefore, results that are related to the association between currency derivatives use and variables that measure financial distress will also measure the potential motives of equityholders to speculate.

Finally, in a signaling framework, Ljungqvist (1994) argues that managers of low-output firms will speculate to create noise so that their output mimics that of high-output firms. He assumes that speculation is an unobservable fair gamble with expected profits equal to zero (including no transactions costs), and that there is no penalty for incurring a negative outcome from the speculative activity. If we assume that low expected output implies financial distress, then the model suggests that firms near bankruptcy have greater incentives to speculate and delay the resolution of uncertainty. This result, however, relies heavily on the assumption that speculation is unobservable. This assumption is unnatural given increased monitoring by outside debtholders as firms near bankruptcy.

Overall, the univariate and logit results of the previous sections do not support speculative motives for derivatives use. Firm size and the use of other derivatives are positively related to the likelihood of using currency derivatives. However, our measures for variation in cash flow or accounting earnings that result from exchange-rate exposure are also significant. Additionally,

our proxies for financial distress are not significantly related to the likelihood of using currency derivatives. Finally, of the 39 firms that we dropped from our sample because they had no *ex ante* foreign exchange-rate risk exposure, none disclosed using currency derivatives. Because the use of currency derivatives by these firms could have suggested speculation, this observation is further evidence against widespread speculation in currency derivatives by our sample firms.

V. The Choice among Types of Currency Derivatives

In this section, we examine how firms' choices among types of derivatives are associated with various sources of exposure to exchange-rate risk. As previously discussed in Section II.C, this link derives from differences in the costs of using particular instruments to manage specific sources of foreign exchange-rate exposure. For example, firms might choose to use long-term customized currency swaps to manage foreign exchange-rate exposures which extend over multiple periods but are predetermined (e.g. foreign-denominated debt payments). This derivative strategy might be the lower cost alternative because it results in a lower level of basis risk than the choice of using a series of short-term forward contracts. In contrast, short-term forwards might be the lower cost alternative for frequent short-term transactions which are characterized by uncertainty about their timing and quantities (e.g. foreign-denominated sales on account).

In our analysis, we partition the sample based on firms' derivative instrument choices. For each choice we examine firms' sources of foreign exchange-rate exposure. We divide the sample into three groups. The first group includes all firms that do not use currency derivatives. The second group includes all firms that use either currency swaps only or currency swaps in combination with other currency derivatives. The third group includes all firms that use only foreign exchange forwards or forwards in combination with futures contracts or options. These groups are designed to distinguish among firms based on the costs associated with these three derivatives choices. This division also allows a workable number of observations for the most important kinds of instrument choices available to currency derivatives users.

[Insert Table VI here]

Table VI shows the frequency of use of currency derivative instruments by type. We include this table as a benchmark for analyzing derivative instrument choices in a multivariate setting. As previously reported, less than half of the sample firms report using currency derivatives. Of those firms that do disclose using currency derivatives, the most frequently used instruments are forwards only or forwards in combination with futures or options. As Panel A reports, 29.3 percent of the firms report using forwards and forward combinations, while only 12.1 percent report using currency swaps either alone or in combination with other currency derivatives.

The remaining results in Table VI document a positive relation between specific derivatives strategies and a firm's underlying foreign exchange exposure. These results offer further support that our sample firms use derivatives to hedge rather than to speculate. Panel B presents the means of various measures of exposure to foreign exchange-rate risk by the type of currency derivatives used. The estimates indicate that both swaps users and forwards users have significantly higher foreign income and sales than firms that do not use currency derivative instruments. However, this measure of foreign exchange-rate exposure is not significantly different across firms that use swaps or forwards.

The other sources of exposure are significantly associated with only one type of derivatives use but not with both. For example, firms that use swaps only or swap combinations have statistically higher levels of long-term foreign-denominated debt than firms that use no currency derivatives. Forwards users, however, do not have statistically higher levels of foreign-denominated debt than non-users of currency derivatives. In addition, firms that use forwards only or forwards in combination with futures and options have higher foreign exchange-rate exposure from import competition than firms that do not use currency derivatives.

We use a multinomial logit (MNL) model to examine firms' choices among the three currency derivative categories (presented in Table VI) in a multivariate setting. The results are

presented in Table VII. The model is normalized with respect to the choice of using no currency derivative instruments. The independent variables are identical to those presented in Table IV for the partial sample, except that we use continuous measures of long- and short-term foreign-denominated debt and do not include industry dummies due to the limited number of observations for the choices.[16] We include these continuous debt measures because we are focusing on the costs associated with various derivative strategies relative to a firm's underlying foreign exchange-rate exposure.

[Insert Table VII here]

Table VII reports the marginal probabilities of choosing a particular derivative instrument combination implied by the multinomial logit coefficient estimates (also reported in Table VII). These marginal sensitivities are labeled *dProb*.

