

## ECONOMIC EXPOSURE AND INTEGRATED RISK MANAGEMENT

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*Most corporate risk management research focuses on particular risk exposures to the exclusion of other interrelated exposures. By contrast, this study models corporate risk exposures using a multivariate approach integrating the distinct exposures of interest to finance, international business, and strategy researchers. The paper addresses the implications of multivariate modeling for corporate risk management, some key methodological issues arising in empirical estimation of corporate economic exposures, and directions for research on integrated risk management.*  
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### INTRODUCTION

Exposure refers to the extent to which external environmental contingencies affect a company's performance. If we conceptualize strategy as the alignment of the firm with its external environment (see, for example, Andrews, 1971; Porter, 1980), then the measurement and management of exposures are central concerns for strategists.

While scholars have acknowledged economic exposure as the relevant basis for corporate risk assessment, risk management practices for the most part continue to reflect accounting-based notions of exposure assessment (Batten, Mellor, and Wan, 1993; George and Schroth, 1991; Rawls and Smithson, 1990; Rodriguez, 1981). Although there appears to be growing interest in economic exposure among managers, only a few large multinationals have implemented economic

exposure assessment and management (Kohn, 1990; Lewent and Kearney, 1990).

The lack of clear guidelines for measuring economic exposure is a major obstacle to implementing economic exposure assessment and hedging. While Dufey (1972) drew attention to the need to rethink foreign exchange exposure in economic rather than accounting terms, finance research has not adequately addressed the practical issue of how to measure corporate economic exposures when firms are simultaneously exposed to multiple uncertain environmental contingencies. Ahkam (1995) recently drew attention to the need for explicit attention to the measurement of corporate economic exposures.

This paper addresses the measurement and management of corporate economic exposures. The measurement perspective adopted is that of top managers concerned with a variety of uncertain environmental contingencies affecting corporate performance. The general management perspective requires integrating the risk exposures considered in the strategy field (e.g., competitive, input supply, market demand, and technological risks) with those of interest to finance and international business scholars. In developing a con-

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ceptual and operational basis for measuring economic exposure, the study also lays the groundwork for strategy research directed at understanding the role of corporate strategy (e.g., diversification or real options) in economic exposure management. The insights from this study have important practical implications for corporate risk assessment and management.

The paper begins with background on the concept of economic exposure. The subsequent section presents multivariate modeling of corporate economic exposures. The starting point for this model is corporate foreign exchange exposure but the model is also extended to an integrated framework incorporating other uncertain environmental contingencies. This is followed by a discussion of the theoretical and managerial implications of multivariate assessment of economic exposure. Next, the paper seeks to resolve some key methodological issues that must be addressed in order to actually measure corporate economic exposures. The final section discusses directions for extending research on integrated risk management.

## ASSESSING AND MANAGING EXPOSURES

### Accounting and economic exposure

In the past, scholarly interest in corporate risk exposure has come almost exclusively from the accounting and finance fields. Exposure assessment has received greatest attention from managers and scholars interested in smoothing the impacts of foreign exchange rate movements on accounting profits. Recognition of foreign exchange exposure arose from the practical need to consolidate the financial statements of foreign operations to local currencies (translation exposure) and the possibility of incurring accounting gains or losses on receivables and payables denominated in foreign currencies (transaction exposure).<sup>1</sup> While much attention has been given to foreign exchange exposure, finance researchers have also considered exposures to movements in other financial market variables, such as interest rates and commodity prices. Such

exposures can be managed through the use of financial hedging instruments such as futures and forward contracts, options, and swaps.

Whereas the accounting concepts of transaction and translation exposure have been codified in accounting standards (e.g., FASB 52), no such standard definition exists for economic exposure. One point of confusion in the existing discussions of economic exposure regards the choice of the dependent variable. Economic exposure has been discussed in terms of the sensitivity of cash flows, accounting profits, and the real value of the firm to exchange rate movements (Lessard, 1986; Bishop and Dixon, 1992; Oxelheim and Wihlborg, 1987a). These varying perspectives on economic exposure point out the need to clarify the choice of the dependent variable in defining and measuring economic exposure.

In his early work, Shapiro (1975, 1977) focused on cash flow sensitivity to nominal movements in foreign exchange rates. The emphasis on cash flows is also found in corporate managers' attempts to assess and hedge economic exposure to foreign exchange rate movements (Kohn, 1990; Lewent and Kearney, 1990). Later, Shapiro (1984) acknowledged that the emphasis on nominal cash flows was inappropriate and, following Cornell (1980) and Wihlborg (1980), asserted real cash flows as theoretically appropriate for measuring economic exposure. The need to use real cash flows, as opposed to nominal values, is, however, not explicit elsewhere in Shapiro's writings on measuring economic exposure (Garner and Shapiro, 1984; Shapiro, 1992).

While focusing on real cash flows is superior to looking simply at nominal cash flows, the emphasis on cash flows needs to be questioned. Looking at the magnitude of net cash flows is clearly incorrect when a firm's level of capitalization changes over time. Consider a firm that raises new capital through debt or equity financing or simply through retention of earnings. Investment of this capital in projects generating returns equal to the cost of capital does not increase shareholder value (Rappaport, 1986). Such investments do, however, increase net cash flows.

Even for firms with constant levels of capitalization, emphasizing real cash flow sensitivity overlooks the distortions in current cash flows. Short-term cash flows provide little information about the value created by a firm's strategy. For

<sup>1</sup> International finance and accounting texts (e.g., Choi and Mueller, 1992; Shapiro, 1992) provide extensive discussions of translation and transaction exposure.

example, new strategic initiatives often require several years of negative cash flows before entering into a period of positive cash flows. These negative cash flows may result from intensive investment in R & D, plants and equipment, and marketing, and limited initial sales. The deficiencies of cash flow or net income as dependent variables in estimating economic exposures bring into question the approach used in recent empirical studies (e.g. Ahkam, 1995; Moens, 1995) and advocated in papers directed towards managers (e.g., Lewent and Kearney, 1990).

From a value creation perspective, we are actually interested in the sensitivity of a firm's present value to exchange rate movements. Present value takes into consideration the discounted cash flows over the life of an investment. Since short-term cash flows are not a direct measure of value creation, cash flows and firm value can present quite divergent criteria for estimating a firm's economic exposure. Unlike current cash flows, present value is a direct measure of firm value.

Calculation of a firm's present value is, however, problematic, given the high uncertainty surrounding forecasted cash flows and the need to make appropriate assumptions regarding the discount rate and time horizon for a firm's operations. On the other hand, if capital markets are not fooled by accounting numbers (i.e., capital markets are able to ascertain the underlying value of the firm's competitive position), market valuation of shareholder equity can be used to measure firm value. This suggests that the market value of a firm's equity can be used as the dependent variable in determining a firm's economic exposure.

