MANAGERIAL INCENTIVES AND THE USE OF FOREIGN-EXCHANGE DERIVATIVES BY BANKS

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Abstract. This paper investigates the effect of managerial incentives on the use of foreign-exchange derivatives by U.S. bank holding companies, as end users, over the period 1996-2000. Our data from 252 large bank holding companies allow us to separate derivatives used for purposes other than trading from derivatives used for trading. This unique data set permits the investigation of derivative use in a hedging framework without the elimination of large dealer firms. Additionally, we employ a model suggested by Cragg (1971) that facilitates the examination of the factors underlying the likelihood a firm will use derivatives and the magnitude of foreign-exchange derivatives utilization. We find that managerial incentives determine the decision to use derivatives to hedge, but once managers decide to hedge, firm-specific risk factors determine the amount of derivatives used.

Keywords: Banking; Derivatives; Foreign-Exchange Exposure
JEL Classification: G15, G21, G32, G35

1. Introduction

One of the unresolved questions associated with the financial decisions of the firm is why firms hedge with derivatives. The conflicts of interest that arise when owners and managers are separate complicate an understanding of the motivation for hedging in the firm. Furthermore, financial and non-financial firms appear to have different motives for hedging. Various reasons for derivative use have been hypothesized

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and empirically investigated but the results are somewhat contradictory. Several investigations specifically address the use of derivatives by banking firms because of the uniqueness of these firms resulting from public deposit guarantees and safety and soundness regulation. The purpose of this analysis is to investigate the relation between managerial incentives and two aspects of the decision to use derivatives by large U. S. bank holding companies (BHCs): (1) the decision to use foreign-exchange derivatives and (2) the extent of foreign-exchange derivatives usage.

This investigation makes a contribution to the literature in three ways. First, we make use of the fact that in recent years, BHCs have been required to report separately derivatives used for trading purposes and derivatives used for other purposes, e.g. hedging. The reasons behind the use of derivatives for trading are obviously different from the motivations underlying the use of derivatives for hedging. Prior studies have not had the benefit of the derivatives data separated by intent and have been forced to address the confounding effect of derivatives used for trading and hedging by other methods. For instance, Sinkey and Carter (2000) add a dummy variable in the regression analysis for the largest derivative dealing banks, while Whidbee and Wohar (1999) eliminate these banks entirely from the sample. Additionally, Carter and Sinkey (1998) and Gunther and Siems (2002) focus on smaller banks with total assets less than $1 billion, since these banks are not likely to be involved as dealers of derivatives. Our data allow us to more cleanly evaluate factors that determine the use of derivatives by end users. In addition, our sample includes the largest banking firms, which are also the most likely to use derivatives.

Second, most studies focus on the relation between various accounting measures and derivatives use by banks (e.g., Carter and Sinkey, 1998; Sinkey and Carter, 2000; and Gunther and Siems, 2002).[1] In this investigation, we include the effect of managerial incentives with

[1]Whidbee and Wohar (1999) is a notable exception. In addition to accounting data, they include various corporate governance measures.

data on executive compensation, director compensation, and ownership structure similar to Whidbee and Wohar (1999).

Third, we focus on the use of foreign-currency derivatives by BHCs rather than either total derivatives (e.g., Sinkey and Carter, 2000) or interest-rate derivatives (e.g., Carter and Sinkey, 1998; Gunther and Siems, 2002). Gczy, Minton, and Schrand (1997) investigate the use of currency derivatives for non-financial firms and find no relation between managerial incentives and currency-risk hedging. To our knowledge, this is the first study to investigate the use of currency derivatives specifically for hedging by large banking firms.

We find that the size of a banking firm has a strong influence on both the use of foreign-exchange derivatives for hedging and the amount of derivatives that are used. Our results indicate that managerial incentive variables, i.e. manager compensation and institutional ownership, are significant in the decision to use derivatives and firm-specific risk variables, i.e. leverage and foreign exchange exposure, are significant factors in the determination of the amount of derivatives a manager uses. Our results are consistent with the idea that the threat of dismissal by regulatory authorities causes BHC managers to reduce the risk of the firm by hedging in order to protect their investment in human capital and preserve the total value of their compensation package. The increased risk of dismissal for managers dominates the motivation to increase the value of the put option resulting from deposit insurance by taking more risk, i.e. not hedging.

The rest of the paper is organized as follows: Section 2 examines the theoretical basis of hedging decisions in the firm and the empirical evidence on hedging with derivatives. Section 3 identifies the data sources, defines the variables, and establishes the empirical methods used in the analysis. Section 4 presents our results while Section 5 summarizes and concludes the paper.