The MNL results in Table VII provide mixed evidence on whether the source of underlying exposure to foreign exchange-rate risk affects the choice among types of currency derivatives. Firms with higher levels of operating and competitive exposure, as measured by pretax foreign income (FORINC) and the percentage of imports relative to total industry sales (IMPORTS), are more likely to choose both classes of currency derivatives. As Table VII reports, the marginal probabilities associated with FORINC and IMPORTS for using forward combinations, however, are about three times those for swap combinations (significantly different at the 2 percent and 1 percent levels, respectively). This suggests that firms with operating or competitive foreign exchange-rate exposure are more likely to use either forwards only, or forwards in combination with futures or options, than swaps.

In contrast, foreign exchange-rate exposure associated with foreign-denominated debt is not a significant determinant of a firm's choice among types of currency derivatives. As Table VII reports, neither long- nor short-term foreign-denominated debt are statistically significant determinants of either currency derivatives choice. Although not reported, we also obtain similar results if we substitute the indicator variable used in Table IV, which is equal to unity if a firm

discloses having any foreign-denominated debt and zero otherwise, instead of the continuous debt variables.

The relation between the ratio of R&D expenses to sales is significant only for users of forwards only and forwards combinations. The point estimate of the marginal probability for the choice of forwards only and forwards combinations (Choice 2) is positive and significant, while it is not reliably different from zero for the choice of swaps and swap combinations (Choice 1). If foreign sales are generally hedged with short-term currency derivatives such as forward contracts, then the greater significance of R&D related to forwards use is consistent with the argument presented in Section IV. As stated previously, a firm might be exposed to foreign exchange-rate risk because of the mismatch between centralized R&D costs and foreign revenues (Lewent and Kearney, 1990). Because foreign revenues represent frequent and uncertain transactions, currency forwards are a more cost-effective alternative for dynamically hedging these revenues than currency swaps.

The remaining results are generally consistent with those of the logit regressions. As Table VII reports, a firm's quick ratio, a measure of a firm's short-term liquidity, is a significant and negative determinant of both choices of currency derivatives. Larger firms and firms that use other derivatives are also more likely to use both classes of currency derivatives. However, the association between SIZE and forwards use is significantly lower than that between SIZE and swaps use at the 3 percent level. As in Section IV, the positive marginal probabilities suggest that economies of scale in implementing and maintaining a derivatives strategy are important determinants of currency derivatives use.

The MNL regressions offer conflicting evidence on the importance of managerial incentives for derivatives use. As Table VII reports, the coefficient estimate on managerial wealth is not statistically different from zero for forwards use (Choice 2). However, managerial wealth is a negative and marginally significant determinant of swaps use (Choice 1). These results are contrary to the prediction of Smith and Stulz (1985).

The coefficient estimate of managerial option ownership, while insignificant for Choice 1, is positive and significant for Choice 2. This indicates that firms with higher option ownership are more likely to use forwards only or forwards combinations than swaps. This positive relation does not support Smith and Stulz' (1985) managerial contracting cost explanation for hedging, which predicts a negative relation between managerial option holdings and derivatives use if derivatives are used for hedging. One possible explanation for this positive relation is the observed positive association between the use of options in managerial compensation contracts and a firm's involvement in research and development activities (Clinch, 1991). In the case of firms with long-term investment projects like R&D, managerial options align the incentives of risk-averse mangers with those of shareholders. High R&D firms are the same firms for which forwards are the low cost alternative for hedging the mismatch between foreign revenues and R&D costs (Lewent and Kearney, 1990).

Finally, standardized analyst following is significantly and positively associated with the use of forwards only, or forwards in combination with futures or options. As with the logit results, this positive association is not consistent with the DeMarzo and Duffie (1991) information argument for optimal hedging.

VI. Conclusions

In this paper, we examine the determinants of corporate use of currency derivatives from the perspectives of managers, debtholders, and equityholders. The results of univariate and multivariate tests of the differences between currency derivatives users and non-users indicate that firms with a combination of high growth opportunities but low accessibility to internal and external financing are most likely to use currency derivatives. This result is consistent with the hypothesis that hedging can reduce underinvestment costs associated with investment opportunities in the presence of financial constraints. Currency derivatives user firms, which are generally larger than non-users, are further characterized by greater analyst following and

institutional ownership, and greater managerial option holdings. These two groups of firms are similar in their tax positions and in managerial share ownership.

We also consider how a firm's exposure to foreign exchange-rate risk affects the potential benefits of using currency derivatives and the costs of implementing a specific derivatives strategy. We find that firm characteristics related to these costs and benefits are related to the general decision to use currency derivatives and the specific choice among various types of currency instruments. We take these results to indicate that our sample firms are hedging, and not speculating, on average.

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Appendix

This appendix provides a summary of all explanatory variables used in our analysis and a detailed description of the method of calculation. The explanatory variables are generally constructed as follows: Flow variables are measured during the year of derivatives use (1991), and stock variables are measured at the beginning of the year (fiscal year end 1990). Implicit in this construction are two assumptions: First, decisions to use derivatives (measured at fiscal year end 1991) are based on information available to the firm during 1991; second, actual flows in 1991 are the best proxy for management's expectations of 1991. Flow variables for 1990, however, may be a better proxy for management's expectations depending on the timing of the flow, the timing of the decision to use derivatives, and the degree to which management uses past performance to estimate future flows.