Hence, this study follows Adler and Dumas (1984), Garner and Shapiro (1984) and Shapiro (1992) in defining economic exposure as the sensitivity of the real value of a company to fluctuations in environmental contingencies. This focus on economic valuation, while consistent with the emphasis on shareholder value creation in strategic management (e.g., Rappaport, 1986), conflicts with accounting exposure defined in terms of the book values of assets and liabilities denominated in foreign currencies. Economic exposure is a forward-looking concept considering future cash flows rather than historical accounting values.

## Why should managers be concerned about economic exposure?

The aforementioned assumption of efficient capital markets raises the question of why firms should be willing to invest resources in exposure assessment and management.<sup>2</sup> Assessment of exposures and establishment of hedging policies are independent decisions. Some justification is needed for investing corporate resources in each of these activities.

Assessment of corporate economic exposure identifies the set of environmental contingencies relevant to shareholder value creation. Hence, measuring economic exposures is very much in keeping with the tradition in strategy research of equipping managers with tools for assessing the company's strategic position with respect to its environment. Such information is fundamental to strategic decisions since it allows management to assess the performance implications of alternative environmental scenarios. The assessment of exposures may have value for understanding the position of one's own firm or those of competitors. This analytical value exists regardless of whether hedging is undertaken.

Based on exposure assessments, management may seek to increase or decrease corporate exposures to certain environmental contingencies. Strategic managers presumably possess inside information useful for predicting the direction of environmental changes affecting their industries. Such inside information allows them to place selective bets which increase corporate exposures but are likely to result in positive pay-offs to shareholders.

More controversial are the decisions to selectively reduce exposures below the levels inherent in their line of business. What justification could be offered for hedging economic exposures? We consider two rationales for hedging economic exposures. Neither conflicts with the assumption of semistrong capital market efficiency.

The first rationale is that many organizational

<sup>2</sup> Adler and Dumas (1983), Dufey and Srinivasulu (1984), and Logue and Oldfield (1977) provide summaries and critiques of the arguments underlying the efficient capital markets perspective on corporate hedging. These arguments, as well as those put forth more recently by Smith and Stulz (1985) and Froot, Scharfstein, and Stein (1993), focus on the management of current cash flows rather than economic exposure.

stakeholders do not hold the broadly diversified portfolio assumed in asset pricing models. Many stakeholders simply cannot diversify their firm-specific investments. Buyers, suppliers, alliance partners, managers, and employees have sunk investments in firm-specific knowledge which tie a disproportionate share of their future earnings to the fate of the firm. While all these stakeholders seek claims to the resources of the firm, their interests are aligned with those of shareholders to the extent that increasing the overall value of the firm is consistent with meeting the firm's ongoing obligations. Firm growth and the generation of slack resources may be wholly consistent with the long-term interests of diverse stakeholders, despite conflicts over claims to current cash flows. Compensation systems designed to alleviate agency problems (e.g., employee stock ownership plans or bonuses tied to shareholder returns) align the interests of management and employees with those of shareholders by tying large components of their earnings to company-specific stock returns. Such compensation systems purposely skew portfolio holdings of key stakeholders by mandating large, undiversifiable stakes in a single company.

Even shareholders with broadly diversified domestic portfolios often do not hold internationally diversified portfolios. Hence, they care a great deal whether exchange rate movements help or hurt domestic firms relative to international competitors. The most extreme example of a stakeholder with a domestic-focused portfolio may be government. Since the revenue base of government is tied to the economic activity within its jurisdiction, government is far from indifferent between the success of domestic and foreign competitors.

Thus, for less than fully diversified stakeholders, downsizing, bankruptcy, and reorganization within a company have large effects on their wealth. Such stakeholders care a great deal about changes in the competitive position of the firm, which are also reflected in the firm's share prices. This creates an incentive to reduce downside movements in the value of the firm even when such practices may be costly. While this motivation for managing economic exposure may conflict with the interests of broadly diversified shareholders, this is not necessarily the case. The alternative to paying for corporate risk reduction is to pay the diverse stakeholders for their risk

bearing. Such payments take the form of discounts to buyers, improved compensation packages for management and employees, and premium prices to suppliers. Thus, from the diversified shareholders' perspective, hedging economic exposures is value-enhancing if it is more economical than paying the various stakeholders for risk bearing. Following this argument, even using efficiently priced financial instruments (futures and forward contracts, options, and swaps) to hedge economic exposures may enhance shareholder value.

An alternative rationale for hedging economic exposures, consistent with shareholder interests, is that markets for strategic hedges may not be efficient. This is the argument implicit in strategy research presenting the acquisition of real options as enhancing shareholder value (e.g., Sanchez, 1993). Just as theorists developing the resource-based view of the firm argue markets for strategic resources are imperfect (e.g., Amit and Shoemaker, 1993; Barney, 1991), markets for options on such resources are also imperfect. Unlike financial options which are highly liquid and trade on organized exchanges, real options are idiosyncratic. The high uncertainty and complexity associated with real options may preclude efficient market transactions. Such inefficiency results in the potential for value enhancement through internal development or acquisition of real options.

Although the approach to assessing economic exposure developed in this paper assumes equity market efficiency, arguing that equity markets are efficient does not preclude inefficiencies in pricing strategic resources or options on such resources. While the overall value of a firm may be efficiently assessed, the price of any particular strategic resource or real option may be very difficult to determine for both those inside and outside a firm. Barney (1988) developed similar theoretical arguments to specify the conditions under which acquisitions can enhance shareholder value. Barney's argument rests on the assumption that while the acquired assets themselves may be difficult to price and trade, once the acquisition is completed equity markets efficiently include the contribution to expected cash flows from the acquisition in the acquiring firm's share price. Presumably private information about the value of the acquisition to the acquirer which was not revealed during the bidding process is revealed

shortly after announcing the terms of the acquisition.

The implementation of financial and strategic hedges is considered in greater depth after discussing the multivariate nature of economic exposures.

## MULTIVARIATE EXPOSURE

Most corporate risk management research to date reflects a 'particularist' view (Miller, 1992; Werner, Brouthers, and Brouthers, 1996). That is, researchers focus on particular risk exposures to the exclusion of other interrelated exposures. Finance researchers have focused on the exposures for which there are well-developed markets and hedging instruments such as foreign exchange, interest rate, and commodity prices. International business scholars have given extensive attention to political risk. In the strategy field, researchers have focused on competitive, input supply, market demand, and technological risk exposures. Given the focus on particular risk exposures, there has been little conceptual and modeling work integrating the various categories of corporate risk exposures. Most research on economic exposure considers simple bivariate relations between firm value (or cash flows) and a single environmental variable, most frequently a foreign exchange rate. Finance researchers have increasingly recognized the shortcomings of the 'particularist' approach and the need for well-developed multivariate models of economic exposures which explicitly take into account the interrelations among various exposures (Cornell, 1980; Froot, Scharfstein, and Stein, 1994; Kaufold and Smirlock, 1986; Oxelheim and Wihlborg, 1987b; Schnabel, 1989; Shapiro and Titman, 1986).