2. The Theory and Evidence on Hedging

2.1. **Hedging in Non-Financial Firms.** The theoretical literature on hedging by value maximizing, non-financial firms focuses on four rationales for a firm to hedge. These rationales are: 1) to reduce cash-flow uncertainty; 2) to reduce the probability of financial distress; 3) to reduce expected taxes; and 4) to increase debt capacity.

Hedging can increase firm value by reducing the variance of the firm's cash flows. Because of cash flow uncertainty, firms may pursue investment strategies that reduce value because of cash flow uncertainty. One way this can happen is the case of a firm that forgoes investments in positive net present value projects when cash flows are low (see Froot, Scharfstein, and Stein, 1993). Firms that hedge can reduce the variance of cash flows and thus avoid the problem of underinvestment. Gczy, Minton, and Schrand (1997) find evidence suggesting that firms use currency derivatives to reduce cash flow variation, allowing them to take advantage of growth opportunities.

A second way hedging can help to maximize firm value is by reducing the probability of financial distress (Smith and Stulz, 1985). The firm can reduce the uncertainty of cash flows by hedging, thus reducing the probability of bankruptcy and the costs associated with financial distress. Firms with a higher probability of financial distress would be most likely to benefit from hedging. This implies that firms with greater leverage, and hence a greater probability of experiencing bankruptcy, are more likely to use derivatives to hedge.

Smith and Stulz (1985) and Nance, Smith, and Smithson (1993) argue that firms hedge because the progressive nature of the U.S. tax code produces a convex relation between a firm's effective tax rate and its pretax income. Firms that hedge can reduce expected tax liabilities by reducing the variability of cash flows. However, Graham and Rogers (2002) find no evidence that firms hedge in response to tax convexity.

Finally, Ross (1997) and Leland (1998) find that the most important benefit of debt financing is the tax deductibility of the interest

payments. Hedging can reduce the likelihood of low cash flow states leading to default which allows the firm to increase debt capacity and ultimately, the tax benefits of interest deductions (Stulz, 1996). Graham and Rogers (2002) find support for the notion that hedging allows firms to increase their debt capacity.

2.2. **The Effect of Managerial Incentives on Hedging.** The reasons for a value-maximizing firm to hedge, discussed above, assume that management and owner interests are congruent. Rogers (2002) points out that it is, in fact, the firm's management that makes the actual decision to hedge. As a result, the agency problems associated with the separation of management and owners in large corporations should affect the hedging decisions of those firms. Agency problems make the incentives of the manager important determinants of a firm's use of hedging and one possible result is that managers implement hedging that does not maximize the value of the firm (Smith and Stulz, 1985). Smith and Stulz (1985) argue that the nature of the relation between the manager's wealth and the value of the firm will determine the incentives managers have to hedge. If the manager's wealth is a concave function of firm value, the manager will have more wealth if the firm hedges while a convex relation between the manager's wealth and firm value would reduce the incentive to hedge (Smith and Stulz, 1985). The shape of the function of the manager's wealth relative to firm value is determined by the manager's ownership position in the firm, the structure of his compensation, and the extent that managers are disciplined as a result of poor performance (Whidbee and Wohar, 1999).

Two significant hypotheses come from the arguments of Smith and Stulz (1985). First, a higher ownership position by managers is predicted to cause greater use of hedging. Second, higher option holdings by managers should result in less hedging. Tufano (1996) finds that a manager that owns more stock options hedges less, while a manager that has more wealth invested in common stock hedges more. He also finds that firms with larger managerial blocks hedge more but those

with larger outside blocks hedge less. In a study of the oil and gas exploration and production industry, Meredith (2002) finds that the likelihood of hedging is positively related to the level of managerial ownership. However, he finds no evidence of a relation between hedging and either compensation structure or options. He also finds no relation between new option grants or the value of options and the extent of hedging. Rajagopal and Shevlin (2002), also study oil and gas producers and find that executive stock option plans provide incentives for managers to alleviate risk-related incentive problems. Rogers (2002) finds a relation between corporate derivative holdings and the characteristics of CEO stock and option holdings. Borokhovich et al. (2003) study the effect of board composition and the use of interest-rate derivatives by non-financial firms. They find a positive relation between outside director influence and derivatives use.

2.3. **Hedging Incentives in Banking Firms.** The existence of a public guarantee of deposits held by banking firms causes the incentives for hedging in banks and BHCs to differ in some respects from non-financial firms. The returns to shareholders in banking firms are more convex than other companies because of high financial leverage and the risk-shifting opportunities associated with deposit insurance (Whidbee and Wohar, 1999). Black and Scholes (1973) and Galai and Masulis (1976) show that the common stock of a firm can be viewed as a call option on the assets of the firm. In addition, the subsidy provided by deposit insurance to the bank's owners could be viewed as a put option (Merton, 1977; Marcus and Shaked, 1984; Ronn and Verma, 1986). Thus, risk taking by the banking firm increases the value of both the put option, created by deposit insurance, and the call option on the assets of the firm, associated with equity, so that higher ownership by managers should result in less hedging in banking firms (Whidbee and Wohar, 1999). This proposition is consistent with the findings of Saunders, Strock, and Travlos (1990), who find that as bank managers acquire more equity in their firm, the bank becomes riskier.

