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

LEE C. ADKINS, DAVID A. CARTER, AND W. GARY SIMPSON
OKLAHOMA STATE UNIVERSITY

ABSTRACT. We examine the effect of managerial incentives on the use of foreign-exchange derivatives by U.S. bank holding companies using data from 1996-2000. Data from 252 large banking firms allow separation of 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. Instrumental variables probit and sample selected regression models are used to estimate the effects of endogenous and exogenous factors on the probability and extent of foreign-exchange derivatives used. We find that both managerial incentives and fundamental firm-specific risk factors determine the decision to use derivatives to hedge and, once managers decide to hedge, the amount of derivatives used.

*Key Words:* Banking; Derivatives; Foreign-Exchange Exposure

*JEL Code:* G15, G21, G32, G35

## I. INTRODUCTION

One of the unresolved questions associated with the financial decisions of the firm is why do 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. Various reasons for derivative use have been hypothesized and empirically investigated but the results are somewhat contradictory. For a sample of 252 large bank holding companies, we investigate the relation between managerial incentives (i.e., managerial compensation and ownership) and the use of foreign-exchange derivatives. In particular, we employ an econometric model that separates the decision to use derivatives from the decision as to the level of derivatives used.

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Corresponding author: David A. Carter, Associate Professor of Finance, Spears School of Business, Oklahoma State University, Stillwater OK 74078. email: david.carter@okstate.edu.

The results of this study suggest that managerial compensation and ownership are important factors in the hedging decisions of banking firms. We find evidence that managers who receive larger option awards are less likely to hedge using derivatives. Further, our results suggest that greater equity holdings by managers are associated with a greater probability of hedging, and given the decision to hedge, a greater level of derivatives usage. These results are consistent with Tufano's (1996) research on the hedging behavior of gold-mining firms and show the applicability of hedging theory to a regulated industry, such as banking. Additionally, we find that larger annual bonuses and smaller options awards add to both the likelihood and extent of hedging. Finally, our results indicate that greater equity ownership by institutional investors is associated with a greater probability of hedging, and given the decision to hedge, a greater level of derivatives usage. Taken together, these results offer powerful evidence of the importance of appropriate managerial contracts to ensure the proper incentives are in place to prevent unwarranted risk-taking by bank managers.

This investigation differs from prior research into hedging and derivatives use by banks in two important ways. First, we make use of the fact that in recent years, bank holding companies 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 published studies (e.g., Kim and Koppenhaver (1993); Carter and Sinkey (1998); Sinkey and Carter (2000); Whidbee and Wohar (1999)) did not have the benefit of the derivatives data separated by intent. Second, it is likely that some of the regressors of our model (e.g., capital and some elements of compensation) are endogenously determined. In this investigation, we correct for endogeneity to ensure consistent estimation of the parameters of our model. To our knowledge, this is the first study of hedging behavior in the banking industry to correct for endogeneity.

## II. Hedging, Managerial Compensation, and Ownership

The theoretical literature on hedging by value maximizing, non-financial firms focuses on four rationales for a firm to hedge. These rationales are: 1) optimization of the capital budget due to the reduction of cash-flow uncertainty (Froot et al. (1993)), 2) reduction of the probability of financial distress (Smith and Stulz (1985)), 3) reduction of expected taxes (Nance et al. (1993)), and 4) expansion of debt capacity (Leland (1998); Graham and Rogers (2002)).

The reasons for a value-maximizing firm to hedge assume that management and owner interests are congruent. However, Rogers (2002) points out that the firm's management makes the actual decision to hedge. If managers and owners are separate, agency problems should affect the hedging decisions of the firm. One possible result is that managers may hedge in a manner that does not maximize the value of the firm (Smith and Stulz (1985)). Smith and Stulz posit that managers become more risk averse as their equity stake in the firm increases. This is due to the fact that as managerial ownership increases, managers are less likely to hold well diversified portfolios and will have incentives to hedge to reduce the firm's risk. In addition, Smith and Stulz also argue that higher option holdings by managers should result in less hedging because the value of the options will increase as the riskiness of the firm increases.