Since most of the work on economic exposure has taken the form of simple bivariate models of foreign exchange exposure, we take such a model as our starting point in this section. We then elaborate the implications of expanding a model of foreign exchange exposure to include additional uncertain environmental contingencies.

### Economic exposure to multiple foreign exchange rates

Adler and Dumas (1984) and Garner and Shapiro (1984) proposed simple bivariate linear models

of exchange exposure. Following their work, we would express the exposure of a dollar-priced asset to movements in the dollar–pound exchange rate as:

$$V(t) = \beta_0 + \beta_1 S_{\text{£}}(t) + \epsilon(t) \quad (1)$$

where  $S_{\text{£}}(t)$  denotes the real spot dollar price of one pound at time  $t$ ,  $V(t)$  is the real dollar value of the firm, and  $\epsilon(t)$  is the random error term. As specified, the U.S. dollar is assumed to be the relevant numeraire for valuing the firm.<sup>3</sup> We further assume the error term is normally distributed with mean zero and a constant variance, i.e.,  $\epsilon(t) \sim N(0, \sigma^2)$ . In this simple bivariate model, the coefficient reflecting the exchange rate exposure,  $\beta_1$ , equals  $\text{cov}[V(t), S_{\text{£}}(t)]/\text{var}[S_{\text{£}}(t)]$ .<sup>4</sup>

While Garner and Shapiro (1984) noted that the bivariate model (1) can be extended to multivariate models allowing for asset exposures to multiple currencies, they did not consider the important implications of switching from bivariate to multivariate exposure measures.<sup>5</sup> Although simplification to the bivariate case is useful for illustrative purposes, focusing on bivariate relations can greatly distort estimated exposures.

<sup>3</sup> Since Equation 1 expresses the value of the firm in real terms, the choice between a single-currency numeraire and a basket of currencies is irrelevant. The model and its implications would be equally valid if the real value of a basket of currencies were chosen as the numeraire. This contrasts with Eaker's (1981) conclusion which considered accounting exposure where nominal exchange rates deviate from purchasing power parity.

<sup>4</sup> The fully hedged position involves taking a position  $\beta^*$  in pounds, which offsets the existing exposure,  $\beta_1$ . This can be represented by the extended form of Equation 1:

$$V(t) = \beta_0 + \beta_1 S_{\text{£}}(t) + \beta^* S_{\text{£}}(t) + \epsilon(t)$$

Solving for the fully hedged value of  $\beta^*$ , we have:

$$\partial V(t) / \partial S_{\text{£}}(t) = \beta_1 + \beta^* = 0$$

or

$$\beta^* = -\beta_1$$

Thus, for an estimated exposure coefficient  $\beta_1 > 0$ , full hedging involves selling  $\beta_1$  pounds for dollars. If  $\beta_1 < 0$ , a hedging strategy of purchasing  $\beta_1$  pounds with dollars would eliminate the exposure. If  $\beta_1$  is not significantly different from zero, there is no exposure to movements in the dollar–pound exchange rate. The best estimate of the residual variance associated with the fully hedged position is  $s^2$ , the estimator of  $\sigma^2$ , equal to the mean of the squared residuals.

<sup>5</sup> An initial step towards considering the implications of multivariate foreign exchange exposure modeling was Schnabel's (1989) brief article.

Bivariate estimates of exposure coefficients overlook the interrelations among exposures. Consider the following model expressing economic exposure in terms of two currencies:

$$V(t) = \beta_0 + \beta_1 S_{\text{£}}(t) + \beta_2 S_{\text{¥}}(t) + \epsilon(t), \quad \epsilon(t) \sim N(0, \sigma^2) \quad (2)$$

$S_{\text{¥}}(t)$  denotes the real spot dollar price of one yen at time  $t$  and the other variables are defined as before. In this multivariate case the coefficient reflecting exposure to movements in the dollar price of the pound sterling,  $\beta_1$ , partials out the effect of the real spot price of the yen,  $S_{\text{¥}}(t)$ . Similarly, the yen exposure coefficient,  $\beta_2$ , partials out the effect of the real pound spot price,  $S_{\text{£}}(t)$ .<sup>6</sup>

These observations have very important practical implications for corporate risk assessment. If the true model is Equation 2, estimating two bivariate models similar to Equation 1 can greatly distort the estimated exposure coefficients. While the estimated pound exposure coefficient from the bivariate Equation 1 may be significant, the estimated pound coefficient in the multivariate Equation 2 may not be significant. Alternatively, an insignificant relation in Equation 1 may be significant in the multivariate Equation 2. Further-

more, the signs of significant parameters may reverse themselves when moving from bivariate to multivariate modeling of exposure coefficients. In short, all the problems associated with specification error due to omitted variables (see Kenny, 1979: 62–65) apply to the misspecification of economic exposure models as simple bivariate relations.

If you have prior knowledge that your firm is exposed to only the pound and not to the yen, then this knowledge should be incorporated in the specification of the exposure model by eliminating the yen exchange rate, as in Model 1. Similarly, if you have predetermined that your firm will hedge the pound but not the yen, then the appropriate model would exclude the yen exchange rate. However, if you lack prior knowledge that certain exposure coefficients are equal to zero and have made no *a priori* choice of a single focal currency for your hedging strategy, then specifying the multivariate Model 2 yields the appropriate exposure coefficient estimates for exposure assessment.

### Exchange rate exposure in an integrated risk management framework

The previous section contrasted bivariate and multivariate models of foreign exchange risk exposure. Taking the multivariate conceptualization of exposures one step further, it is important to recognize that in addition to exposures to multiple foreign currencies, companies have exposures to a variety of other uncertain environmental contingencies. Oxelheim and Wihlborg point out: ‘managing exchange rate exposure per se is not clearly meaningful without considering the interdependence between the exchange rate and other variables related to the exchange rate in a general equilibrium system such as inflation rates and interest rates’ (1987a: 88). Consistent with this reasoning, Grammatikos, Saunders, and Swary (1986) considered the joint implications of exchange rate and interest rate risks for U.S. banks. Kawai and Zilcha (1986) modeled export firm behavior under foreign currency and commodity price uncertainties.