Whidbee and Wohar (1999) find that BHC managers with incentives more closely aligned with those of the shareholders (i.e., high percentage of CEO shareholdings) are less likely to use derivatives when insider holdings exceed 10 percent. Additionally, they find that if outside directors own larger proportions of the shares, the firm is also less likely to use derivatives. Whidbee and Wohar (1999) interpret these results to mean that BHC managers with large equity holdings take advantage of risk-shifting opportunities due to deposit insurance by not hedging. Alternatively, they find greater use of derivatives is associated with outside monitoring when insider holdings are less than 10 percent

The motivation for non-financial firms to reduce the probability of financial distress with hedging is less clear for banking firms due to the existence of deposit insurance. The existence of deposit insurance guarantees should mitigate the need for bankruptcy-avoiding hedging strategies. We expect that banking firms with high leverage (lower capital ratios) are less inclined to hedge than non-financial firms with high leverage. Federal deposit guarantees may lessen the need for BHCs to hedge to increase debt capacity. However, regulatory authorities can dismiss bank managers if they take excessive risks which lead to financial distress, unlike the managers of non-financial firms that must be removed by the board of directors. Thus regulatory oversight of the actions of banking firm managers may mitigate, or even dominate, the incentives provided by deposit insurance to hedge less.

Organizational size is an important factor in the decision for a banking firm to hedge because the costs of implementing a risk-management/hedging program using derivatives may keep smaller banks from participating. The costs include the hiring of skilled personnel and the implementation of internal-control systems necessary to participate in the market for derivatives (Sinkey and Carter, 2000). Additionally, the maintenance of regulatory capital and meeting of margin requirements are also costs of using derivatives. Prior research documents the difficulty smaller banks have hiring and retaining the skilled employees needed

for an effective risk-management program (see Smith and Stolz, 1984).[2] Previous research in the use of derivatives by banks documents the importance of size in banks' use of derivatives (see Koppenhaver, 1990; Kim and Koppenhaver, 1993; and Sinkey and Carter, 2000). Research on derivative use by non-financial firms also finds a positive relation between derivative use and size (see Nance, Smith, and Smithson, 1993; Mian, 1996; and Gczy, Minton, and Schrand, 1997). Carter and Sinkey (1998) and Gunther and Siems (2002), using an empirical framework similar to this study, find that while there is a significant positive relation between size and the likelihood of derivative use, there is a negative relation between size and the extent of derivative use.

The business of banking includes a number of important risk factors (for example, default or credit risk, interest-rate risk, and foreign-exchange risk) that may be related to the use of derivatives for hedging purposes. Gczy, Minton, and Schrand (1997) find that non-financial firms with greater foreign-exchange exposure are more likely to use currency derivatives. Several prior studies find that U.S. banking institutions are exposed to exchange-rate risk (see Choi, Elyasiani, and Kopecky, 1992; Wetmore and Brick, 1994; Choi and Elyasiani, 1997; and Chamberlin, Howe, and Popper, 1997).[3]

Another important factor in how derivatives are used by banks may be the regulatory capital requirements. Presently, risk-based-capital standards require derivative activities by banks to be supported with capital. Merton and Bodie (1992) argue that banks engaging in non-traditional activities need additional capital, i.e. "assurance capital", to cushion losses. However, prior research by Sinkey and Carter (2000) finds no support for this notion, at least with respect to the use of derivatives by banking institutions.

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[2]Block and Gallagher (1986) find similar results for non-financial firms.

[3]Unlike the other studies cited, Martin (2000) does not find that U.S. BHCs are exposed to foreign-exchange risk. She argues that regulatory constraints or risk aversion account for lack of exposure.

3. Empirical Methods

In this section we discuss the data sources, sample characteristics, the model specification, empirical variables, and the hypotheses tested.

3.1. **Data Sources and Sample Characteristics.** The data for this investigation is taken from two sources: First, financial statement information, including that related to a BHC's use of foreign-exchange derivatives, is obtained from the Federal Reserve System's Consolidated Financial Statements for Bank Holding Companies (FR Y-9C). Second, information related to ownership and compensation is taken from the SNL Executive Compensation Review and the SNL Quarterly Bank Digest, compiled by SNL Securities. We limit our sample to BHCs with total assets of at least $1 billion. Our data covers the five-year period of 1996 through 2000 and the entire sample contains 970 observations from 252 BHCs, or approximately 3.8 observations per BHC, on average. Of the 970 observations, there were a number of missing values for one or more of the variables of interest. Consequently, only 795 observation were available for estimation of the FX derivative equations. Ther reduced form equations could be estimated using 800.

