

Firm Complexity and FX Derivatives Use

Walter Dolde*
University of Connecticut

Dev R. Mishra
University of Saskatchewan

We simultaneously test complexity (the degree of information asymmetry) and six other theories of FX derivatives use. Structural equations modeling, a method common in other disciplines but dormant in finance since Titman and Wessels (1988), provides a natural arena for testing multiple theories against each other. We find clear empirical evidence that complexity, managerial options ownership, financial distress, and primitive risk relate to two measures of hedging behavior. Our estimates do not support roles for underinvestment or scale economies in explaining hedging. Our data set comprises all US firms with sales exceeding \$1 billion.

Introduction

Complexity is the degree of information asymmetry between managers' and shareholders' knowledge of a firm's cash flows and risks to those cash flows. It is the amount of information that would have to be transmitted to eliminate the asymmetry. We have two main interests in this research: to test a complexity theory of corporate FX derivatives use and to test it simultaneously against six other theories using structural equations methods common in other disciplines but dormant in finance since Titman and Wessels (1988).

Why do many firms manage foreign exchange (FX) exposures at the firm level rather than devolving the responsibility to shareholders? Researchers have examined a number of deviations from perfect markets assumptions, including underinvestment, managerial interests, financial distress, scale economies, and tax convexity.

* Many thanks to Thomas J. O'Brien and seminar participants at the University of Saskatchewan, especially George Tannous and Dale Domain, the Memorial University of Newfoundland, the University of Connecticut, Yale University, the Eastern Finance Association, the Financial Management Association, and the Northern Finance Association. Dev Mishra is grateful to the UConn Department of Finance and UConn-CIBER for financial support.

Corporate treasurers often cite an additional reason, however: the quantity of information that would have to be conveyed to shareholders and the impediments to doing so. Consider, for example, the comments of Berenson (2001): “Even medium-sized companies often have offices and sales around the world. No shareholder could personally check all of the operations ...” Discussions with treasurers also reveal that even the most financially sophisticated firms face challenges in maintaining corporate awareness of the FX exposures of foreign business units.

DeMarzo and Duffie (1991, 1995) analyze theoretical models of FX exposure management in which it is infeasible or inefficient for stockholders to receive sufficient information to manage their individual portions of those exposures. Firm complexity, strategic interest in safeguarding proprietary business plans, and fixed and decreasing hedging costs are among the reasons cited. One implication is that shareholders might best execute homemade FX exposure management for a simple domestic firm operating in a single, mature, well-understood industry. More complex firms operating in several industries, countries, and new technologies may be less amenable to shareholder hedging.

Firms face two levels of decisions about FX exposures. First is the qualitative decision of whether the benefits exceed the costs of preparing for, establishing, maintaining, and monitoring a hedging program. For those that embark on a program, a second, quantitative decision is the extent of hedging positions. We think of these respectively as the use decision and the extent decision. Here we develop empirical counterparts for complexity and other hedging theories and simultaneously test their ability to explain hedging use and extent. Our data set comprises all US nonfinancial firms with sales of \$1 billion or more.

Previous empirical studies generally examine the use decision with nonparametric bivariate methods and with probit regression. Those with quantitative data on hedging positions also perform tobit or heckit analysis, both of which correct for the censoring of the hedging positions at zero. In contrast, we simultaneously estimate the two equations for use-no use and extent of use. We also correct for the censored nature of extent, but with a maximum likelihood approach different from tobit or heckit. In addition to these structural equations, we simultaneously estimate seven measurement equations that relate seven theoretical concepts to 11 observable proxies.

We find clear evidence that links complexity, managerial options ownership, financial distress, and primitive risk to FX derivatives behavior. Our estimates do not support underinvestment or scale economies theories in explaining hedging.

Related Literature

Information asymmetry explicitly informs theoretical papers by DeMarzo and Duffie (1991, 1995). In DeMarzo and Duffie (1991), prohibitive dissemination expense and competitive safeguarding of proprietary information prevent firms from

conveying sufficient data to shareholders for them to manage their portions of the firm's FX exposures. The authors demonstrate conditions under which shareholders unanimously would endorse management hedging policies if communication of full information were possible. Note that it is not asymmetric information per se that prevents homemade hedging, but rather that complexity makes the asymmetry difficult and costly to overcome. About their own empirical results, Bartov and Bodnar (1994) observe that "due to the complexity of the relation between currency changes and firm performance, assets, and liabilities, a complete market response to the impact of past changes in the dollar on firm value is delayed until information regarding past performance, assets and liabilities is disseminated." The more complex the firm, the more difficult for the shareholder to forecast these delayed data.

DeMarzo and Duffie (1995) provide an information-theoretic model of corporate hedging based on managerial career interests. Current and future management compensation depends on current firm performance, but stockholders lack sufficient information to disentangle the effects of managers' decisions from factors beyond their control, including FX movements. Risk-averse managers have incentives to avoid poor outcomes that would trigger reduced future compensation and possibly even dismissal. Greater complexity compounds the obstacles managers face in avoiding unjustified disparagement, thereby increasing incentives for hedging.

Breeden and Viswanathan (1998) provide a related argument motivated by managerial interests and asymmetric information. Higher quality managers are more likely to hedge because they want to lock in the higher expected profits corresponding to their ability advantage. Although hedging is unobservable in this model, it improves the ability of investors to infer management quality from financial results. Empirical support related to some arguments in DeMarzo and Duffie (1995) and Breeden and Viswanathan (1998) appears in DaDalt, Gay, and Nam (2002). They find hedging associated with lower levels of asymmetric information, represented by forecast errors and dispersion among security analysts' earnings estimates. The relation is much stronger for FX than for interest rate hedging. There is little empirical evidence, however, about hedging and differential degrees of complexity.

Other theories of hedging focus on underinvestment (Froot, Scharfstein, and Stein, 1993), managerial interests (Smith and Stulz, 1985; Breeden and Viswanathan 1998), financial distress (Smith and Stulz, 1985), tax convexity (Smith and Stulz, 1985; Graham and Smith, 1999), and scale economies (e.g., Dolde, 1993).