While finance researchers have broadened the concept of corporate exchange risk management to include interrelated macroeconomic variables, they neglect the interrelated risk exposures of

<sup>6</sup> These conditional relations can be shown as follows. Let  $c_{ij}$  be the estimated coefficient from a simple bivariate regression model (which includes an intercept term) where the first subscript denotes the dependent variable and the second subscript denotes the independent variable. The OLS estimates for the Model 2 regression coefficients  $\beta_1$  and  $\beta_2$ , call them  $b_1$  and  $b_2$ , can be expressed in terms of the bivariate regression coefficients,  $c_{ij}$ . These relations take the following form (see Land, 1969: 12–14).

$$b_1 = (c_{V\text{£}} - c_{V\text{¥}}c_{\text{¥}\text{£}})/(1 - c_{\text{¥}\text{£}}c_{\text{¥}\text{£}}) \quad (f1)$$

$$b_2 = (c_{V\text{¥}} - c_{V\text{£}}c_{\text{£}\text{¥}})/(1 - c_{\text{¥}\text{£}}c_{\text{¥}\text{£}}) \quad (f2)$$

These expressions indicate each regression coefficient in Model 2 is a function of the bivariate coefficients expressing the relations between the predictor variables,  $c_{\text{¥}\text{£}}$  and  $c_{\text{£}\text{¥}}$ , as well as the bivariate coefficients involving the endogenous variable,  $c_{V\text{¥}}$  and  $c_{V\text{£}}$ . Hence, for any nonzero covariance between the spot prices of the yen and the pound, the Model 2 multivariate exposure coefficients will differ from the coefficients derived by running separate bivariate OLS regressions for each currency.

For exposure regression models with more than two explanatory variables, the parameter estimates can also be expressed in terms of the bivariate coefficients between the predictor variables, and predictor-endogenous variable coefficients. The expressions are, however, more complex than Equations f1 and f2.

most interest to corporate strategists.<sup>7</sup> Competitive, input supply, and product demand risks are often interrelated with movements in real exchange rates. Since industry variables affecting the competitive position of a firm may be interrelated with movements in exchange rates, the effect of exchange rates may be negligible after partialing out such variables. By focusing on exchange rate and other macroeconomic exposures, previous finance research may have overlooked the most relevant economic exposures such as exposures to strategic moves by competing firms.

For example, if Japanese exporters to the United States reduce real dollar prices in response to yen devaluations, this increases the economic exposure of competing U.S. firms to movements in the real value of the yen. If Japanese exporters' response is symmetric (i.e., they raise real dollar prices in response to yen appreciation), the magnitude of the economic exposure of U.S. firms is further increased. On the other hand, if Japanese exporters maintain constant dollar prices in the face of yen appreciation or depreciation, the yen exposure of U.S. competitors is reduced. Hence, the strategic variable of product pricing by Japanese competitors affects the foreign exchange exposure of U.S. firms, even U.S. firms producing and selling exclusively in their home market.

Expanding on the model developed earlier, we could incorporate the real dollar price of competing Japanese products,  $P(t)$ , into the economic exposure model.

$$V(t) = \beta_0 + \beta_1 S_{\text{£}}(t) + \beta_2 S_{\text{¥}}(t) + \beta_3 P(t) + \epsilon(t), \quad \epsilon(t) \sim N(0, \sigma^2) \quad (3)$$

If as the yen decreases in real value, Japanese exporters seek to increase their U.S. market shares through reductions in their real dollar price,  $P(t)$  would be positively correlated with  $S_{\text{¥}}(t)$ .<sup>8</sup> Hence,

<sup>7</sup> Lessard's work on operating exposure (e.g., Flood and Lessard, 1986; Lessard, 1986) is a notable exception.

<sup>8</sup> We assume that due to lags in price adjustments or possible asymmetries in pricing responses to exchange rate movements, Japanese export prices are not perfectly correlated with movements in the real value of the yen. If movements in Japanese export prices and the real yen exchange rate were perfectly correlated, Model 3 could not be estimated. Furthermore, if the two variables were perfectly correlated, the firm could simply estimate Model 2 and use the yen exposure coefficient as the basis for exposure assessment and hedging.

the OLS estimate of the yen exposure coefficient,  $\beta_2$ , in Equation 3, may be quite different from that estimated using Equation 2.<sup>9</sup>

As noted earlier, foreign exchange rates and the prices of foreign competitors' exports are just two types of variables that may affect firm value. We could also incorporate other variables such as the prices for inputs, substitutes, and domestic competitors' goods. A general model for economic exposures would take the form:

$$V(t) = X'(t)\beta + \epsilon(t), \quad \epsilon(t) \sim N(0, \sigma^2) \quad (4)$$

where the vector of independent variables,  $X(t)$ , consists not only of exchange rates and foreign competitors' prices, but also other macroeconomic and industry contingencies.<sup>10</sup>  $\beta$  is a vector of exposure coefficients. Some independent variables may be continuous (e.g., macroeconomic variables or input, competitor, and substitute prices) while others may be expressed as discrete indicator variables (e.g., technological state or political and government policy variables).

Changes in the estimated foreign exchange coefficients are not the only implications of the expanded multivariate model. A significant foreign exporter price coefficient may suggest very different hedging practices than would a model incorporating only the variables of primary interest in finance research—exchange rates, interest rate, or commodity prices. Exposure to competitor prices may require strategic risk management responses rather than hedging through the use of financial market instruments. The next section elaborates some implications of the integrated approach to risk assessment and management.

<sup>9</sup> The pricing-to-market literature (e.g., Krugman, 1987) contends pricing decisions in an international market may differ depending on whether the host country currency appreciates or depreciates. Alternatively, prices may only respond to large exchange rate movements and not to minor changes. The way to handle such inconsistencies in the exposure coefficients is to separate the time series data into distinct subperiods for exposure model estimation. Such an approach also allows explicit testing of whether exposure coefficients differ among subperiods. This is an interesting empirical issue—one that has not been addressed in finance treatments of economic exposure.

<sup>10</sup> This is a reduced form equation which does not model the relations among explanatory variables. In the context of measuring economic exposures, we have no need to estimate the parameters associated with structural relations among explanatory variables. Our interests are limited to the relations of the explanatory variables to firm value controlling for other variables in the model.

## IMPLICATIONS OF MULTIVARIATE ASSESSMENT OF ECONOMIC EXPOSURES

The multivariate approach to economic exposure has important implications for corporate risk assessment and hedging. These implications have been broadly overlooked in previous research on economic exposure and corporate risk management.

A fundamental conclusion from the earlier discussion is that specifying simple bivariate models of foreign exchange exposure can result in very different assessments of corporate exposures than estimating a multicurrency exposure model. Using a series of bivariate models is inappropriate given the failure of such an approach to take into consideration the correlations among real exchange rates.