We report descriptive statistics for the sample BHCs used in the regressions in Table 1. The average size of a BHC in our sample is $23.6 billion with a median of $3.25 billion, indicating a large amount of skewness with respect to size. On average, the percentage of ownership by insiders is 13.1 percent (median = 8.18 percent) and by institutional investors is 27.7 percent (median = 24.3 percent). The mean return on equity is 14.7 percent and the ratio of market value to book value of equity is 2.33 times. Sample BHCs have an average ratio of equity capital to total assets of 8.3 percent. About fourteen percent of the sample BHCs report foreign interest income amounting to an average of 1.4 percent of total interest income. Slightly less than one-fourth of the BHCs (23.5 percent) use derivatives for trading purposes to some extent. We report means and medians for three compensation variables: CEO base salary, CEO annual bonus, and the value of CEO

option awards. The mean annual compensation for CEOs in our sample amounts to a base salary of $479 thousand (median = $400 thousand), annual bonus of $568 thousand (median = $221 thousand), and value of option awards of $1.61 million (median = $178 thousand). Almost three-fourths of our sample BHCs (73.3 percent) have director stock plans in place.

Table 2 provides a breakdown of foreign-exchange derivative usage, by contract type, for our sample BHCs. Over the sample period, BHCs held an average of approximately $36.4 billion of foreign-exchange derivative contracts. Of these contracts, the majority were used for trading purposes ($35.5 billion). Sample BHCs held an average of just under $1 billion ($952.85 million) in currency derivatives for purposes other than trading. With respect to contract type, foreign-exchange forwards were the most important individual contract type, amounting to over $26 billion and almost three-fourths of all currency contracts. Over-the-counter currency options were next in importance with an average amount of $6.13 billion. Finally, sample BHCs used an average of $3.869 billion of FX swaps, $91.49 million of exchange-traded currency options, and $81.49 million of FX futures. Interestingly, the most prevalent contracts are non-exchange-traded contracts that are nonstandard, allowing the bank greater flexibility in managing its risk.

Summary statistics for the data used appear in table 1.

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3.2. **Model Specification.** Because many banks do not use derivatives at all, prior studies often employ probit or tobit models to analyze banking behavior with respect to derivatives (see Koppenhaver, 1990; Kim and Koppenhaver, 1993; and Sinkey and Carter, 2000). However, the decision to use derivatives may be affected by entirely different factors than the decision as to how much involvement is desired.[4] We use

[4]Greene (2002, p. 915) illustrates the problem this way: "One can imagine, for instance, the decision on whether or not to purchase a car as being different from the decision on how much to spend on the car, having decided to buy one."

TABLE 1. Summary statistics

Variable	Mean	Std. Dev.	Median	N
$d = 1$ if FX derivatives > 0	0.235	0.424	-	795
FX derivatives	964408	6975134	0	795
Equity/assets	0.083	0.018	.0808251	800
# Employees	7619.371	20328.553	1411.5	800
# subs	4.832	6.723	2	800
# offices	221.694	455.38	66.5	800
CEO age	56.124	7.201	56	800
Gap	0.16	0.13	.1315799	800
Cash flow	399621	1323143	49941.5	800
Total assets	25662462	77494054	3868077	800
Insider ownership	13.146	14.315	8.18	800
Institutional ownership	27.716	18.809	24.3	800
Return on equity	14.722	5.164	14.91	800
Market to book ratio	233.034	94.349	218.3	800
Foreign to total interest	0.014	0.061	0	800
Dealer activity	0.295	0.456	-	800
Dividends	114359	319837	15427.5	800
Director stock plan	0.733	0.443	-	800
Base salary	479229	249234	400000	799
Bonus	567617	1292369	221421	799
Options	1612678	1.20e+07	178223	799

a model suggested by Cragg (1971) to investigate the use of derivatives by BHCs, a framework that separates the participation decision from the extent of use decision. Gunther and Siems (2002) and Carter and Sinkey (1998) use a similar framework to investigate the use of interest-rate derivatives by U.S. commercial banks. In this framework, the decision to use derivatives is evaluated using a probit model, while the extent of derivative use is analyzed using a truncated regression

TABLE 2. The notional values of Foreign-Exchange Derivatives by Sample BHCs (1996-2000) measured in $million.