Variable Name	Variable Description
ANLST	The number of analyst firms covering a company as of September/October 1990, according to *Nelson's Directory of Investment Research*. Alternatively, ANLST is measured as the number of analysts, rather than firms, following each sample firm. The results are qualitatively similar using both specifications of ANLST, so we present only those based on the number of firms.
BM	Ratio of book to market value of the firm. Book value of common shareholders' equity as of the end of fiscal year 1990 is total assets less total liabilities less outstanding preferred stock (Compustat data items 6, 181, and 130, respectively). Market value is closing share price times common shares outstanding at year-end 1990 (Compustat data items 199 and 25, respectively).
CONV	Ratio of book value of total convertible debt as of fiscal year-end 1990 (Compustat data item 79) to SIZE.
COV[a]	Interest coverage ratio. Ratio of pretax income for 1991 (Compustat data item 170) plus interest expense for 1991 (Compustat data item 15) to interest expense plus capitalized interest (Compustat data item 239) for 1991.
DE[a]	Long-term debt ratio. Ratio of book value of long-term debt as of the end of fiscal year 1990 (Compustat data items 34 plus 9) to SIZE.

DIV[a]	Dividend yield. Ratio of cash dividend per share in 1991 (Compustat data item 26) to closing price per share as of fiscal year-end 1990 (Compustat data item 199).

Variable Name	Variable Description
FORASSETS	Ratio of identifiable foreign assets at year-end 1990 (annual report) to total assets.
FORDEBT	An indicator variable equal to one if the firm has either non-zero LTFRDT or STFRDT or qualitatively discusses the existence of foreign-denominated debt in its fiscal year-end 1990 annual report.
FORINC	Ratio of pretax income from the firm's foreign operations (Compustat data item 273) to sales (Compustat data item 12).
FORSALES	Ratio of foreign sales plus export sales for the year ended 1991 (annual report) to sales (Compustat data item 12).
IMPORTS	The percentage of imports to total production (domestic production plus imports) as of December 31, 1991. These data are reported by the Department of Commerce for 4-digit SIC codes and matched to the sample based on Compustat dnums. Where 4-digit dnums are not available, we obtain 4-digit industry classifications from the 1991 annual report.
IO	The percentage of the firm's common shares outstanding held by institutional owners at fiscal year-end 1990 as reported by *Nelson's Directory of Investment Research.* Institutional investors include banks, brokerage firms, investment managers, insurance companies, mutual funds, and pension funds. Similar results related to institutional ownership are obtained using figures reported by *Business Week* and *O'Neil Database.*
LTFRDT	The long-term and current portion of debt issued with an original maturity greater than one year, denominated in a currency other than US dollars (annual report) at year-end 1990.
MGRWLTH	Market value of common shares beneficially owned (excluding shares that can be obtained within 60 days through the exercise of options) by officers and directors as a group as of fiscal year-end 1990 reporting date (Compact Disclosure, proxy statements, and 10-K filings).
NOL	The portion of prior and current year net operating losses applied as a reduction of taxable income in 1990 (Compustat data item 52) scaled by total assets (Compustat data item 6). The book value of NOL is only reported on Compustat if it appears in the firm's tax footnote. When net operating loss carryforwards

	are missing, we examine the firm's annual reports and 10-Ks to determine the book value of NOL if available, or the tax value of net operating loss carryforwards if the book value is unavailable.
OPTS	The log of the market value of shares that can be obtained by exercise of options. The options areexercisable within 60 days of the reporting date for common shares beneficially owned by offices and directors as a group (Compact Disclosure, proxy statements, and 10-K filings).
OTHDERIV	An indicator variable equal to one if the firm discloses using either interest-rate-based or commodity-based derivative instruments; equal to zero otherwise.

Variable Name	Variable Description
PPE	Intensity of capital investment. Ratio of property, plant, and equipment at year-end 1990 (Compustat data item 187) to SIZE.
PS	Ratio of book value of total preferred stock as of the end of fiscal year 1990 (Compustat data item 130) to SIZE.
QUICK[a]	Quick ratio. Ratio of cash and short-term investments as of fiscal year-end 1990 (Compustat data item 1) to current liabilities as of fiscal year-end 1990 (Compustat data items 34, 70, 71, and 72).
RD	Ratio of R&D expenses during 1991 (Compustat data item 46) to sales (Compustat data item 12).
SIZE	Market value of the firm at fiscal year-end 1990. Natural logarithm of the sum of the market value of equity (Compustat data item 199 times Compustat data item 25), book value of long-term debt (Compustat data items 9 and 34), and book value of preferred stock (Compustat data item 130).
STFRDT	Debt issued with an original maturity less than one year denominated in a currency other than U.S. dollars (annual report) at year-end 1990.

[a]COV_AV, DE_AV, DIV_AV, and QUICK_AV are computed as three-year averages of COV, DE, DIV, and QUICK, respectively.