These observations have very important ramifications for corporate hedging practices. Hedging based on simple bivariate exposure estimates will generally result in suboptimal risk management. Firms may engage in inadequate or excessive hedging to cover their currency exposures if they fail to take into consideration the correlations among various currencies. If the real spot prices of two currencies have a nonzero correlation, the bivariate and multivariate model coefficients will indicate different quantities of each currency to be bought or sold in order to fully hedge. Significant exposure coefficients estimated in a series of bivariate models may be insignificant in a combined multivariate model. Conversely, insignificant coefficients from bivariate models may be significant in a multivariate model. The signs of significant relations may even be reversed in moving from a bivariate to a multivariate model. The implication of this latter observation is that firms engaging in hedging practices based on bivariate exposure estimates may actually increase their aggregate exposure relative to the 'unhedged' position.

Furthermore, movements in foreign exchange rates may be correlated with other environmental contingencies. Examples of such variables include interest rates, input prices, and the prices of competing, substitute, or complementary goods. Even political and social risks affecting MNCs could have significant inverse relations with the value of a country's currency. Hence, competitive, macroeconomic, and political risk—facets of

corporate risk management generally treated in isolation from foreign exchange risk—may be best modeled in a single multivariate model to determine corporate exposures.<sup>11</sup>

While the implications of including noncurrency variables in a model of foreign exchange exposure are similar to the implications of moving from a single currency to a multiple currency model, the inclusion of these additional variables suggests very different corporate hedging practices. While financial market instruments exist for hedging currency, interest rate, and commodity price exposures, financial hedging instruments may not be available to hedge movements in many critical environmental contingencies such as the prices of noncommodity inputs or competitors' goods. Corporate responses to these risks may require strategic rather than financial hedging practices. For example, firms facing uncertainty regarding the price of a noncommodity input may seek to vertically integrate to control a key supplier. Exposure to competitors' prices may be reduced through a strategy of product differentiation increasing customer brand loyalty and switching costs, thereby reducing the price elasticity of demand.

The integrated risk management perspective reflected in the multivariate estimation of exposure coefficients suggests a complementary role for financial and strategic hedging practices. Where appropriate financial instruments exist, they may be relatively inexpensive (i.e., low transaction cost) means to hedge short-term economic exposures. However, financial hedging instruments cover only a limited subset of the environmental contingencies affecting firm value and the time frame for corporate economic exposures frequently exceeds the terms for financial hedging instruments.

Where appropriate financial hedging instruments do not exist, firms have available a variety of strategies to deal with economic exposures. These include gaining control over external contingencies, cooperating with suppliers, buyers, or

<sup>11</sup> It also follows from the discussion above that if a particular environmental contingency is orthogonal to other corporate contingencies, it need not be included in an integrated assessment of risk exposures. This is a very restrictive condition and it is difficult to conceive of such risks. Recognizing the restrictiveness of the orthogonality condition highlights the general inappropriateness of assessing and managing individual risks to the exclusion of other risks.

competitors, and developing flexibility. Diversification into new product or geographic markets, and operational flexibility have option characteristics that can be used to hedge corporate downside risk in a manner analogous to financial options. As noted earlier, the markets for such idiosyncratic investments may be inefficient due to information asymmetry. Hence, such hedging has the potential to increase firm value.

Whereas financial hedging instruments can be tailored to specific financial market contingencies (e.g., particular foreign exchange rates, interest rates, or commodity prices), changes in strategy are likely to have broad implications across a corporation's set of exposure coefficients.<sup>12</sup> This observation indicates that rather than a simple one-to-one mapping between exposures and relevant hedging instruments, prescribing hedging practices involving changes in strategy must take into consideration the entire risk exposure profile of a firm. As such, it may often be inadequate to make simplistic assertions about the appropriateness of strategic changes as responses to particular risk exposures.

Consider, for example, the case of a firm with a significant negative exposure to input prices. Such a firm may be encouraged to engage in backward vertical integration through developing an in-house capacity to produce the inputs. Such a strategy would reduce the variability of input prices in local currency terms. At the same time, however, vertical integration could increase the firm's exposure to foreign exchange rate movements. This becomes evident if we consider a situation in which the local exchange rate appreciates making foreign inputs cheaper than the firm's own in-house inputs. Since the company continues to source inputs through its in-house production, the availability of lower cost imported inputs to competing firms would put the company at a competitive disadvantage, thereby reducing the competitiveness and value of the firm. Hence, the prescription available to reducing input price volatility involves increased exposure to foreign exchange rate movements. Such exposure trade-offs must be explicitly considered in determining

the role of strategic responses in corporate hedging.

If the proposed change in strategy involves acquiring an existing firm, estimates of the firm's own exposures and the acquisition candidate's exposures using a multivariate model could be compared to indicate the potential exposure coefficients associated with running the two firms as a single entity. The validity of such an assessment depends on whether management intends to significantly change the strategy of the acquired (or acquiring) unit after acquisition. For full hedging, the ideal candidate for a firm with exposure coefficients given by the vector  $\beta$  would be a firm of equivalent size with an exposure vector  $-\beta$ . It is unlikely that such an ideal candidate would be found. Most acquisition candidates would have some exposure coefficients which are opposite in sign from those of the acquiring firm and other exposures with the same sign. Hence, acquisitions which reduce the firm's exposure along certain dimensions will increase the exposure to other environmental contingencies. While the 'ideal' acquisition candidate is unlikely to exist, a linear combination of various acquisition candidates may approximate full hedging. Such linear combinations may involve partial or full acquisition, or even taking short positions.<sup>13</sup>

More realistically, firms will select acquisition candidates based foremost on their strategic implications. Risk management is generally viewed as subordinate to consideration of the competitive ramifications of corporate strategic decisions (Kenyon, 1990: Ch. 9). Even when strategic rather than hedging considerations drive the selection of acquisition candidates, assessment of the risk implications may be an important input into the acquisition decision.

Unlike acquisitions or divestitures, the use of options has the potential to eliminate downside losses without eliminating the potential for upside gains. Currency options provide a good illustration of this property. If a firm is exposed to downside risk in the event of depreciation in the pound relative to the dollar, this downside risk can be averted through selling a pound put option

<sup>12</sup> It should be noted, however, that even hedging by purchasing an option tied to a particular financial market price will affect other corporate exposure coefficients to the extent that movements of the hedged currency are correlated with movements of other environmental contingencies.

<sup>13</sup> This discussion of hedging through acquisition is intended to be illustrative, not normative. Many such acquisitions may fail the value creation criterion. See Barney (1988) for a discussion of the conditions necessary for an acquisition to enhance shareholder value.

or buying a dollar call option. Elimination of downside risk results from the option holder's flexibility to exercise the option or allow it to expire unexercised. To fully eliminate the downside economic risk, the exercise price must be equivalent to the current spot price. For such an 'at the money' spot option, the writer of the option bears the full downside risk and receives the option premium for this risk-bearing service.