Variable	Mean	Std. Dev.	N
FX Futures	$81.43	706	882
FX Forwards	$26,157	163661	883
FX Exchange traded options	$91.49	578	882
FX OTC options	$6,173	39119	882
FX Swaps	$3,869	31421	884
FX Derivatives used for trading	$35,457	219377	882
FX Derivatives used for other purposes	$952.85	7059	882
Total Value of FX Derivatives	$36,409	225580	882

model for the banks that have made the decision to use derivatives. The model can be expressed as follows:

Let D_i^* denote the net benefits to the i^{th} BHC of using foreign exchange derivatives for purposes other than trading. For simplicity, it is assumed that the benefits derived depend linearly on a set of independent variables, x_{1i} and on another, possibly, endogenous set of variables, w_{1i}. Thus,

$$D_i^* = x_{1i}\beta_1 + w_{1i}\delta_1 + e_{1i} \tag{3.1}$$

where the e_{1i} are $iidN(0, \sigma_1^2)$, and β_1 and δ_1 are vectors of unknown parameters. The net benefits of using derivatives in this manner are not directly observed; instead, one only observes whether the BHC decides to use them or not, D_i:

$$D_i = \begin{cases} 1 & \text{if } D_i^* > 0 \\ 0 & \text{otherwise.} \end{cases} \tag{3.2}$$

which is the standard probit model.

Now consider the desired amount of foreign exchange derivative use, A_i^*. Again, actual usage is observed, and not the desired level. In this

case,

$$A_i^* = x_{2i}\beta_2 + w_{2i}\delta_2 + e_{2i} \tag{3.3}$$

$$A_i = \begin{cases} A_i^* & \text{if } A_i^* > 0 \\ 0 & \text{otherwise.} \end{cases} \tag{3.4}$$

where where the e_{2i} are $iidN(0, \sigma_2^2)$, and β_2 and δ_2 are vectors of unknown parameters. This is the Type I Tobit model. A limitation of the Tobit model is that the decision to use derivatives and the amount used are determined by the same mechanism.

Cragg (Cragg 1971) proposes a two-tiered model that contains the usual Tobit model as a special case:

$$A_i = \begin{cases} A_i^* & \text{if } A_i^* > 0 \text{ and } D_i^* > 0 \\ 0 & \text{if } D_i^* \leq 0. \end{cases} \tag{3.5}$$

In this case, a BHC uses foreign exchange derivatives only if it desires to use them, $D_i^* > 0$, and if the desired amount, A_i^*, conditional on x_i and w_i, is positive. The model is useful if either the determinants of the decision to use and the amount used differ, or if the relative magnitudes of the determinants are not the same. There is a rather simple likelihood ratio test of Cragg's model relative to the simpler Type I Tobit. It consists of estimating the probit, Tobit, and truncated regression models and using the likelihood ratio statistic

Estimation of these models is relatively straightforward if the w_i are exogenous. Probit and Tobit estimators are ubiquitous in software, and Cragg's model can be easily estimated (though not efficiently) using two-step estimators. The likelihood ratio test for Cragg's model can be used to differentiate the process from the usual Tobit model. However, if any of the regressors are endogenous, then a set of instrumental variables are required to estimate probit and Tobit models; the likelihood ratio test statistic has an unknown sampling distribution in this case.

With some regressors endogenous, Amemiya's AGLS estimator of probit and Tobit models with endogenous regressors can be used. The software was written for STATA by Joseph Harkness (Harkness 2001) and uses Newey's (Newey 1987) formulae to compute the reported standard errors.

Valid instruments must be correlated with the endogenous variables, but not correlated with the other unobserved determinants of D_i^* and A_i^*. Several instruments are available in these data. CEO compensation is likely to be a function of the CEO' human capital (age and experience), and the size and scope of the firm (number of employees, number of offices and subsidiaries). Leverage might also be related to the scope of the firm and GAP, which is the 12-month maturity mismatch.[5] Finally, a dummy variable is created that equals 1 if the BHC earns any foreign interest and is zero otherwise.

With Cragg's model, estimating correct standard errors or valid confidence intervals is not so easy. An estimator for an endogenous Cragg type model has not been developed. A consistent three step estimator is proposed here and asymptotically valid confidence intervals are constructed using the bootstrap.

Consistent estimation of a Cragg type model can be done in three steps. First, estimate reduced form equations for each of the right-hand-side endogenous variables using all exogenous variables, x and instruments z. Next, estimate the selection equation using probit, replacing the endogenous variables with predictions. Then, construct the inverse mills ratio, add it to the regression equation, replace the endogenous regressors with predictions from step one, and estimate the parameters using truncated regression. Consistency of the estimator follows from Slutsky's theorem and is analogous to that in two step models like the instrumental variable probit and Tobit considered

[5]assets repricing in 12 months less liabilities repricing in 12 months, scaled by total assets. GAP is something that should impact the use of interest-rate derivatives. Larger gaps mean a greater effect on bank value when interest rates change, so larger gaps should mean banks would hedge more with interest rate derivatives.

above, and of similar Heckit models where the third step consists of OLS estimation of the regression (omitting the zero observations).