Table I

Predicted Signs of Coefficient Estimates

Predicted signs of coefficient estimates for variables used as proxies for incentives to use foreign currency derivatives based on the testable implications of Smith and Stulz (1985, S&S), Froot, Scharfstein, and Stein (1993, FSS) and DeMarzo and Duffie (1991, D&D). "D" refers to a direct prediction of a model; "I" refers to an indirect prediction. "NA" indicates that the independent variable is not applicable to a particular model. "?" indicates that the predicted sign is indeterminate. Variable names appear in the second column. Predicted signs appear in the third through fifth columns.

Independent Variables	Variable Name	Prediction		
		S&S (1985)	FSS (1993)	D&D (1991)
Managers				
Managerial wealth	MGRWLTH	+, D	NA	NA
Managerial option ownership	OPTS	-, D	NA	NA
Bondholders				
Interest coverage ratio	COV_AV	-, D	-, D	NA
Long-term debt ratio	DE_AV	+, D	+, D	NA
R&D expenses/sales	RD	+, I	+, D	+, I
Plant, property, and equipment investment expenditures/SIZE	PPE	+, I	+, D	+, I
Book-to-market ratio	BM	-, I	-, D	-, I
Substitutes for off-balance sheet assets				
Convertible debt /SIZE	CONV	-, I	+, I	NA
Preferred stock/SIZE	PS	-, I	+, I	NA
Quick ratio	QUICK_AV	-, I	-, D	NA
Dividend yield	DIV_AV	+, I	+, I	NA
Equityholders				
Tax-loss carryforwards/total assets	NOL	+, D	-, I	NA
Institutional ownership	IO	NA	NA	-, D
Number of analyst firms	ANLST	NA	NA	-, D
Firm Size	SIZE	?	?	-, I

Table II

Frequency of Use of Derivative Instruments by Size and Industry

Frequency of use of derivative instruments by 372 large U.S. firms for fiscal year-end 1991 that have foreign exchange rate exposure as of fiscal year-end 1990. Companies are among the 500 largest firms (by sales) in the *Fortune* 500. A firm has foreign exchange rate exposure if it has non-zero foreign pretax income, positive foreign sales or debt, or is in the upper quartile of the sample firms on the basis of imports as a percentage of total industry sales. *Currency Derivatives* include currency swaps and foreign exchange forwards, futures and options. *Any Derivatives* include interest rate, commodity, and currency derivatives. All data on derivatives use are from annual reports and 10-K disclosures. The 1st quartile for firm size includes the smallest firms based on 1990 sales; the 4th quartile includes the largest firms.

	N	Currency Derivatives	Any Derivatives
All Firms	372	*41.4%*	*59.1%*
Panel A: By firm size (by 1990 sales)[1]			
4th quartile	93	75.3	90.3
3rd quartile	93	38.7	64.5
2nd quartile	93	34.4	48.4
1st quartile	93	17.2	33.3
Panel B: By Fortune's industry grouping			
Consumer Goods	*47*	*66.0%*	*78.7%*
Beverages	6	83.3	100.0
Food	22	59.1	81.8
Pharmaceuticals	14	85.7	85.7
Tobacco	5	20.0	20.0
Electronics	*71*	*56.3%*	*63.4%*
Computers, office equipment	18	83.3	88.9
Electronics, electrical equipment	35	42.9	48.6
Scientific, photographic, and control equipment	18	55.6	66.7
Energy	*32*	*34.4%*	*68.8%*
Mining, crude oil production	12	8.3	58.3
Petroleum refining	20	50.0	75.0
Metals	*32*	*21.9%*	*50.0%*
Jewelry, silverware	1	0.0	0.0
Metal products	19	21.1	47.4
Metals	12	25.0	58.3
Non-durable consumer products	*35*	*28.6%*	*42.8%*
Apparel	11	27.3	36.4
Furniture	5	0.0	20.0
Soaps, cosmetics	11	36.4	36.4
Textiles	6	16.7	16.7
Toys, sporting goods	2	100.0	100.0
Paper	*41*	*17.1%*	*39.0%*
Forest and paper products	27	18.5	44.4
Publishing, printing	14	14.3	28.6
Production materials	*50*	*44.0%*	*62.0%*
Building materials, glass	7	57.1	100.0
Chemicals	33	42.4	57.6
Rubber and plastic products	10	40.0	50.0
Transportation	*64*	*40.6%*	*59.4%*
Aerospace	16	12.5	43.8
Industrial and farm equipment	32	53.1	65.6
Motor vehicles and parts	13	38.5	53.8

Transportation equipment	3	66.7	100.0

Table III

Summary of Financial Characteristics of Currency Derivative Users and Non-Users

Selected summary statistics for managerial and financial characteristics for firms that disclose the use of currency derivative instruments (currency derivative users), and firms that do not (currency derivative non-users) for 372 large U.S. firms with foreign exchange rate exposure. Companies are among the 500 largest firms (by sales) in the *Fortune* 500. A firm has foreign exchange rate exposure if it has non-zero foreign pretax income, positive foreign sales or debt, or is in the upper quartile of the sample firms on the basis of imports as a percentage of total industry sales. Panel A reports summary statistics for proxies related to incentives for hedging. Panel B reports summary statistics for proxies for foreign exchange exposure. All data are measured as of fiscal year-ends. In the cases of missing data, the number of observations are given in parentheses. t-statistics are given for tests of the equality of means between currency derivative users and non-users. p-values are in parentheses.