There is empirical support for a relation between underinvestment and derivatives use (e.g., Géczy, Minton, and Schrand, 1997). Numerous empirical studies (e.g., Hagelin, 2003; Gay and Nam, 1998; Dolde, 1995; and Nance, Smith, and Smithson, 1993) have shown that firms with richer investment opportunities are more likely to hedge. Likewise, substantial empirical evidence exists on hedging and managerial ownership. Tufano (1996) finds hedging bears a significantly positive relation to management share ownership and a significantly negative relation to

management options ownership. Knopf, Nam, and Thornton (2002) separate managerial options holdings into their price and volatility sensitivities and find price sensitivity exhibits a significantly positive relation to corporate hedging, while volatility sensitivity exhibits a negative, but insignificant relation. Most other empirical studies fail to find a significant relation between managerial interests and derivatives use (e.g., Glaum, 2000; Géczy, Minton, and Schrand, 1997).

Empirical evidence on cost of financial distress and derivatives use is mixed, in part because many proxies for financial distress interact with firm value in multiple ways. Nance, Smith, and Smithson (1993), for example, find no evidence of relations between hedging and high leverage, low liquid assets, or small firm size, while Mian's (1996) results are mixed. But Géczy, Minton, and Schrand (1997) indicate significant relations with the hypothesized signs for leverage and liquidity. Jalilvand (1999) finds that hedgers have lower credit ratings. Glaum (2000) reports that high leverage reduces the likelihood of selective hedging, i.e. market timing based on management FX forecasts. Theory suggests that hedging and leverage are complementary for a given firm. In a sample of firms differing in primitive risk, however, the empirical relation may be negative. Firms with higher business risk tend to choose lower leverage *and* more hedging. Dolde (1995) provides strong empirical support for the complementarity hypothesis, once one controls for primitive risk. More recently, in a dynamic setting, Fehle and Tsyplakov (2005) find a non-monotonic relation between financial distress and derivatives use. They show that the firms in extreme low and extreme high financial distress do not initiate hedging, while firms between these extremes initiate and dynamically adjust hedges.

Scale economies characterize the costs of operating a hedging program (e.g., Bodnar, Hayt, and Marston, 1996, 1998; Dolde, 1993). Empirical studies robustly exhibit a positive relation between hedging and size, whether measured by sales or assets (e.g., Nance, Smith, and Smithson, 1993; Mian, 1996). As noted above, this evidence is not consistent with small size serving as a proxy for financial distress.

Tax convexity implies that the average taxes paid by a firm with more variable taxable income will exceed those of a firm with more stable income (e.g., Smith and Stulz 1985; Graham and Smith 1999). By offsetting the inherent volatility of a firm's business, hedging can reduce average taxes paid. As a practical matter, there is no tax convexity in the U.S. for large firms. The highest regular tax rate of 34 percent applies to corporate incomes above \$100,000.¹ Géczy, Minton, and Schrand (1997) cannot reject the null hypothesis that taxes and hedging are unrelated. The results of Nance, Smith, and Smithson (1993) and Mian (1996) are inconclusive. Moreover, Graham and Rogers (2002) find that tax convexity is not a significant factor in corporate hedging.

¹ There are surcharge ranges with marginal tax rates of 35 percent and 39 percent. All income above \$18 million is taxed at 34 percent.

Database Construction

Because there is no tabular database available on derivatives use, researchers often survey some population of firms, using an instrument designed to elicit information on hedging activities. Examples include Nance, Smith, and Smithson (1993), Bodnar, Hayt, and Marston (1996, 1998), and Jalilvand (1999). The alternative is to examine firms' financial reports, such as in Mian (1996), Tufano (1996), and Géczy, Minton, and Schrand (1997). A series of FASB statements² since 1990 have required disclosure of gross summary information about hedging positions and policies in financial report footnotes. These two methods for constructing databases present tradeoffs among sample size, information richness, and reliability. Surveys produce richer data, but generate smaller sample sizes due to non-responses. They also may be biased, as hedgers may have greater interest in survey participation than non-hedgers.³

The data for this study represent a 100 percent sample of all US nonfinancial firms with sales of \$1 billion or more with records in both the CompuStat and Disclosure databases for fiscal years ending between October 1995 and September 1996. We eliminate duplications, such as reorganizations and consolidated parent company-operating units. Cases with multiple missing variables, most of them nonpublic, are eliminated as well, leaving 773 firms. We search the financial footnotes in Disclosure for the keywords *derivatives*, *swap*, *forward*, *futures*, *notional*, and *foreign exchange option* and analyze each occurrence for use or nonuse of foreign exchange derivatives. Firms that make no mention of any keywords are labeled nonusers, consistent with SEC required disclosure. Users number 468, and nonusers total 305.

Of the users, 184 firms nevertheless provide no quantitative data on their FX hedging activities, even though SEC regulations follow FASB statements in requiring disclosure of the face, contract, or notional principal amount. Some firms (14) indicate that although they had used derivatives at times, their positions were zero at the date of the financial statement. Others (24) decline quantitative disclosure on the permissible grounds of non-materiality. Still others (127) disclose interest rate or commodity derivatives positions but make no indication of foreign exchange derivatives, even though some of these firms generate foreign income. A final group (19) simply provides no explanation for the absence of position sizes. These 184 firms are classified as marginal users, leaving 284 active users.

Table 1 indicates the data and sources of observable dependent and explanatory variables. Data records for our 493 firms are largely complete for the variables in Table 1, but not entirely. FASB rules permit firms to omit some detail items that fall below a threshold, generally less than 10 percent of a relevant aggregate like sales or

2 See FAS 105, 107, 119, 133. The first two were in place at the time of the data analyzed here. The latter two subsequently clarified and extended them.

3 See Dolde, Staelin, and Yao (1980).

total expenses. To preserve degrees of freedom and power, we develop an econometric procedure to estimate instruments for the missing data, which we know to have small means and variances. Details of this procedure are available from the authors.

Table 1—Index to Observed Variables and Sources.

Reference	Variable	Source
USE_D	Dummy variable coded 1 for FX derivatives users, 0 for nonusers	Constructed
NODT_SL	Sum of the absolute values of notional FX derivatives positions, scaled by total sales	CompuStat
SICNO	Number of SIC codes that account for at least 5 percent of a firm's sales	Disclosure
MVBVA	Ratio of market to book value of assets	CompuStat
RD_SL	Ratio of R&D expense to total sales	CompuStat
MOPT_SL	Market value of shares reserved for conversions of stock options, millions of dollars	Constructed
MSHR_SL	Market value of shares owned by officers and directors, millions of dollars	Constructed
HCAP_SL	Present value of CEO's future salary and bonus, millions of dollars	Constructed
LEV	Ratio of book value of long-term debt to book value of long-term debt plus market value of equity	CompuStat
L_SALES	Total sales, millions of dollars	CompuStat
L_A	Total assets, millions of dollars	CompuStat
FI_SL	Ratio of the absolute value of foreign income to total sales	CompuStat
CTAV_SL	Ratio of the volatility of the cumulative translation adjustment to total sales	CompuStat

This table provides an index to variables used in empirical analyses. Additional detail on constructed variables appears in the text.