Bootstrapping has been shown to perform well in Heckit type models ((Hill, Adkins & Bender 2003)) and it is used here to obtain 90% bias-corrected confidence intervals for the model's parameters. Although it has been argued by Horowitz (Horowitz 2001) and others that bootstrap methods based on pivotal statistics usually provide better coverage properties in finite samples than percentile methods used here, they require a consistent estimator of each parameter's standard error to implement and that is currently unavailable with this procedure. A total of 1500 bootstrap samples are taken for each model. Not all bootstrap samples converged and hence the actual number of bootstrap samples on which the intervals are computed are substantially smaller. The number of samples used for each model appears in the appropriate column at the bottom of the table.

3.3. **Hypothesized Relations and Variable Definitions.** In this section, we discuss the variables used in this study and expected relations between the independent variables and the likelihood and extent of foreign-currency hedging by large BHCs. We use two measures of foreign-exchange derivative usage as dependent variables in this investigation. The dependent variable in the likelihood of use equation (Equation 1) is a dummy variable indicating that the BHC is a user of non-trading currency derivatives. This dummy variable is coded as a 1 if the bank is a user and 0 if not. The notional value of foreign-exchange derivatives not used for trading (scaled by total assets) is used as the dependent variable in the extent of use equation (Equation 2) to capture end-user behavior.[6]

[6]Demsetz and Strahan (1997) and most other studies of derivative use by banks make use of notional values. Since the focus of this study relates to the factors affecting foreign-exchange usage, notional values satisfactorily measure the likelihood and extent of use of these instruments.

Ownership by Insiders. When managers have a higher ownership position in the bank, their incentives are more closely aligned with shareholders so they have an incentive to take risk to increase the value of the put option created by deposit insurance and increase the value of the call option associated with equity ownership. This suggests that a higher ownership position by insiders (officers and directors) results in less hedging. We use the natural logarithm of the percentage of the total shares outstanding that are owned by officers and directors as an independent variable in both the likelihood and extent of use models. We expect a negative relation between insider ownership and hedging by BHCs.[7]

An alternative relation is also possible. Because banks exist in a regulatory environment, incentives provided by regulation may dominate the expected incentive relation. Because regulators can replace management at poorly performing banks, managers may refrain from taking on too much risk to avoid the loss of continued employment and protect both their personal wealth and human capital. Thus, failure to reject a null hypothesis of no relation, or the finding of a positive relation between derivative use and insider ownership may be consistent with the domination of regulatory incentives.

Ownership by Institutional Blockholders. Institutional blockholders have incentive to monitor the firm's management due to the large ownership stake they have in the firm (Shleifer and Vishny, 1986). Whidbee and Wohar (1999) argue that these investors will have imperfect information and will most likely be concerned about the bottom line performance of the firm. Therefore, we expect that as institutional investors' stakes in the firm increase, there should be a greater likelihood of the firm hedging. We include the natural logarithm of the percentage of the total shares outstanding that are owned by all institutional investors

[7]We assume here that insider ownership is predetermined with respect to hedging activity. We thank the referee for pointing this out to us.

as an independent variable and predict that the sign will be positive, with respect to the likelihood of hedging.

CEO Compensation. CEO compensation also provides its own incentives with respect to risk management. In particular, compensation with more option-like features induces management to take on more risk to increase the value of the option (Smith and Stulz, 1985; Tufano, 1996). Thus, we expect higher option compensation for managers to result in less hedging. We make use of three measures of CEO compensation as independent variables in our regression model: 1) annual salary, 2) annual cash bonus, and 3) value of option awards. We expect a negative relation between the value of option awards and the likelihood of hedging. Alternatively, large, fixed salaries and cash bonuses may increase the likelihood of hedging in order to decrease variability in the firm's cash flows, and thus ensure a continued stream of cash payments to the CEO. This is particularly true because the manager of the firm is likely to have little diversification in personal wealth.

There is a possibility that CEO compensation is endogenous. Successful hedging activity could indeed lead to higher executive compensation.[8]

Other Managerial Incentives. We include a dummy variable that represents the existence of a director stock plan in our models to capture the effect of director ownership incentives. As with ownership by insiders, we expect an ownership stake in the firm by the directors will provide incentives to take more risk to increase the option value of the firm. Thus, we expect the sign of the estimated coefficient for this variable to be negative.

BHC Size. We use the natural logarithm of total assets as a control variable for BHC size. Based on prior research, we expect that larger banks are more likely to be able to make the investment in intellectual

[8]Instruments used for the compensation variables are based on the executive's human capital (age and experience), and the size and scope of the firm (number of employees, number of offices and subsidiaries.)

capital and control systems necessary to participate in derivatives markets, and thus are more likely to be users of foreign-exchange derivatives. However, Carter and Sinkey (1998) and Gunther and Siems (2002) suggest that conditional upon the decision to be a participant in the market for derivatives, the extent of use of derivatives is not positively affected by size. In fact, the relation may even be negative. Because the behavior of BHCs involved with the trading/dealing of derivatives may be very different from other nondealer users of currency derivatives, we use a dummy variable, coded as 1 if the bank reports the use of foreign-exchange derivatives for trading purposes, and 0 otherwise, to control for their actions. We expect the size of the BHC and derivative trading activities to be positively correlated.