While the pay-offs associated with options traded on financial markets are generally described in terms of just one contingency variable (e.g., a single foreign exchange rate), it is possible to reconceptualize option pay-offs in terms of multiple contingencies. In fact, such a multivariate conceptualization may be much more appropriate than the typical univariate perspective when we seek to describe the risk management implications of corporate strategies with option characteristics. An ideal multivariate call option for a firm with exposure coefficients given by the vector  $\beta$  would have a pay-off expressed as  $\max \{0, -X'(t)\beta - P_e\}$ , where  $X(t)$  is the vector of values for the uncertain environmental contingencies and  $P_e$  is the exercise price reflecting the initial capital investment needed to implement the strategy. Such complex options can be implemented through changes in strategies resulting in increased flexibility (Ware and Winter, 1988). Options traded on financial markets could be used in combination with changes in strategic flexibility to achieve management's desired option hedge. Hence, financial market instruments and strategic choices have complementary roles in hedging economic exposure. As argued earlier, however, the inefficiency of real options markets may make such investments more value enhancing than investments in options traded in financial markets.

## ESTIMATION OF ECONOMIC EXPOSURES

Up to this point, we have considered theoretical arguments supporting multivariate modeling of economic exposures and the implications of this approach for corporate exposure assessment and hedging. We turn now to the practical issues involved in specifying and estimating multivariate models of corporate economic exposures.

### Specifying an estimable model

While the above specifications of economic exposure equations using firm value as the dependent variable are useful for theoretical discussion, such specifications present problems for estimation. Using the total market value of the firm is problematic because shifts in the size of the firm over time may not reflect shareholder wealth creation. For example, dividend payments reduce firm value. Public offerings of new shares of stock increase the total market value of the firm but will only change the value of previously outstanding shares if the newly raised capital is invested in projects earning a rate of return which differs from the cost of capital. These observations indicate that using the total market value of equity as the dependent variable does not result in estimable exposure coefficients using time series data from a single firm if new shares are issued or dividends paid. For similar reasons, the use of total firm value precludes cross-sectional comparison of exposure coefficients.

For estimation purposes, it is useful to specify firm value as a nonlinear function. The relations previously expressed in Equation 3 can be respecified as

$$V(t) = \beta_0 S_{\text{£}}(t)^{\beta_1} S_{\text{¥}}(t)^{\beta_2} P(t)^{\beta_3}(t). \quad (5)$$

This specification does not solve the problems with the earlier specifications but it can be used to derive an estimable equation. After logarithmic transformation and taking the derivative of Equation 5 with respect to time, we have

$$\begin{aligned} [dV(t)/dt]/V(t) &= \beta_1 [dS_{\text{£}}(t)/dt]/S_{\text{£}}(t) \\ &+ \beta_2 [dS_{\text{¥}}(t)/dt]/S_{\text{¥}}(t) \\ &+ \beta_3 [dP(t)/dt]/P(t) + \eta(t) \end{aligned} \quad (6)$$

where the error term,  $\eta(t) = [d\epsilon(t)/dt]/\epsilon(t)$ . The coefficients in this equation can be interpreted as the elasticities of firm value with respect to each of the independent variables (Glaister, 1978: 117–118). For example,  $\beta_1$  measures the elasticity of firm value with respect to movements in the dollar spot price of the pound (controlling for all other variables in the model). As such, these coefficients can be interpreted as hedge ratios (Bilson, 1994). For example, complete hedging of exposure to the pound involves taking a posi-

tion of  $-\beta_1$  times the total dollar market value of the firm. For  $\beta_1 > 0$ , this implies taking a short position. This contrasts with estimation of the coefficients in Equation 3 which can be interpreted as the dollar magnitudes of firm exposures.

Using discrete data, we can express the Equation 6 relations in terms of the rates of change of each of the variables:

$$R_V(t) = \beta_1 R_f(t) + \beta_2 R_{\$}(t) + \beta_3 R_P(t) + \eta(t) \quad (7)$$

Treating  $R_V(t)$  as the rate of return in period  $t$  to shareholders for a specific firm, this equation provides a basis for estimating exposure coefficients using time series data.<sup>14</sup> Unlike models of economic exposure using cash flows or market value of equity as the dependent variable, expressing the dependent variable as the rate of return to shareholders results in a model which is invariant to changes in the size of the firm over time. Estimated parameters from Equation 7 are also comparable across organizations.

The general form of Equation 5 for a model of economic exposure using  $n$  independent variables would be

$$V(t) = \prod_{i=1}^n \beta_i X_i(t)^{\beta_i} \epsilon(t) \quad (8)$$

As before, using a logarithmic transformation and taking the derivative with respect to time gives rise to the estimable rate of return model:

$$R_V = \sum_{i=1}^n \beta_i R_i(t) + \eta(t) \quad (9)$$

where  $R_V$  is rate of return to shareholders and  $R_i$  is the rate of change of  $X_i$ .

Equation 9 has several desirable properties. It offers a multivariate model of exposures, the coefficients are interpretable as elasticities and comparable across organizations, and the model

is estimable using corporate time series data. One limitation arises from the requirement that all variables must be transformed into discrete rates of change. Hence, it is preferable that each explanatory variable,  $X_i$ , be continuous. Ordinal scale variables could be used, but nominal scale (i.e., indicator) variables could not be included. During periods of dramatic change in the explanatory variables, stock prices may not adjust instantaneously, hence evaluation of outlier observations may be an important supplemental analysis to obtain robust parameter estimates.

### Deviations from expectations or total variability?

Equation 9 presented an estimable multivariate model of corporate economic exposures. As specified, changes in shareholder returns are a function of changes in a set of independent variables. Hence, this specification measures economic exposures with respect to total movements in the independent variables rather than focusing solely on movements that are deviations from expectations. Since other researchers have argued for specifying economic exposure only in terms of deviations from expectations, it is worthwhile to consider whether deviations from expectations or total variability are most appropriate.

Hodder (1982) and Adler and Dumas (1984) argued economic exposure to foreign exchange rates should be defined in terms of random deviations from expected real rates. Oxelheim and Wihlborg state:

There are reasons to distinguish between exposure to anticipated and unanticipated changes in, for example, the exchange rate. The firm can incorporate the former in its budget and planning process, while exposure to unanticipated changes constitutes the firm's risk exposure. (1987a: 88)

Emphasizing unanticipated currency movements accommodates hedging using available financial instruments. The primary financial hedging tools (futures and forward contracts, options, and swaps) allow firms to hedge unexpected deviations from the market's expected price but do not hedge total price variability. Financial hedging instruments do not, therefore, eliminate exposure to widely expected price changes.