The number of firms available for analysis here, 493 users and nonusers (677 including marginal users), compares favorably with sample sizes in previous studies. For example, Tufano (1996) and Géczy, Minton, and Schrand (1997) have 105 and 282 firms, respectively. Mian (1996) has 543 user firms, 228 marginal firms, and 2251 nonusers, but his extra firms are small because he includes firms with sales less than \$1 billion.

Development of Hypotheses and Proxies

Under perfect markets assumptions, nothing prevents shareholders from hedging a firm's FX exposures themselves. In markets as they exist, important practical concerns arise. First, the aggregate costs of disseminating data on revenues and expenses by business unit and currency to millions of shareholders would be enormous. Individual shareholder costs of analyzing the information and undertaking appropriate hedging of individual transactions likewise would prove daunting, more so for more complex firms. Second, the danger of competitors intercepting proprietary information poses a grave threat to a firm's cash flows and value. The more complex is the firm, the more valuable would proprietary information be for competitors, because it would be more expensive for them to replicate or approximate from other sources. On both counts, value maximization by and on behalf of shareholders suggests hedging should be undertaken at the corporate level. Value maximization is fostered

in two ways. First, lower costs for the firm correspond to higher cash flow and value. Second, between firms with identical cash flows, investors will pay less for the firm that necessitates higher out-of-pocket FX transactions costs for the investor. Thus, our principle hypothesis is that firm complexity is associated positively with FX derivatives use, as motivated by the DeMarzo and Duffie (1991, 1995) information asymmetry work.

Some evidence on the practicalities of foreign exchange exposures lends credence to the DeMarzo and Duffie framework. The Financial Accounting Standards Board (1996) cites two obstacles to proposed fuller disclosure of hedging positions and corresponding risk exposures. First, firms are motivated to protect proprietary information from competitors. If firm A observes changes in competitor B's hedging position in, say, sterling, firm A can make inferences about firm B's business plan for the UK. Second, some firms take a portfolio approach to hedging to minimize transactions costs, including the amount of professional time required to monitor and adjust hedging positions. According to Bodnar, Hayt, and Marston (1998), only 28 percent of firms evaluate their derivatives position as frequently as weekly and only 55 percent as frequently as monthly.⁴ If frequent valuations are suboptimal at the corporate level, they would be even more value-destructive if delegated to shareholders. Complexity amplifies these costs for both the firm and the investor, doubly reducing shareholder value.

Differential transactions costs in executing derivatives trades form a third factor suggesting cost savings to shareholders through firm-level FX management. Multinational firms vary on the degree of decentralization permitted to business units in setting exposure management strategies. But even where the decision-making is decentralized, many firms require that all derivatives trades be executed by corporate treasury. The stated reason is that corporate treasury obtains better prices from derivatives dealers than subsidiaries could. Corporate treasury gains leverage with dealers through larger transactions and by the awarding of other commercial and investment banking business.⁵ The more complex is the firm, the greater is the potential for internally netting transactions, massing transactions, and reducing costs. Lower costs, higher cash flows, and potentially higher valuation multiples from shareholders freed of hedging costs all foster value maximization by complex firms facing less-than-perfect markets.

Measures of FX Hedging Behavior

We observe both qualitative and quantitative measures of FX derivatives behavior. As Table 1 indicates, *USE_D* is a dummy variable coded 1 for 255 user

4 Dolde (1993) provides data on resources allocated to managing hedging positions in Fortune 500 firms.

5 This perspective often is voiced in practitioner roundtable discussions on risk management in which an author participates.

firms and 0 for 238 nonusers. $NODT_SL$, a quantitative measure of the extent of use, is the sum of the absolute values⁶ of the notional amounts of forwards, futures, options contracts and swaps, all divided by sales. The notional amount of an option is the contract size, the number of units of a foreign currency that can be bought or sold at the strike price. The options are not delta-weighted because nonfinancial firms tend to use options as buy-and-hold hedges rather than as trading vehicles. Thus, they tend to match the contract size at option expiration to the underlying exposure (e.g., Géczy, Minton, and Schrand, 1997; Tufano, 1996; Dolde, 1993). Derivatives denominated in foreign exchange are converted to U.S. dollars at 1995 year-end exchange rates, contemporaneous with the financial statement date of the bulk of the firms in the sample.

We take reported derivatives positions as hedges, not speculation. The overwhelming evidence is that nonfinancial firms use derivatives for hedging (Covitz and Sharpe, 2005; Lel, 2005). Hedging may be partial rather than total (Glaum, 2000; Adam and Fernando, 2006), but derivatives nevertheless are used to reduce risk, not increase it. Speculation, in contrast, is the conscious acceptance of greater risk exposure in the pursuit of higher return. Faulkender (2005) concludes that corporate debt issue and use of interest rate derivatives reflect speculation or myopia, rather than hedging. The behavior he describes, however, seems more to assume management disbelief in the efficient markets hypothesis and reaction to short-term compensation incentives. Neither of these necessarily increases interest rate exposure.

Measures for Complexity

Four observable characteristics of firms make them vary in complexity. The first is a pure indicator of complexity, the number of four-digit SIC codes representing 5 percent or more of sales. As examples, Delta Air Lines has one SIC code, Amgen two, Eastman Kodak three, and GE seven. This variable is denoted as $SICNO$.

The number of revenue and expense items that must be monitored and forecasted increases proportionately with the number of business units. Hence, firm-initiated hedging would be more likely for a firm operating in a greater number of industries and market segments.

A second type of complexity proxy deals with intangible assets, knowledge, and intellectual capital. Gu and Lev (2001) observe that the market value of the assets of the average firm is 4.0 times as great as its GAAP book value, which recognizes only plant and equipment, working capital, and financial assets. For firms characterized as high on knowledge characteristics, market value of assets is 8.1 times as great as book value. Gu and Lev (p. 1) state: "It is widely accepted that intangible (knowl-

⁶ Absolute size of positions seems a better indicator of the extent of use than would be net positions. In any event, FASB and SEC rules require only reporting of gross positions without reference to whether bought or sold.

edge or intellectual) assets are the major drivers of corporate value and growth. ...” They also note the greater informational challenges presented by intangible assets, which for the most part are not traded in markets, lack complete property-rights protection and are riskier than physical assets.