Capital. We include the ratio of equity capital to total assets as a control variable to capture the capital regulation of BHCs for purposes of safety and soundness. A positive relation between the equity ratio and derivative use suggests that banks only use derivatives when they have sufficient capital to meet regulatory requirements consistent with Merton and Bodie's (1992) notion of assurance capital. A negative relation suggests that banks use derivatives to reduce the likelihood of default when debt levels are high (i.e., to hedge low capital adequacy) or simply that the use of derivatives is associated with a higher probability of default.

Like the compensation variables, we expect leverage to be endogenously determined. Firms that are successfully hedging create more debt and thus have higher leverage, other things equal.[9]

[9]Thanks again to a referee for pointing this important point out. Leverage is thought to be be related to the scope of the firm and to the 12-month maturity mismatch (GAP). GAP is measured as assets repricing in 12 months less liabilities repricing in 12 months, scaled by total assets. The maturity mismatch is expected to impact the use of interest-rate derivatives. A larger gap means a greater effect on bank value when interest rates change, so a larger gap should lead a bank to hedge more with interest rate derivatives. We expect this to also be predetermined with respect to the decisions to hedge using foreign exchange derivatives.

Foreign Exchange Risk. A bank's use of currency derivatives should be related to its exposure to foreign exchange rate fluctuations. We use the ratio of interest income from foreign sources to total interest income to measure foreign exchange exposure. We expect that greater exposure, as represented by a larger proportion of income being derived from foreign sources, should be positively related to both the likelihood and extent of currency derivative use.

Growth Opportunities. Froot, Scharfstein, and Stein (1993) argue that hedging may alleviate the underinvestment problem by reducing the variance of cash flows. Thus, firms with more growth options are more likely to benefit from hedging. We use the ratio of market value of equity to book value of equity as a proxy for growth opportunities.

Profitability. The return on equity is included to represent the profitability of the BHCs.

4. Empirical Results

In this section we present the results of our estimation procedure. Table 3 reports some important results from the reduced form equations. Because leverage and many of the CEO compensation variables are believed to be endogenous, instrumental variables estimation must be used to ensure consistent parameter estimates are obtained. Table 4 reports coefficient estimates for the instrumental variable estimation of the probability that a BHC will use foreign exchange derivatives for hedging. Table 5 reports the results from the estimation of the double-hurdle model of the BHC's decision about how much these instruments are to be used.

Summary statistics from the first stage reduced form estimates appear in table 3. The p-values associated with the hypothesis that the coefficient is zero are presented as well as the R^2 from each regression. Low values of R^2 indicate that the instruments are weak and this can substantially impede one's ability to make inferences in the model. In

this case, the instrument set appears to be quite good, with the smallest, which is from the leverage equation, is $R^2 = .1825$. Those of the other equations are between .6 and .7. Also, there appears to be a high probability that instruments are correlated with the desired variables in each equation.

Rivers and Vuong (1988) proposed a simple two-step statistic to test the exogeneity of regressors in a probit model. In the first step residuals from each reduced form equation are obtained and in the second they are added to the probit model and their joint significance is tested using a Wald test. The Rivers-Vuong statistics are presented in table 4 and both are significant at the 5% test level, providing evidence of the endogeneity of our measures of leverage and CEO compensation.

4.1. **Probability of Derivative Use.** Columns (1) and (2) include instrumental variables probit estimates of the probability of foreign exchange derivative use and the asymptotic t-ratios. The probit and tobit results are very similar. Each coefficient has the same same sign in each model and, in most instances, significance in each specification. Base salary is not statistically significant at 5% or 10% levels in any event and is dropped from the regressions in columns (2) and (4). Its removal from the model improves estimator precision, though the improvement is not dramatic. At the 5% level of significance, the value of CEO options reduces the probability of using foreign exchange derivatives to hedge. On the other hand, CEO bonuses, firm size, insider ownership, and institutional ownership increase the probability of their use.

4.2. **Extent of Derivative Use.** The results of the double hurdle model of the extent of foreign exchange derivative use are similar. When a zero coefficient lies outside of the 90% confidence interval it is significant at the 10% level. Base salary appears to have no effect on the extent of derivative use. After dropping it from the model, larger values of CEO options are associated with lower levels of derivative use, while higher CEO bonuses increases use. Firm size, market to book

TABLE 3. Summary results from reduced form equations. The columns contain p-values associated with the null hypothesis that the indicated instrument's coefficient is zero in each of the four reduced form equations. The instruments include number of employees, number of subsidiaries, number of offices, CEO's age– which proxies for his or her experience, the 12 month maturity mismatch, and a dummy variable that is 1 if the BHC earns foreign interest. The p-values associated with the other variables have been suppressed to conserve space.