Variable	Currency Derivative Users (N = 154)			Currency Derivative Non-Users (N = 218)			t-statistic a (p-value)
	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.	
Panel A: Incentives for hedging							
Managerial wealth (log $MM)	$8.23 (N = 141)	$8.02	$1.64	$7.93 (N = 203)	$7.86	$1.79	-1.60 (0.11)
Managerial option ownership (log $MM)	7.45 (N = 131)	7.60	1.47	6.46 (N = 169)	6.50	1.37	-5.97 (0.00)
Interest coverage ratio	7.96 (N = 152)	4.43	17.00	10.56 (N = 213)	3.82	41.78	0.819 (0.41)
Long-term debt ratio	0.28	0.22	0.20	0.31 (N = 214)	0.31	0.20	1.71 (0.09)
R&D expenses/sales	0.05 (N = 136)	0.03	0.04	0.02 (N = 133)	0.02	0.02	-5.58 (0.00)
Plant, property, and equipment investment expenditures/SIZE	0.35	0.29	0.23	0.41	0.34	0.28	2.24 (0.03)
Book-to-market ratio	0.52	0.51	0.53	0.70	0.61	0.56	3.20 (0.00)
Convertible debt/SIZE	0.01 (N = 150)	0.00	0.00	0.02 (N = 216)	0.00	0.06	0.98 (0.33)
Preferred stock/SIZE	0.01	0.00	0.03	0.01	0.00	0.04	1.29 (0.20)
Quick ratio	0.25 (N = 153)	0.15	0.29	0.35	0.19	0.79	1.73 (0.08)
Dividend yield	0.03	0.03	0.09	0.04 (N = 214)	0.03	0.08	0.28 (0.78)
Tax-loss carryforwards / total assets	0.02 (N = 153)	0.00	0.08	0.02 (N = 213)	0.00	0.07	-0.26 (0.80)
Institutional ownership	55.46 (N = 152)	58.3	14.70	48.59 (N = 205)	52	16.67	-4.05 (0.00)

Number of analyst firms	26.16	25	13.14	15.43 (N = 211)	14	9.37	-8.65 (0.00)
Firm SIZE (log $MM)	$8.24	$8.26	$1.41	$7.13 (N = 217)	$7.13	$1.01	-8.33 (0.00)
Panel B: Foreign exchange exposure							
Pretax foreign income / total sales	0.033 (N = 149)	0.027	0.035	0.018 (N = 162)	0.008	0.039	-3.70 (0.00)
Foreign & export sales / total sales	0.389 (N = 141)	0.376	0.195	0.282 (N = 141)	0.228	0.241	-4.10 (0.00)
Identifiable foreign assets / total assets	0.346 (N = 138)	0.316	0.205	0.350 (N = 116)	0.240	0.313	0.12 (0.91)
Foreign long-term debt / total assets	0.023 (N = 153)	0.001	0.045	0.005 (N = 216)	0	0.014	-4.81 (0.00)
Foreign short-term debt / total assets	0.006 (N = 153)	0	0.018	0.003 (N = 216)	0	0.013	-1.85 (0.07)
Percentage of imports in 4-digit SIC industry	16.35%	12%	14.37%	12.03%	10%	11.05%	-3.13 (0.00)

[a] t-tests assume equal variances unless the null hypothesis of equal variances is rejected at a 10% significance level.

Table IV

Logit Regression Estimates of the Likelihood of Using Currency Derivatives

Logit regression estimates of the relation between the likelihood that a firm uses currency derivatives and proxies for incentives to use derivatives, proxies for foreign exchange exposure, and *Fortune* industry indicator variables for large U.S. firms that have foreign exchange rate exposure as of fiscal year-end 1990. Companies are among the 500 largest firms (by sales) in the *Fortune* 500. A firm has foreign exchange rate exposure if it has non-zero foreign pretax income, positive foreign sales or debt, or is in the upper quartile of the sample firms on the basis of imports as a percentage of total industry sales. The second through fourth columns present the signs of the coefficient estimates based on the testable implications of Smith andStulz (1985, S&S), Froot, Scharfstein, and Stein (1993, FSS), and DeMarzo and Duffie (1991, D&D). The full sample of 282 firms does not use the ratio of research and development expenses to sales (R&D) and contains firms for which all data is available. The partial sample of 220 firms contains firms with R&D data. *ΔProb.* measures the marginal change in the probability of using derivatives resulting from a change in the independent variable. The marginal effects of the regressors on the probabilities are calculated as: $\partial / \partial = \Lambda \quad - \Lambda$, where Y = dichotomous dependent variable; x_i = ith independent variable; x = vector of independent variables; Λ = the logistic cumulative distribution function; and z = vector of coefficient estimates. ∂ / ∂ is calculated at the means of the regressors. t-statistics are for the logit coefficients. Summary statistics for the logit regression are presented in Panel B