High growth firms often possess potentially profitable future investment opportunities, primarily via proprietary new technologies or methods. The cash flows of such firms are more complex to analyze than those of traditional firms and more likely to be associated with corporate hedging. In terms of observable characteristics of firms, a higher ratio of market value to book value of assets (MVBVA) suggests a more complex firm with greater unexplored growth opportunities.⁷ Similarly higher R&D expenditures indicate higher growth opportunities, future investment potential, and greater technological change for the firm.

MVBVA and R&D indicate firm complexity. They are also standard proxies for the underinvestment theory of corporate derivatives use. In order to facilitate comparison with earlier studies, we treat these variables as proxies for underinvestment alone.

How shall we think about exposures to foreign markets and currencies? In the sense of DeMarzo and Duffie (1991, 1995), firms that operate in more markets in more countries and in more currencies are more complex than purely domestic firms. It seems likely that shareholders can monitor the domestic business climate more thoroughly and at less cost than foreign business environments. Thus from a complexity perspective, we expect more hedging among firms with more and larger foreign exposures.

Foreign exposure also represents a form of primitive risk cited by Froot, Scharfstein, and Stein (1993) to motivate hedging. In the presence of fixed and increasing costs of external finance, greater primitive risk exposure increases the probability of underinvestment. For these reasons we do not include foreign exposure measures as components of complexity. We instead think of it as a good control variable whose inclusion may foster more precise estimation of the conditional effects of other theories.

Measures for Other Theories

Beyond complexity, we simultaneously test six other theories of corporate hedging. First is underinvestment, for which the proxies are market to book value of assets (MVBVA) and R&D expenses scaled by sales (RD_SL).

We separate managerial interests into two unobserved explanatory variables, managerial interests-options and managerial interests-undiversified wealth. This separation is necessary because theory predicts different signs for their relations to

⁷ We use the market-to-book ratio for assets rather than equity because book equity is negative for a few firms in our sample. All have positive book asset value.

corporate hedging. Stock options provide incentive for greater volatility and less hedging. Undiversified wealth induces more hedging. Our proxy for managerial interests-options is the market value of shares reserved for option grants as a ratio to sales (MOPT_SL).

There are two components of managerial interests-undiversified wealth: human capital and financial wealth tied to the firm, excluding options. Our financial proxy is the market value of shares owned by officers and directors (MSHR_SL) as a ratio to sales. The human capital proxy is the present value of the CEO's future compensation through age 65, scaled by sales (HCAP_SL). The present value, up to a proportionality factor, depends on current salary plus bonus, age, and the value of the ratio $(1+g)/(1+r)$, where g is the growth of compensation and r is the discount rate for human capital. We set $(1+g)/(1+r)$ equal to 0.9, implying a large discount rate for non-tradable, non-guaranteed future compensation. For CEO's older than 65, human capital is $(1+g)/(1+r)$ times the last reported compensation, i.e., the present value of next year's expected compensation.

Our measure of financial distress is leverage (LEV), which is the ratio of long-term debt to the sum of long-term debt and equity. As is standard in previous studies, long-term debt is at book value, equity at market value.

We have two measures for scale economies, log of sales (L_SALES) and log of market value of total assets (L_A).

There are two empirical proxies for foreign primitive risk. The first is the ratio of the absolute value of foreign income to sales (FI_SL).⁸ The second is the ratio of the volatility of the cumulative translation account (CTA) to total sales (CTAV_SL). CTA cumulates the effects of exchange rate changes on translating a subsidiary's balance sheet into the home currency of a parent's balance sheet.

Model Specification

We discuss seven theories, represented by 11 observed proxies, to explain two dependent variables. Structural equations modeling, used previously in the finance literature by Titman and Wessels (1988), provides a means for estimating such structures simultaneously. We apply the LISREL system of Jöreskog (1981) and Jöreskog and Sörbom (1996). The system contemplates a measurement model and a structural model. As applied here, the measurement model consists of equations for seven unobserved theoretical concepts (e.g., underinvestment), expressed in terms of 11 observed explanatory variables (e.g., market-to-book-value of assets). The structural model has two equations relating the dependent variables (use of hedging and extent of hedging) to the seven unobserved theoretical concepts.

⁸ We would prefer foreign sales rather than foreign income in the numerator. But foreign sales was not a regular CompuStat field for the year of our data set. Total income is not a good candidate for the denominator because some firms have losses.

The measurement model recognizes that we often cannot observe theoretical concepts but have only proxy variables thought to capture some aspect of theory. These proxies are imperfect representations, subject to errors in variables. The observed proxies are modeled as linear functions of the theoretical concepts together with an error term. The measurement model is

$$x = \Lambda \xi + \delta \quad (1)$$

where x is an 11×1 vector of observed indicators, ξ is a 7×1 vector of unobserved explanatory concepts, Λ is an 11×7 matrix of coefficients, and δ is an 11×1 error vector. The structural model is

$$y = \Gamma \xi + \varepsilon \quad (2)$$

where y is a 2×1 vector of observed dependent variables, Γ is a 2×7 matrix of coefficients, and ε is a 2×1 error vector.

Assign these abbreviations to the seven theoretical concepts: complexity (Com), underinvestment (Und), managerial interests-options (MIO), managerial interests-undiversified wealth (MIU), financial distress (FD), scale economies (ScE), and foreign exposure (FEx). Then the components of equations (1) and (2) stated in terms of the hypotheses are:

$$\begin{bmatrix} \text{SICNO} \\ \text{MVBVA} \\ \text{RD_SL} \\ \text{MOPT_SL} \\ \text{MSHR_SL} \\ \text{HCAP_SL} \\ \text{LEV} \\ \text{L_SALES} \\ \text{L_A} \\ \text{FI_SL} \\ \text{CTAV_SL} \end{bmatrix} = \begin{bmatrix} \lambda_{1,1} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \lambda_{2,2} & 0 & 0 & 0 & 0 & 0 \\ 0 & \lambda_{3,2} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \lambda_{4,3} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \lambda_{5,4} & 0 & 0 & 0 \\ 0 & 0 & 0 & \lambda_{6,4} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \lambda_{7,5} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \lambda_{8,6} & 0 \\ 0 & 0 & 0 & 0 & 0 & \lambda_{9,6} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \lambda_{10,7} \\ 0 & 0 & 0 & 0 & 0 & 0 & \lambda_{11,7} \end{bmatrix} \times \begin{bmatrix} \xi_{\text{Com}} \\ \xi_{\text{Und}} \\ \xi_{\text{MIO}} \\ \xi_{\text{MIU}} \\ \xi_{\text{FD}} \\ \xi_{\text{ScE}} \\ \xi_{\text{FEx}} \end{bmatrix} + \delta \quad (3)$$