Despite the arguments for specification of exposure models in terms of deviations from

<sup>14</sup> There are several studies using such models with a single currency proxy. Booth and Rotenberg (1990) considered movements in the Canadian dollar relative to the U.S. dollar to the exclusion of all other foreign currencies that could affect the stock returns of Canadian companies. Other studies used trade-weighted sums of nominal or real foreign exchange rates as their foreign exchange proxies (Amihud, 1994; Bodnar and Gentry, 1993; Jorion, 1990).

expectations, most models purporting to measure economic exposure as a regression coefficient do not incorporate expectations (e.g., Garner and Shapiro, 1984; Jorion, 1990; Oxelheim and Wihlborg, 1987b; Rawls and Smithson, 1990; Shapiro, 1992: 242–243). Presumably, forward market prices could be incorporated into such models but, in order to simplify their models, these researchers have chosen not to incorporate available market expectations proxies. If, however, variables were included in the economic exposure model for which there are no existing forward markets to generate proxies for expected future prices (e.g., the price of noncommodity competitors' goods), the lack of data would present a significant obstacle to exposure model estimation.

Beyond the pragmatic concern of data availability, there are theoretical arguments for using the total variability of the independent variables rather than just deviations from expectations. From a top management perspective, exposure to both predictable and unpredictable changes are important. This is an important point separating strategy and finance perspectives on risk management.<sup>15</sup> Downside potential rather than unpredictability is the essence of risk for strategic decision-makers (Aaker and Jacobson, 1990; Baird and Thomas, 1990; March and Shapira, 1987; Miller and Leiblein, 1996; Miller and Reuer, 1996). Consider, for example, the perspective of an incumbent firm in an industry where new technology is replacing existing technology. While information about the emerging technology may be widely known, firms unable to appropriate the technology stand to lose sales, or at the extreme, be completely displaced by competitors and new entrants with the resources necessary to exploit the technology. Hence, while the technological change is predictable, it constitutes a threat, and hence a risk, for the incumbent firm. Similarly, movements in prices may be predictable but not all firms will be equally capable of reacting to expected changes. That firms may be incapable of strategic responses, despite their managements' foresight, is a fundamental premise of the resource-based view of competitive advantage.

<sup>15</sup> For further discussion on the discrepant assumptions underlying strategy and finance risk management discussions, see Bettis (1983).

Since managers are interested in how the variability of environmental contingencies affects corporate performance regardless of whether the variability is foreseen or not, it makes sense to specify models of economic exposure in terms of total variability of the independent variables. While defining economic exposure just in terms of unanticipated movements in the independent variables accommodates the properties of financial market hedging instruments, such a definition is inconsistent with managers' concerns about the performance impacts of both foreseeable and unforeseeable contingencies.

### Selection of regressors

The model of economic exposure expressed in Equations 8 and 9 leaves open the question of which regressors should be included. In order to estimate multivariate exposure models, we need a theoretical basis for the selection of regressors. Furthermore, we need to deal with the potential problem of multicollinearity among the chosen regressors. The objective is to specify a parsimonious model with neither omitted variables nor redundant variables.<sup>16</sup>

The environmental contingencies relevant to explaining corporate returns to shareholders may vary across industries and firms within industries. This point was made by Robock (1971), Kobrin (1982), and Simon (1982) whose discussions of political risk contrasted firm-specific 'microrisks' with general 'macrorisks' applicable across firms. This contention also underlies strategy perspectives grounded in both industrial organization economics (e.g., Porter, 1980) and resource-based theory (e.g., Barney, 1991; Wernerfelt, 1984). Differences in strategies and hedging practices across firms create different exposure profiles. Hence, any attempt to empirically derive a set of regressors that explain returns across all firms is unlikely to be a fruitful exercise. Empirical estimates of foreign exchange exposures at the industry level or some other aggregation of firms (e.g., Bodnar and Gentry, 1993; Amihud, 1994) over-

<sup>16</sup> These are the ideals advocated in econometrics. Practical issues regarding data availability and underdevelopment of theory generally preclude realizing these ideals. Nevertheless, the ideals of completeness and parsimony are relevant criteria for evaluating alternative model specifications.

look intercompany differences in exposure coefficients.

Our objective ought to be to glean from existing theory a typology of potentially relevant environmental contingencies. Some such contingencies may prove significant across a wide range of firms, while others may affect few firms. Assessment of the significance of particular environmental variables across different industries and firm strategies within industries is an interesting empirical issue for future research.

Previous theoretical treatments of corporate risk have done little to develop a comprehensive typology of relevant environmental contingencies. Given the emphasis on particular environmental contingencies in most of the previous risk management research, it is necessary to draw from a broad range of literature (finance, international business, and strategy) to formulate a more comprehensive view of corporations' risk profiles.

The typology of uncertain environmental contingencies offered by Miller (1992) sought to respond to the need for an integrated framework for corporate risk assessment.<sup>17</sup> As such, the typology provides one possible starting point from which to develop empirical proxies for the contingencies relevant to corporate risk assessment. The typology categorized environmental uncertainties into two broad categories: (1) general environmental and (2) industry. General environmental uncertainties include political, government policy, macroeconomic, social, and natural contingencies. This suggests economic exposure models include measures of political and social risk, fiscal, trade, and regulatory policies, and macroeconomic performance, as well as the contingencies often given attention in finance studies—foreign exchange and interest rates, and the performance of the overall stock market. Industry dynamics involve input market, product market, competitive, and technological uncertainties. Relevant proxies include input and product market prices, measures of competitor behaviors, and the rate of new patent applications.

Environmental analysis, using the Miller (1992) typology or some other framework found in the strategy field (e.g., Austin, 1990; Porter, 1980), is the starting point for identifying relevant contingencies to include in an economic exposure

model. Such firm-specific analysis lays the groundwork for maximizing the explanatory power of an exposure model and reduces the likelihood of omitting key variables. Such analyses may offer key qualitative insights into the economic exposures of the firm, even if model estimation is not undertaken. This link between industry analysis and the assessment of economic exposures involves an integration of finance and strategic management research which has not been adequately developed.

Using theory-grounded analysis to select a broad set of regressors to include in a model of corporate risk exposure, we are likely to encounter multicollinearity. Correlations among the regressors may be spurious or involve causal relations. For example, currency values may be pegged to one another. Comovements in interest rates and currency values may reflect causal relations or be due to other macroeconomic variables. The earlier example of pricing exports in the home currency rather than the export market currency (and thereby gaining market share when the home currency devalues) illustrated that even competitive variables may be correlated with currency values. Hence, in order to empirically estimate a multivariate model of economic exposure, we must assess and deal with multicollinearity. Econometric research provides guidelines for dealing with multicollinearity in model specification (e.g., Belsley, Kuh, and Welsch, 1980).

## Temporal stability of exposure coefficients

Finance researchers have cautioned that corporate economic exposures may be unstable over time (Adler and Dumas, 1984; Garner and Shapiro, 1984; Shapiro, 1992). Oxelheim and Wihlborg (1987b: 115) stress exposure coefficient stability using time-series estimation depends on the government policy regime, including both domestic and foreign fiscal and monetary policies.