Panel A: Logit regression estimates

Variable	Predicted Sign:			Full Sample (N = 282)			Partial Sample: RD Available (N = 220)		
	S&S	FSS	D&D	Coeff.	Δ Prob.	t-stat.	Coeff.	Δ Prob.	t-stat.
Constant	NA	NA	NA	-4.634[1]	-1.154	-2.709	-6.359[1]	-1.550	-3.094
Managerial wealth	+	NA	NA	0.018	0.004	0.156	0.045	0.011	0.333
Managerial option ownership	-	NA	NA	0.062	0.016	0.916	0.107	0.026	1.216
Tax-loss carryforwards/ total assets	+	-	NA	0.401	0.100	0.174	2.992	0.729	1.307
Long-term debt ratio (DE_AV)	+	+	NA	-1.416	-0.353	-1.172	0.132	0.032	0.086
Book-to-market ratio (BM)	-	-	-	-0.052	-0.013	-0.109	-	-	-
DE_AV*(1/BM)	+	+	+	0.561[10]	0.140	1.854	-	-	-
R&D expenses/sales (RD)	+	+	+	-	-	-	28.610[1]	6.976	2.466
DE_AV*(RD)	+	+	+	-	-	-	-43.603	-10.632	-1.214
Quick ratio	-	-	NA	-0.919	-0.229	-1.541	-1.921[1]	-0.468	-2.497
Number of analyst firms	NA	NA	-	0.066[1]	0.016	2.606	0.047	0.011	1.432
Firm size	?	?	-	0.726[1]	0.181	4.380	0.600[1]	0.146	3.087
Pretax foreign income/ total sales	+			8.671[10]	2.159	1.745	15.527[5]	3.786	2.028
Firm has foreign denominated debt	?			0.776[5]	0.193	2.434	1.239[1]	0.302	3.086
Percentage of imports in 4-digit SIC industry	+			0.053[1]	0.013	3.591	0.060[1]	0.015	3.356
Firm uses other derivatives	?			0.736[5]	0.183	2.068	1.307[1]	0.319	2.898
Industry Indicator Variables:									
Consumer Goods	?			0.572	0.142	0.857	1.230	0.300	1.421
Electronics	?			-	-	-	-	-	-
Energy	?			-1.495[5]	-0.372	-2.116	-0.025	-0.606	-0.022
Metals	?			-0.503	-0.125	-0.723	0.707	0.172	0.803
Non-Durable Cons. Goods	?			-0.264	-0.263	-0.396	0.517	0.126	0.554
Paper	?			-0.822	-0.205	-1.294	-0.319	-0.078	-0.381
Production Materials	?			0.466	0.116	0.829	1.049	0.226	1.573
Transportation	?			0.296	0.074	0.592	0.615	0.150	1.063

Table IV (continued)

Panel B: Summary Statistics for Logit Regressions

	Full Sample			Partial Sample		
Number of Observations	Predicted Dependent Variable:			Predicted Dependent Variable:		
Actual Dependent Variable:	0	1	Total	0	1	Total
0 (Discloses no use of currency derivatives)	117	31	148	77	24	101
1 (Discloses use of currency derivatives)	39	95	134	25	94	119
Total	156	126	282	102	118	220
Log Likelihood at convergence	-132.41			-95.72		
Restricted Log Likelihood: Slopes = 0	-195.12			-151.76		
-2*(Log Likelihood Ratio)/(degrees of freedom)	125.41/(20)			112.08/(20)		

[1] [5] [10] Significant at the 1% (5%) {10%} significance level for a two-tailed test.

Table VI

Frequency of Use of Foreign Currency Derivative Instruments by Instrument Type

Frequency of use of selected foreign currency derivative instruments by 372 large U.S. industrial firms that have foreign exchange rate exposure as of fiscal year-end 1990. Companies are among the 500 largest firms (by sales) in the *Fortune* 500. A firm has foreign exchange rate exposure if it has nonzero foreign pretax income, positive foreign sales or debt, or is in the upper quartile of the sample firms on the basis of imports as a percentage of total industry sales. Panel A reports the frequency of use of different types of foreign currency derivatives for all firms. Panel B reports the frequency of derivatives use by type of foreign exchange rate exposure. None of the means of the proxy variables are significantly different across the choice between "Currency swaps and swap combinations" and "Currency forwards and forward combinations." t-tests assume equal variances unless the null hypothesis of equal variances is rejected at a 10% significance level.

Panel A: Derivative instrument choice

	No currency instrument	Currency swaps and swap combinations	Currency forwards and forward combinations	Total
N	218	45	109	372
%	*58.6*	*12.1*	*29.3*	*100.0*

Panel B: Exposure to operating, financing, and competitive risk by derivative instrument choice

	No currency instrument		Currency swaps and swap combinations		Currency forwards and forward combinations		Total
	N	Mean	N	Mean	N	Mean	N
Operations:							
Foreign pretax income/ total sales	165	0.0171	44	0.0290[10]	105	0.0346[1]	314
Foreign & export sales/total sales	141	0.2824	42	0.3879[5]	99	0.3902[1]	282
Identifiable foreign assets/ total assets	116	0.3505	39	0.3548	99	0.3432	254
Foreign debt:							
Foreign long-term debt /total assets	41	0.0258	36	0.0543[5]	43	0.0361	120
Foreign short-term debt/ total assets	25	0.0281	10	0.0255	22	0.0328	57
Competitive:							
Percentage of imports in 4-digit SIC industry	218	12.03%	45	14.24%	109	17.22%[1]	372

[1] [5] [10] Significantly different from the choice of no currency instrument at the 1 (5) {10} % level, respectively.