$$\begin{bmatrix} \text{USE_D} \\ \text{NODT_SL} \end{bmatrix} = \begin{bmatrix} \gamma_{1,1} & \gamma_{1,2} & \gamma_{1,3} & \gamma_{1,4} & \gamma_{1,5} & \gamma_{1,6} & \gamma_{1,7} \\ \gamma_{2,1} & \gamma_{2,2} & \gamma_{2,3} & \gamma_{2,4} & \gamma_{2,5} & \gamma_{2,6} & \gamma_{2,7} \end{bmatrix} \times \begin{bmatrix} \xi_{\text{Com}} \\ \xi_{\text{Und}} \\ \xi_{\text{MIO}} \\ \xi_{\text{MIU}} \\ \xi_{\text{FD}} \\ \xi_{\text{ScE}} \\ \xi_{\text{FEx}} \end{bmatrix} + \varepsilon. \quad (4)$$

Zeros in Λ and Γ designate coefficients for which theory does not suggest a relation. Indeed, as in standard regression applications, the model would not be identified without these restrictions. In a typical factor analysis application, the factors (ξ) have no ex ante theoretical interpretation. One generally identifies them by constraining them to orthogonality. In equations (3) and (4), the ξ do have interpretations and, according to other parts of finance theory, may be correlated. In principle there

is no reason to restrict each row of Λ to a single nonzero entry. The current specification, while simpler than it might be, facilitates comparison with previously reported empirical results.

We estimate equations (3) and (4) simultaneously by maximum likelihood methods. Three of the observed variables depart from normal distributions, an assumption underlying maximum likelihood estimation. *USE_D* is dichotomous, *NODT_SL* is censored from below, and *SICNO* is censored from above.⁹ Another advantage of the estimation method used here is that Jöreskog (1986) develops a correction for nonnormalities, including categorical variables. A first step in the estimation produces an asymptotic covariance matrix of correlations of the observed variables corrected for nonnormalities. The simultaneous maximum likelihood estimation of equations (3) and (4) starts with this corrected covariance matrix.

Correlation Matrix and Summary Statistics for Observed Variables

Table 2 presents correlations among our observed variables corrected for nonnormalities. One notes several numerically high correlations among growth opportunities, foreign exposure, managerial options ownership, and managerial undiversified human and financial wealth. These high correlations could suggest, for example, a tendency for a US international comparative advantage in knowledge-based and technology goods and services. Firms in technology industries are characterized in the business press as having both relatively greater insider ownership and options compensation compared to other industries.

Table 3 provides summary statistics. In our sample, 51.7 percent of our 493 firms use FX derivatives. The average absolute notional value of their FX derivatives positions scaled by sales is 0.145 (not shown). This represents about two months' sales or about \$1.2 billion for the average user firm. Averaged over all firms, including nonusers, the derivatives ratio is 0.072 with a standard deviation of 0.25. On average, sample firms operate in 4.1 industries or business lines representing more than 5 percent of their sales. R&D expenses and absolute value of foreign income, respectively, average 3 percent and 2.6 percent of sales. Long-term debt accounts for 25.2 percent of total capital (with equity at market value).

⁹ The numerator of *NODT_SL* is a sum of absolute values of positions. This is necessary because many firms have a natural short position in some currencies and a natural long position in others. *SICNO* is censored because Disclosure codes firms with more than seven large SIC code segments as having seven. This appears to affect approximately 7 percent of firms.

Table 2—Corrected Correlations among Observed Variables

	USE D	NODT SL	SIC- NO	MV- BVA	RD SL	MOPT SL	MSHR SL	HCAP SL	LEV	L SALES	L_A	FI SL	CTAV SL
USE_D	1.000												
NODT_SL	0.835	1.000											
SICNO	0.324	0.168	1.000										
MVBVA	0.108	0.139	-0.108	1.000									
RD_SL	0.273	0.263	-0.065	0.305	1.000								
MOPT_SL	0.103	0.092	-0.100	0.462	0.475	1.000							
MSHR_SL	-0.096	-0.054	-0.094	0.373	0.099	0.265	1.000						
HCAP_SL	-0.035	-0.039	-0.131	0.143	0.127	0.106	0.064	1.000					
LEV	-0.232	-0.165	-0.079	-0.545	-0.218	-0.207	-0.134	-0.064	1.000				
L_SALES	0.281	0.159	0.269	-0.059	0.032	-0.036	-0.148	-0.439	0.004	1.000			
L_A	0.281	0.207	0.250	-0.142	0.095	0.052	-0.128	-0.369	0.143	0.828	1.000		
FI_SL	0.252	0.340	-0.050	0.405	0.377	0.365	0.219	0.008	-0.273	0.058	0.107	1.000	
CTAV_SL	0.223	0.152	0.092	-0.010	0.162	0.050	0.011	0.012	-0.127	0.020	0.141	0.338	1.000

The table shows correlations among observed variables, corrected for the dichotomous nature of USE_D and the censored nature of NODT_SL and SICNO. USE_D is a dummy variable coded 1 for FX derivatives users, 0 for nonusers; NODT_SL is the ratio to sales of the sum of the absolute values of the notional values of FX derivatives positions; SICNO is the number of SIC codes that account for at least 5 percent of a firm's sales; MVBVA is the ratio of market to book value of assets. RD_SL is the ratio to sales of R&D expense; MOPT_SL is the ratio to sales of the market value of shares reserved for conversion of stock options; MSHR_SL is the ratio to sales of the market value of shares owned by officers and directors; HCAP_SL is the ratio to sales of the present value of the CEO's future salary and bonus; LEV is the ratio of the book value of long-term debt to book value of long-term debt plus market value of equity; L_SALES is the log of total sales; L_A is the log of total assets; FI_SL is the ratio of the absolute value of foreign income to total sales; CTAV_SL is the ratio to sales of the volatility of the cumulative translation adjustment. N = 493 firms