	Reduced Form Equation			
	Leverage	Base Salary	Options	Bonus
Instruments	Coefficient P-values			
Employees	0.646	0.348	0.000	0.000
Subs	.000	0.625	0.130	0.007
Offices	0.037	0.000	0.000	0.000
CEO age	.022	0.000	0.749	0.606
Gap	0.001	0.243	0.328	0.380
D=1 if for interest	0.068	0.436	0.271	0.401
R-Square	0.1825	0.698	0.698	0.606

ratio, and dealer activity have no significant effect. Insider and institutional ownership have a positive effect on use; return on equity, the ratio of foreign to total interest, and dividends have a negative effects on derivative use. Interestingly, a positive value of the inverse mills ratio is also within the 90% confidence interval, providing additional evidence of the appropriateness of the double hurdle specification over the standard Tobit model.

TABLE 4. Estimation results : Instrumental variables Probit and Tobit. T-ratios appear in parentheses.

	Probit		**Tobit**	
	(1)	(2)	(3)	(4)
Leverage	32.82397	28.15458	0.2815208	0.0878573
	(1.39)	(1.27)	(0.41)	(0.13)
Base salary	-1.78E-06	-	-7.89E-08	-
	(-0.62)	-	(-0.96)	-
Options	-1.05E-07	-1.07E-07	-2.53E-09	-2.70E-09
	(-2.05)	(-2.06)	(-1.90)	(-1.93)
Bonus	1.91E-06	2.01E-06	5.42E-08	5.83E-08
	(2.15)	(2.27)	(2.20)	(2.27)
Assets	0.5807128	0.3353446	0.0214453	0.0105422
	(1.37)	(1.93)	(1.75)	(2.02)
Insider Ownership	0.3110961	0.2841329	0.00768	0.0066718
	(2.12)	(2.05)	(1.82)	(1.55)
Inst. Ownership	0.4169117	0.3699098	0.0149391	0.0131039
	(2.44)	(2.53)	(2.84)	(2.72)
Return on equity	0.0297204	-0.0388401	-0.0010743	-0.0014722
	(-0.94)	(-1.35)	(-1.16)	(-1.71)
Market to book	-0.0014364	-0.0019192	-0.0000627	-0.0000836
	(-0.95)	(-1.44)	(-1.44)	(-2.10)
Foreign interest	-4.17574	-4.775516	-0.0552313	-0.0789997
	(-1.07)	(-1.25)	(-0.51)	(-0.71)
Dealer =1	-0.3021597	-0.2869957	-0.0137554	-0.0130925
	(-1.07)	(-1.04)	(-1.68)	(-1.52)
Dividends	-8.36E-07	-9.55E-07	-4.01E-08	-4.38E-08
	(-1.38)	(-1.63)	(-2.46)	(-2.61)
N	795	795	795	795
Rivers & Vuong	13.76	12.83		

TABLE 5. Estimation results: double hurdle model with bias-corrected 90% bootstrap confidence intervals

	Double-Hurdle					
		90% C.I.			90% C.I.	
Variable	Coefficient	0.05	0.95	Coefficient	0.05	0.95
Leverage	5.96367	-9.17989	47.86321	5.19837	-8.90219	30.89414
Base salary	9.17E-08	-1.21E-06	4.51E-06	-	-	-
Options	-3.05E-08	-6.11E-07	-7.54E-09	-2.85E-08	-5.62E-07	-1.03E-08
Bonus	5.75E-07	3.04E-07	6.77E-06	5.37E-07	2.98E-07	3.32E-06
Assets	0.01336	-0.56982	0.18275	0.01915	-0.15708	0.10878
Insider Ownership	0.11434	0.04832	0.56808	0.11046	0.04794	0.36032
Inst. Ownership	0.41301	0.24873	1.24212	0.41222	0.22622	1.05573
Return on equity	-0.02024	-0.14897	-0.00419	-0.01955	-0.08710	-0.00608
Market to book	-0.00035	-0.00301	0.00041	-0.00031	-0.00174	0.00048
Foreign interest	-1.23056	-46.56341	0.09277	-1.09755	-28.16870	-0.05343
Dealer =1	-0.02416	-0.22050	0.27512	-0.02334	-0.20715	0.26021
Dividends	-3.29E-07	-3.09E-06	-5.45E-08	-3.01E-07	-1.99E-06	-9.49E-08
IMR	0.22636	0.05241	1.59318	0.19485	0.00377	1.15589
N	187			187		
Bootstrap N	1126			1162		

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