Table V
Pearson Correlation Coefficients

Pearson correlation coefficients for explanatory variables used in the logit and multinomial logit regressions (expressed in percentages). Variables are as follows: NOL is tax-loss carryforwards scaled by total assets. COV_AV is interest coverage ratio. DE_AV is long-term debt ratio. SIZE is log of firm size. MGRWLTH is log of the market value of common shares beneficially owned (excluding options) by officers and directors as a group. OPTS is log of the market value of managerial option ownership. RD is the ratio research and development expenses to total sales. PPE is the ratio of plant, property, and equipment investment expenditures to SIZE. BM is the book to market ratio. CONV is the ratio of convertible debt to SIZE. PS is the ratio of preferred stock to SIZE. QUICK_AV is the quick ratio. DIV_AV is the dividend yield. IO is institutional ownership. ANLST is number of analyst firms.

	NOL	COV_AV	DE_AV	SIZE	MGRWLTH	OPTS	RD	PPE	BM	CONV	PS
COV_AV	-6.2%										
DE_AV	14.6[1]	-24.7[1]									
SIZE	-11.7[5]	0.7	-7.3								
MGRWLTH	-14.5[1]	21.3[1]	-33.9[1]	31.6[1]							
OPTS	-1.8	2.4	-13.1[5]	36.9[1]	3.1						
RD	11.4[10]	2.2	-32.4[1]	11.8[5]	11.3	15.3[5]					
PPE	8.7[10]	-7.5	32.9[1]	-5.1	-30.3[1]	-9.3[10]	-23.5[1]				
BM	0.0	-9.1[10]	36.5[1]	-19.2[1]	-23.3[1]	-13.2[5]	-6.5	40.0[1]			
CONV	27.1[1]	-6.8	17.9[1]	-17.0[1]	-8.5	-4.0	11.4[10]	5.4	15.2[1]		
PS	16.8[1]	-5.2	14.9[1]	-3.5	-22.9[1]	-9.6[10]	-1.4	20.3[1]	7.1	-4.3	
QUICK_AV	3.7	11.3[5]	-20.9[1]	3.4	21.7[1]	-12.5[5]	30.3[1]	-15.6[1]	-1.4	5.2	-2.4
DIV_AV	-6.7	6.5	21.4[1]	-3.3	-10.7[5]	-7.6	-14.0[5]	4.0	-34.4[1]	-6.7	-1.9
IO	-11.1[5]	-9.0[10]	-24.6[1]	15.7[1]	-11.4[5]	25.7[1]	27.5[1]	-5.6	-4.6	-15.7[1]	-7.5
ANLST	-5.3	0.2	-19.8[1]	81.4[1]	22.0[1]	41.9[1]	32.6[1]	4.3	-15.6[1]	-11.8[5]	-3.3

[1] [5] [10] Statistically different from zero at the 1% (5%) {10%} significance level.

Table VII

Multinomial Logit Estimates of the Likelihood of Using Different Classes of Currency Derivatives

Multinomial logit estimates of the relation between the likelihood that a firm chooses one of two categories of derivative strategies and variables measuring hedging incentives in fiscal year 1991 for 220 large U.S. industrial firms with foreign exchange rate exposure. This sample represents all firms that have research and development (R&D) expense data. Companies are among the 500 largest firms (by sales) in the *Fortune* 500. A firm has foreign exchange rate exposure if it has nonzero foreign pretax income, positive foreign sales or debt, or is in the upper quartile of the sample firms on the basis of imports as a percentage of total industry sales (i.e., high import competition). Classes of currency derivatives choices presented in the table are expressed relative to the choice of not using currency derivatives. Choice 1 refers to using currency swaps only or currency swaps in combination with forwards, futures and options (Swaps Only and Swap Combinations). Choice 2 refers to using foreign exchange forwards only or using foreign exchange forwards in combination with foreign exchange futures or options (Forwards Only and Forward Combinations). *ΔProb.* measures the marginal change in the probability of making Choice 1 or Choice 2 resulting from a change in the independent variable, calculated at the means of theregressors. The t-statistics are for the coefficient estimates. Summary statistics for themultinominallogit regressions are presented in Panel B.