Table 3—Summary Statistics for Observed Variables

	Mean	Std. Dev.	Min	Quart 1	Med	Quart 3	Max
USE_D	0.517	0.500	0.000	0.000	1.000	1.000	1.000
NODT_SL	0.072	0.250	0.000	0.000	0.003	0.054	3.383
SICNO	4.114	2.090	1.000	2.000	4.000	6.000	7.000
MVBVA	1.663	0.859	0.806	1.147	1.393	1.864	6.838
RD_SL	0.030	0.031	0.000	0.010	0.026	0.029	0.200
MOPT_SL	0.071	0.104	0.000	0.018	0.045	0.095	1.339
MSHR_SL	0.085	0.168	0.000	0.009	0.033	0.115	1.744
HCAP_SL	0.025	0.029	0.001	0.008	0.018	0.033	0.337
LEV	0.252	0.197	0.000	0.094	0.217	0.364	0.974
L_SALES	8.299	1.034	6.911	7.480	8.055	8.957	12.037
L_A	8.235	1.234	5.456	7.325	8.092	9.015	12.402
FI_SL	0.026	0.023	0.000	0.010	0.025	0.028	0.154
CTAV_SL	0.561	0.700	0.000	0.000	0.460	0.800	5.110

This table shows the mean, standard deviation, and all quartiles for each variable. USE_D is a dummy variable coded 1 for FX derivatives users, 0 for nonusers; NODT_SL is the ratio to sales of the sum of the absolute values of the notional values of FX derivatives positions; SICNO is the number of SIC codes that account for at least 5 percent of a firm's sales; MVBVA is the ratio of market to book value of assets. RD_SL is the ratio to sales of R&D expense; MOPT_SL is the ratio to sales of the market value of shares reserved for conversion of stock options; MSHR_SL is the ratio to sales of the market value of shares owned by officers and directors; HCAP_SL is the ratio to sales of the present value of the CEO's future salary and bonus; LEV is the ratio of the book value of long-term debt to book value of long-term debt plus market value of equity; L_SALES is the log of total sales; L_A is the log of total assets; FI_SL is the ratio of the absolute value of foreign income to total sales; CTAV_SL is the ratio to sales of the volatility of the cumulative translation adjustment. N = 493 firms

Maximum Likelihood Estimates of the Measurement Model

Table 4 presents estimates of the Λ matrix relating observed proxy variables and corresponding theoretical concepts (equation 3). All of the signs correspond to theoretical predictions and the estimated standard errors are small.¹⁰ From a behavioral perspective, the excellent fit to these proxy variables is not surprising, as, with the exception of complexity, they have withstood substantial previous theoretical and empirical examination in the literature.

Maximum Likelihood Estimates of the Covariance Matrix of the Theoretical Concepts

Table 5 presents estimates of the covariances of the theoretical concepts. The diagonal elements, the variances, are all 1.0 because the theoretical concepts lack natural quantitative measures. The usual assumption, adopted here, is to scale each so that its variance is 1.0.

10 The t statistics for estimates in Table 4 (not shown) are all significant at much better than the 0.01 level. Titman and Wessels (1988) report t statistics indistinguishable from these.

Table 4—Maximum Likelihood Estimates of the Measurement Model

	Com	Und	MIO	MIU	FD	ScE	FEx
SICNO	1.000 (0.029)						
MVBVA		1.825 (0.136)					
RD_SL		0.042 (0.003)					
MOPT_SL			1.001 (0.030)				
MSHR_SL				0.326 (0.018)			
HCAP_SL				0.409 (0.022)			
LEV					0.995 (0.030)		
L_SALES						0.925 (0.057)	
L_A						0.892 (0.057)	
FI_SL							0.525 (0.109)
CTAV_SL							0.092 (0.016)

This table shows estimates (and standard errors) of the measurement matrix Λ relating theoretical concepts in the top row to observed explanatory variables in the first column. USE_D is a dummy variable coded 1 for FX derivatives users, 0 for nonusers; NODT_SL is the ratio to sales of the sum of the absolute values of the notional values of FX derivatives positions; SICNO is the number of SIC codes that account for at least 5 percent of a firm's sales; MVBVA is the ratio of market to book value of assets. RD_SL is the ratio to sales of R&D expense; MOPT_SL is the ratio to sales of the market value of shares reserved for conversion of stock options; MSHR_SL is the ratio to sales of the market value of shares owned by officers and directors; HCAP_SL is the ratio to sales of the present value of the CEO's future salary and bonus; LEV is the ratio of the book value of long-term debt to book value of long-term debt plus market value of equity; L_SALES is the log of total sales; L_A is the log of total assets; FI_SL is the ratio of the absolute value of foreign income to total sales; CTAV_SL is the ratio to sales of the volatility of the cumulative translation adjustment. The concepts are complexity (Com), underinvestment (Und), managerial interests-options (MIO), managerial interests-undiversified wealth (MIU), financial distress (FD), scale economies (ScE), and foreign exposure (FEx). N = 493 firms

A few covariances are numerically large. Two exceed 0.7 in absolute value, while another five range between 0.31 and 0.53. These instances of high correlations across explanatory variables are not a product of the simultaneous estimation method used here. They are characteristics of the data. Traditional estimation methods such as probit, tobit, and heckit are perhaps less likely to induce researchers to examine covariances of explanatory concepts. It is possible that unexamined high correlations account, in part, for conflicting empirical results in the literature.

Table 5—Maximum Likelihood Estimates of the Covariance Matrix of the Theoretical Concepts

	Com	Und	MIO	MIU	FD	ScE	FEx
Com	1.000						
Und	-0.056	1.000					
MIO	-0.099	0.238	1.000				
MIU	-0.314	0.340	0.485	1.000			
FD	-0.079	-0.285	-0.205	-0.247	1.000		
ScE	0.284	-0.053	0.001	-0.835	0.063	1.000	
FEx	-0.078	0.367	0.704	0.236	-0.523	0.185	1.000

This table shows estimates of the covariance matrix of the theoretical concepts. Because the theoretical concepts have no natural units, their scales have been set to produce variances of 1.0. The concepts are complexity (Com), underinvestment (Und), managerial interests-options (MIO), managerial interests-undiversified wealth (MIU), financial distress (FD), scale economies (ScE), and foreign exposure (FEx). N = 493 firms

Maximum Likelihood Estimates of the Structural Model

Consider the estimates in Table 6, relating theoretical concepts and observed dependent variables, the Γ matrix (equation 4). Complexity has the predicted positive sign and is statistically nonzero in explaining both the decision on whether to establish a hedging program and the decision on the extent of hedges. Other concepts whose coefficients are significant with a sign that tends to confirm theory are managerial interests—options ownership (negative), financial distress costs (positive), and foreign exposure (positive). The t statistics reported in Table 6 should be taken as indicative, because the estimated standard errors have not been shown to be consistent. The parameter estimates are consistent. Even allowing for healthy haircuts from the estimated t statistics, however, the coefficients here are more than measurably different from zero.