While instability of exposure coefficients over time is viewed as problematic in finance research, temporal instability is of fundamental interest in the field of strategy. Largely overlooked in finance discussions of economic exposure is the observation that changes in corporate strategy give rise to changes in economic exposure. Corporate changes in strategy and hedging policies may be much more influential in shifting economic exposure coefficients than changes in the

<sup>17</sup> For an application of the Miller (1992) typology to strategy research see Brouthers (1995).

government policy regime. If so, the period for time series estimation of corporate economic exposure coefficients should be limited to the duration of the corporate strategy. As noted earlier, shifts in strategy such as acquisitions, divestitures, or changes in strategic flexibility (i.e., strategies with option characteristics) influence corporate exposure coefficients. Whether exposure coefficients can be estimated for any given firm is a function of the frequency of strategy changes and the periodicity of the model variables.

## RESEARCH DIRECTIONS

In the past, strategy and finance research has sought to measure risk as a single corporate or business-level construct reflecting financial performance variability. The emphasis on risk measures such as the variance of accounting returns, stock returns beta and unsystematic risk, and the variance of analysts' earnings forecasts reflect this orientation toward general measures of firm risk (Miller and Bromiley, 1990). The primary applications of such measures in strategy research have been studies on corporate risk-return relations, and the risk implications of specific strategies (corporate diversification being the research domain most widely incorporating risk measures) and business environments. In focusing on general measures of risk, previous research has not addressed the managerial concern for determining exposures to specific environmental contingencies and developing appropriate hedges for identified exposures. This previous research also fails to take into consideration the possibility that changes in strategy may have little impact on the overall risk of the firm despite changing significantly the exposures to particular environmental contingencies. By dealing at the level of general measures of risk, strategy research offers little guidance as to how specific risks affect strategies and vice versa.

The integrated risk management perspective elaborated in this paper offers an alternative approach to that of earlier strategy and finance research. Multivariate modeling of economic exposures offers the possibility of assessing corporate exposures along many different dimensions. Distinguishing among exposures is likely to be quite important for explaining firm strategic responses. Casual observation suggests companies

respond quite differently to exposures to political and government policy, macroeconomic, input and product market, and competitive factors that affect firm value. Breaking the risk construct into distinct exposures to multiple environmental contingencies allows for more precise specification of the relations between risks and strategies. The development and testing of multivariate models linking corporate exposures to strategies could provide valuable guidelines for strategic risk management.

While this study provided general guidance regarding the choice of regressors when specifying economic exposure models, further conceptual and empirical development is needed. Case studies identifying relevant firm-specific environmental contingencies may prove insightful for managers and researchers alike.

As is frequently done in econometrics, this study made the simplifying assumption that all model constructs are observable and measured without error. While the assumption of direct observability often holds for economic variables (e.g., foreign exchange rates, prices of competitors' products, input prices), we may have only indirect indicators of other relevant environmental contingencies. For example, government policy, social, and technological variables may be complex constructs with multiple indicators. In such instances, the structural economic exposure model could be augmented by an explicit measurement model with multiple indicators of latent variables. In such a case, assessments of reliability and validity should be undertaken (see, for example, Bagozzi, Yi, and Phillips, 1991). As before, the coefficients of a structural equations model containing latent variables are the elasticities of firm value with respect to each of the variables. Hedging exposures to latent constructs requires looking beyond available financial hedging instruments to insurance (e.g., political risk insurance) and investments in strategic flexibility (e.g., purchasing real options on emerging technologies).

Assessment of economic exposure is an important complement to an emerging stream of strategy research applying option theory (Bowman and Hurry, 1993; Chi and McGuire, 1996; Folta and Leiblein, 1994; Hurry, Miller, and Bowman, 1992; Kogut, 1991; Kogut and Kulatilaka, 1994; Sanchez, 1993). Viewing strategic moves resulting in increased flexibility as options provides a useful theoretical perspective

for thinking about strategic flexibility as a means to hedge corporate exposures. However, modeling the option characteristics of strategies is much more complex than modeling financial options. Strategy research cannot assume the simple one-to-one mapping between exposures and hedging instruments generally followed in finance research. Just as economic exposure is multi-dimensional, so changes in strategies alter exposures to many different environmental contingencies. Changes in strategies resulting in increased flexibility can be viewed as the purchase of options with pay-offs contingent on multiple environmental contingencies (Ware and Winter, 1988). This suggests moving beyond option theory models of strategic flexibility as responses to a single environmental contingency such as a foreign exchange rate (Kogut and Kulatilaka, 1994) or technological turbulence (Folta and Leiblein, 1994; Hurry *et al.*, 1992). Incorporating multiple environmental contingencies should provide a more complete picture of the role of strategic flexibility responses in corporate risk management.

The instability of corporate exposure coefficients over time offers an interesting research opportunity. Future research could consider both the implications of corporate exposure profiles for subsequent changes in strategies and, conversely, the implications of strategy changes for corporate exposures. We know of no previous research looking at the shifts in exposure coefficients following changes in corporate strategies. Such research could provide practical risk management guidance to corporate strategists.

Whereas finance research has struggled to explain hedging by firms given the efficiency of capital markets, this study offered two explanations as to why management of economic exposures may be consistent with shareholder interests even under the assumption of capital market efficiency. The two alternative arguments are based on (1) undiversified stakeholders needing to be compensated for risk bearing and (2) inefficiencies in the market for strategic resources and real options. These perspectives, derived from stakeholder and resource-based views of the firm, are firmly grounded in strategic management theory and deserve further attention in finance research.

## CONCLUSION

This study sought to clarify a number of issues left unaddressed in previous research on economic exposure. The guidelines offered for specifying estimable models of economic exposure included clarification of the choice of the dependent variable and regressors, and the functional form of the relations. While cash flows have been widely recommended as the focus for exposure assessment, this study pointed out shortcomings of that approach and emphasized shareholder returns as an appropriate dependent variable. The recommendation to incorporate total variability of regressors, rather than deviations from expectations, reflects a divergence in the strategic management perspective from previous treatments of economic exposure in finance.

Many of the issues highlighted in this study arise from the recognition that the various exposures corporations face must be assessed and managed from an integrated perspective. The integrated risk management perspective encompasses the risk exposures considered in the strategy field (e.g., competitive, input supply, market demand, and technological risks) and those of interest to finance and international business scholars (e.g., interest rate, foreign exchange, and political risks). Drawing from econometrics research, the study indicated the problems associated with exposure assessments that isolate particular uncertain environmental contingencies from others. Hedging strategies based on separate bivariate exposure estimates are suboptimal.

The multivariate approach to exposure assessment has implications for theory development. In particular, this study points out the need to distinguish among exposures in explaining firms' strategic risk management actions. Research seeking to explain strategic risk management responses such as acquisitions and the purchase of real options requires theory development incorporating multiple environmental contingencies.

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