Panel A: MultinomialLogit Estimates

	Derivative Instrument Choice			
	Choice 1 Swaps Only and Swap Combinations (N = 35)			Forwards Only a
	Coefficient	ΔProb	t-statistic	Coefficient
Constant	-10.001[1]	-0.623	-3.296	-3.686[10]
Managerial wealth	-0.337	-0.029	-1.573	0.098
Managerial option ownership	-0.098	-0.016	-0.996	0.228[5]
Tax loss carry forwards/total assets	0.538	-0.045	0.099	2.245
Long-term debt ratio	-3.963[10]	-0.306	-1.672	0.088
R&D expenses/total sales	12.501	-0.036	0.816	25.961[5]
Long-term debt ratio * R&D expenses	7.157	1.778	0.128	-32.314
Quick ratio	-2.886[5]	-0.148	-2.051	-1.905[10]
Analyst firms	-0.020	-0.004	-0.479	0.055[10]
Firm size	1.184[1]	0.075	3.933	0.392[10]
Foreign pretax income/total sales	21.338[5]	0.955	1.926	17.658[5]
Long-term foreign debt /total assets	0.000	-0.000	0.408	0.001
Short-term foreign debt/total assets	-0.002	-0.000	-0.617	-0.002
Firm has high import competition	0.056[5]	0.003	2.318	0.040[1]
Firm uses other derivatives	2.215[1]	0.139	3.403	0.787[10]

Panel B. Summary Statistics forMultinomialLogit Regression

Number of Observations	Predicted Dependent Va		
Actual Dependent Variable:	0	1	2
0 (Does not disclose the use of currency derivatives)	83	4	14
1 (Discloses using currency swaps only or currency swap combinations)	7	18	10
2 (Discloses using forwards only or forwards combinations)	25	8	51
Total	115	30	75
Log Likelihood at convergence	-151.57		
Restricted Log Likelihood: Slopes = 0	-223.85		
-2*(Log Likelihood Ratio)/(degrees of freedom)	144.55/(28)		

1 (5) {10}Significant at the 1% (5%) {10%} significance level for a two-tailed test.

Endnotes

See, for example, Smith and Stulz (1985) and Froot, Scharfstein, and Stein (1993).

[1]Breeden and Viswanathan (1996) and DeMarzo and Duffie (1995) develop models in which managerial reputation provides incentives for managers to use derivatives. Using our sample, specific testable implications of the these models are difficult to implement.

[2]Financial statement amounts include the effects of interest rate derivative products. Therefore, COV_AV and DE_AV measure post derivative-use coverage and leverage, respectively. This measurement may overstate or understate pre-hedging exposure to financial distress. Our preferred measure of COV_AV is unhedged interest expense; our preferred measure of DE_AV is the average market value of debt. Neither of these measures, however, is available.

[3]Expected taxes and the expected availability of internal cash flows are negatively related. Consequently, decreasing expected taxes indirectly increases the availability of internal funds. We interpret the FSS model to imply that firms facing a convex tax function will hedge less, *ceteris paribus*.

[4]Following the Nance et al. procedure, we classify 55 percent of our sample firms as having a high probability of operating in the progressive tax region. None of the firms, however, realize income subject to a progressive tax.

[5]Translation adjustments on assets and liabilities in place or transaction gains and losses represent the *ex post* impact of currency value changes, not the total dollars at risk. These data are available only for a limited number of firms in our sample (145 observations).

[6]These data are collected by reading segment-reporting footnotes and other disclosures within the annual report. We also include export sales when disclosed.

[7]There are only three firms with foreign exchange-rate exposure based only on IMPORTS. To check the robustness of our results to our competitive exposure classification, we also include firms with IMPORTS greater than the median. This results in 18 additional sample firms but does not change the empirical results.

[8]Only two firms have foreign-denominated debt but no operating exposure. Neither firm discloses using currency derivatives.

[9]We also estimate the logit regressions without industry indicator variables because of the potential overlap between IMPORTS, which is based on the four-digit SIC classification, and the industry indicator variables that are based on *Fortune's* industry classifications. The results are qualitatively similar, except that DE_AV is negative and significant at the 10 percent significance level for the full sample.

[10]Due to high correlations between analyst following and firm size, and managerial option ownership and firm size (see Table V), we use the residuals from a separate regression of each variable on SIZE, standardized by its predicted value, as a measure of analyst following and managerial option ownership, respectively, in the logit regression. In addition, where other independent variables are highly correlated we test the joint significance of groups of coefficients. Based on these F-tests, the conclusions are unchanged.

[11]We thank Michael Brennan for suggesting this alternative explanation.

[12]See, for example, Titman (1992) and Minton (1994) for models in which the choice of interest rate derivatives use is made simultaneously with the choice of the type of debt financing. See Kim and Titman (1996) for a discussion about the choice of managerial compensation structure and derivatives use.

[13]Gilson (1989), and Gilson and Vetsuypens (1993) find evidence that managerial tenure and compensation is affected by financial distress.

[14] The multinomial logit regressions presented in Section V also are subject to this criticism. For these regressions, we perform robustness checks of our variable specification similar to those discussed here, and the results are qualitatively similar

[15]See Titman (1992) and Minton (1994) for models examining capital structure choice in the presence of interest-rate derivative instruments.

[16]As a robustness check, we also estimate the model using BM as our measure of growth opportunities. The results, not presented, are qualitatively the same.