Managerial interests—undiversified wealth and scale economies present the predicted positive coefficients but do not appear to be statistically significant. It is noteworthy that the attempt to separate conflicting aspects of managerial interests resulted in the anticipated signs for both concepts. Greater managerial options ownership is associated with lower likelihood and extent of hedging, while greater managerial undiversified wealth is associated with more hedging.

The only explanatory concept with signs counter to theory is underinvestment, although the coefficients are not significantly different from zero. This finding contrasts starkly with the existing literature. There is near unanimity in previous empirical work that the observables for underinvestment, R&D spending, and market-to-book value are significantly positively related to hedging.

The χ^2 for the entire model—the measurement model, the covariance matrix of the concepts, and the structural model of Tables 4 through 6—is 472.1 with 35 degrees of freedom, which represents a probability value near 0.0. The degrees of freedom for the χ^2 statistic is the difference between the number of observed explanatory and dependent variables ($13 \times (13+1)/2 = 91$) and the number of

parameters estimated in the measurement model, the structural model, the covariance model, and the equation error variances (56).

Table 6—Maximum Likelihood Estimates of the Structural Model

	USE_D	NODT_SL
Com	0.513 (4.89)	0.376 (5.45)
Und	-0.752 (-1.73)	-0.445 (-1.46)
MIO	-2.111 (-2.00)	-1.602 (-2.42)
MIU	3.359 (1.36)	1.402 (0.78)
FD	0.507 (2.77)	0.666 (5.32)
ScE	2.658 (1.33)	0.858 (0.57)
FEx	1.305 (5.01)	1.839 (4.77)
χ^2	472.1	
df	35	
p value	0.0	

This table shows estimates (and t statistics) of the structural matrix Γ relating observed dependent variables to theoretical concepts. USE_D is a dummy variable coded 1 for FX derivatives users, 0 for nonusers; NODT_SL is the ratio to sales of the sum of the absolute values of the notional values of FX derivatives positions. The concepts are complexity (Com), underinvestment (Und), managerial interests-options (MIO), managerial interests-undiversified wealth (MIU), financial distress (FD), scale economies (ScE), and foreign exposure (FEx). N = 493 firms

Comparison with Previous Empirical Studies

The empirical method here simultaneously tests seven theories of corporate FX hedging. There are a number of contrasts with the results of previous empirical studies. First, complexity, the degree of information asymmetry, is an important characteristic for predicting a firm's FX hedging behavior. While there is existing evidence for asymmetric information itself, e.g., DaDalt, Gay, and Nam (2002), this is the first test of an explicit quantitative measure of complexity.

Second, there is no empirical support here for underinvestment as a theory of FX hedging behavior when it is tested simultaneously with other theories. This contrasts sharply with previous studies, which nearly unanimously report significance for R&D and only slightly less frequently for market-to-book value. Perhaps the correlations among theoretical concepts (Table 5) provide some insight. Underinvestment is correlated with four other concepts at absolute values between 0.23 and 0.37. This raises the possibility that in some studies underinvestment serves as a proxy for omitted factors, but that it is superfluous when these factors are included.

Third, there is clear empirical backing here for a negative relation between managerial options and the probability of FX hedging and the size of hedging positions. Among previous studies, only Tufano (1996) reports a significant negative

relation. Other studies find no link or a significant positive connection, contrary to theory.

Fourth, the estimates here suggest a strong relation between financial distress costs and both use and size of hedging. The existing empirical literature is divided roughly evenly in whether financial distress and hedging behavior are linked empirically. The foreign control here, which is statistically significant both for qualitative and quantitative hedging behavior, may serve as a conditioning primitive risk variable in sorting how leverage and hedging relate.

Fifth, none of the coefficients of scale economies are significantly nonzero here, when tested simultaneously against other theories. This contrasts sharply with previous studies, which overwhelmingly find a positive relation between size and derivatives behavior. But in the presence of complexity, managerial options, financial distress costs, and foreign exposure, scale economies do not add to our understanding of hedging behavior.

Sixth, the results here on undiversified managerial interests are consistent with the bulk of previous studies that have failed to detect a relation to hedging behavior. The examination of the covariance matrix of explanatory variables provides some insight into why this may be. All six of the off-diagonal correlations exceed 0.23 in absolute value. Two exceed 0.48.

Summary and Conclusions

We simultaneously test complexity and six additional theories of FX derivatives against each other. Structural equations modeling, a method common in other disciplines but dormant in finance since Titman and Wessels (1988), provides a natural arena for the contest. Complexity is the degree of information asymmetry between managers' and shareholders' knowledge of exposures. We find that more complex firms are more likely to hedge rather than devolving that activity to shareholders (DeMarzo and Duffie, 1991, 1995). They are also likely to have larger hedging positions. We also find clear evidence for managerial interests—options, financial distress, and primitive risk theories relating to both measures of hedging behavior. Our estimates do not support underinvestment, undiversified managerial interests, or scale economies theories of hedging. The dataset comprises all US firms with sales exceeding \$1 billion, 493 firms that are major users of FX derivatives or are not users. (128 marginal users are excluded.) This sample is much larger than the samples examined in previous empirical studies, with the exception of Mian (1996), who includes about 2000 firms with sales smaller than \$1 billion.

Structural equations modeling can test competing theories simultaneously. A useful byproduct is the covariance matrix among theoretical concepts, given the specification of multiple proxies for multiple theories. This covariance matrix provides insights into reconciling empirical results that differ across studies. For example, underinvestment is not significant here, although its proxies (market-to-

book-value of assets and R&D expense relative to sales) are almost universally significant in other studies. The covariance matrix in Table 5 suggests a reconciliation. Underinvestment bears several numerically large correlations with other explanatory theories. Thus the proxies used to represent underinvestment may serve as proxies for other theories as well.

There are many tasks remaining for future research. First, along with all previous studies, we would benefit from a better proxy for pre-hedging foreign exposure, what Froot, Scharfstein, and Stein (1993) term *primitive risk*. Second, disaggregating extent of hedging by currency and matching the hedges with exposures would provide greater insight. These tasks will require new data sources and will be challenging for large numbers of firms such as used in this study. It may prove interesting to apply structural equations estimators to other data sets to further sort out the relative usefulness of competing theories of corporate derivatives use.

References

1. Adam, T., and C.S. Fernando, "Hedging, Speculation and Shareholder Value," *Journal of Financial Economics* (August 2006), pp. 283-309.
2. Bartov, E., and G.M. Bodnar, "Firm Valuation, Earnings Expectations, and the Exchange Rate Exposure Effect," *Journal of Finance* (December 1994), pp.1755-1785.
3. Berenson, A., "The Dangers Behind a Leap of Faith," *The New York Times* (December 9, 2001), p. BU1.
4. Bodnar, G.M., G.S. Hayt, and R.C. Marston, "1995 Wharton Survey of Derivatives Usage by U.S. Nonfinancial Firms," *Financial Management* (Winter 1996), pp. 113-133.
5. Bodnar, G.M., G.S. Hayt, and R.C. Marston, "1998 Wharton Survey of Derivatives Usage by U.S. Nonfinancial Firms," *Financial Management* (Winter 1998), pp. 70-91.
6. Breeden, D., and S. Viswanathan, "Why Do Firms Hedge? An Asymmetric Information Model," (Working paper 1998) Fuqua School of Management, Duke University.
7. Covitz, Daniel M., and Stephen A. Sharpe, "Do Nonfinancial Firms Use Interest Rate Derivatives to Hedge?" (Working paper 2005), Board of Governors of the Federal Reserve.
8. DaDalt, P., G.D. Gay, and J. Nam, "Asymmetric Information and Corporate Derivatives Use," *Journal of Futures Markets* (March 2002), pp. 241-267.
9. DeMarzo, P.M., and D. Duffie, "Corporate Financial Hedging with Proprietary Information," *Journal of Economic Theory* (April 1991), pp. 261-286.
10. DeMarzo, P.M., and D. Duffie, "Corporate Incentives for Hedging and Hedge Accounting," *The Review of Financial Studies* (Fall 1995), pp. 743-771.
11. Dolde, W., "The Trajectory of Corporate Financial Risk Management," *Journal of Applied Corporate Finance* (Fall 1993), pp. 33-41.
12. Dolde, W., "Hedging, Leverage, and Primitive Risk," *Journal of Financial Engineering* (June 1995), pp. 187-216.
13. Dolde, W., R. Staelin, and T. Yao, "Estimating Response Rates for Different Market Segments from Questionnaire Data," *Journal of Marketing Research* (May 1980), pp. 245-252.
14. Faulkender, M., "Hedging Or Market Timing? Selecting the Interest Rate Exposure of Corporate Debt," *Journal of Finance* (April 2005), pp. 931-962.

15. Fehle, F., and S. Tsyplov, "Dynamic Risk Management: Theory and Evidence," *Journal of Financial Economics* (October 2002), pp. 3-47.
16. Froot, K.A., D. Scharfstein, and J. Stein, "Risk Management: Coordinating Corporate Investment and Financing Policies," *Journal of Finance* (December 1993), pp.1629-1658.
17. Gay, G.D., and J. Nam, "The Underinvestment Problem and Corporate Derivatives Use," *Financial Management* (Winter 1998), pp. 53-69.
18. Géczy, C., B.A. Minton, and C. Schrand, "Why Firms Use Currency Derivatives," *Journal of Finance* (September 1997), pp. 1323-1354.
19. Glaum, M., "Foreign Exchange Risk Management in German Nonfinancial Corporations: An Empirical Analysis," *Risk Management: Challenge and Opportunity*, (January 2000)
20. Graham, J.R., and C.W. Smith, Jr. "Tax Incentives to Hedge," *Journal of Finance* (December 1999), pp. 2241-2262.
21. Graham, J.R., and D.A. Rogers, "Do Firms Hedge in Response to Tax Incentives?" *Journal of Finance* (April 2002), pp. 815-839.
22. Gu, F., and B. Lev, "Intangibles: Measurement, Drivers, Usefulness," (2001), working paper New York University.
23. Hagelin, N., "Why Firms Hedge with Currency Derivatives: An Examination of Transaction and Translation Exposure," *Applied Financial Economics* (January 2003), pp. 55-69.
24. Jalilvand, A., "Why Firms Use Derivatives: Evidence from Canada," *Canadian Journal of Administrative Sciences* 16, No.3 (1999), pp. 213-228.
25. Jöreskog, K., "Structural Equations Models in the Social Sciences: Specification, Estimation, and Testing," in P.R. Krishnaiah (ed.), *Applications in Statistics* (Amsterdam: North-Holland, 1981), pp. 265-287.
26. Jöreskog, K., "Estimation of the Polyserial Correlation from Summary Statistics," (Research Report 86-2, 1986) University of Uppsala, Department of Statistics.
27. Jöreskog, K., and D. Sörbom, *LISREL 8: User's Reference Guide* (Lincolnwood, IL, 1996): Scientific Software International.
28. Knopf, J.D., J. Nam, and J.H. Thornton, Jr., "The Volatility and Price Sensitivities of Managerial Stock Option Portfolios and Corporate Hedging," *Journal of Finance* (April 2002), pp. 801-813.
29. Lei, U., "Currency Hedging and Corporate Governance: a Cross-Country Analysis," (Working paper, 2005), Board of Governors of the Federal Reserve System.
30. Mian, S.L., "Evidence on Corporate Hedging Policy," *Journal of Financial and Qualitative Analysis* (September 1996), pp. 419-439.
31. Nance, D.R., C.W. Smith, and C.W. Smithson, "On the Determinants of Corporate Hedging," *Journal of Finance* (March 1993), pp. 267-284.
32. Smith, C.W., and R.M. Stulz, "The Determinants of Firms' Hedging Policies," *Journal of Financial and Quantitative Analysis* (December 1985), pp. 391-405.
33. Titman, S., and R. Wessels, "The Determinants of Capital Structure Choice," *Journal of Finance* (March 1988), pp. 1-19.
34. Tufano, P., "Who Manages Risk? An Empirical Examination of Risk Management Practices in The Gold Mining Industry," *Journal of Finance* (September 1996), pp.1097-1137.

Copyright of Quarterly Journal of Business & Economics is the property of College of Business Administration/Nebraska and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.