Consistent with Smith and Stulz's (1985) hypothesis, Chen et al. (1998) find that risk-taking behavior decreases as managerial ownership increases for depository institutions. Further, in a study of the gold mining industry, Tufano (1996) finds that a manager who owns more stock options hedges less, while a manager who has more wealth invested in common stock hedges more.

An alternative view holds that because the common stock of a firm can be viewed as a call option, it becomes more valuable as risk increases (Galai and Masulis (1976)). Therefore, managers with greater equity ownership will have incentives to increase the risk of the firm. This proposition is consistent with the findings of Saunders et al. (1990), who find that as bank managers acquire more equity in their firm, the bank becomes riskier.[1]

In addition to the incentives to hedge provided by managerial ownership and compensation, the existence of large outside block holders, particularly institutional investors, may affect the risk-taking behavior of management. Whidbee and Wohar (1999) argue that these investors, as outsiders, have only limited information about derivatives activities and are primarily concerned with the firm's performance; disciplining poorly performing managers. Because managers know this, they should be more likely to use derivatives to hedge as institutional shareholdings increase.

[1]An additional possibility is that the existence of fixed-price deposit insurance may also affect the incentives of bank management. Merton (1977) argues that the subsidy provided by deposit insurance to the bank's owners could be viewed as a put option. Additional risk-taking will thus increase the value of the put option created by deposit insurance, particularly when managers have a greater ownership stake in the bank and are thus able to capture a larger portion of the wealth transfer. However, the Federal Deposit Insurance Corporation Improvement Act of 1991 (FDICIA) introduced risk-based deposit insurance premia which have reduced the incentives previously produced by fixed-price deposit insurance. Further, while deposit insurance reduces the incentive for depositor to monitor the bank (at least for those deposits under $100,000), it does provide incentive for the FDIC to monitor.

## III. Empirical Methods

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

**Data Sources and Sample Characteristics.** The data for this investigation are taken from two sources: First, we obtain financial statement information, including that related to a bank holding company's use of foreign-exchange derivatives, from the Federal Reserve System's Consolidated Financial Statements for Bank Holding Companies (FR Y-9C). Second, we take information related to ownership and compensation from the *SNL Executive Compensation Review* and the *SNL Quarterly Bank Digest*, compiled by SNL Securities. We limit our sample to firms 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 bank holding companies, or approximately 3.8 observations per holding company, on average. Of the 970 observations, there were a number of missing values for one or more of the variables of interest. Consequently, only 794 observation were available for estimation.

We report descriptive statistics for the sample bank holding companies used in the regressions in Table 1. The average size of a firm in our sample is $25.7 billion with a median of $3.87 billion, indicating a large amount of skewness with respect to size. On average, the percentage of ownership by insiders is 13.2 percent (median = 8.2 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 2.3 times. The sample of bank holding companies has an average ratio of equity capital to total assets of 8.3 percent. About fourteen percent of the sample companies report foreign interest income amounting to an average of 1.4 percent of total interest income. Slightly less than one-fourth of the companies (23.5 percent) use foreign currency derivatives. 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).

Table 2 provides a breakdown for the notional value of foreign-exchange derivatives, by contract type, used by our sample bank holding companies. Over the sample period, holding companies 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 companies 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 just over $26 billion and almost three-fourths of all currency contracts. Over-the-counter currency options were next in importance with an average notional amount of $6.13 billion. Finally, sample companies used an average of $3.869 billion of foreign exchange swaps, $91.49 million of exchange-traded currency options, and $81.49 million of foreign exchange futures. Interestingly, the most prevalent contracts are non-exchange-traded derivatives that are nonstandard, allowing the bank greater flexibility in managing its risk.

**Model Specification and Estimation.** 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 Kim and Koppenhaver (1993); Sinkey and Carter (2000). However, the decision to use derivatives may be affected by entirely different factors than the decision of how much to use. In addition, it is possible, if not likely, that common factors affecting these decisions are either unobserved or unobservable. This causes the two decisions to be correlated in their unobserved components (errors) and a type II tobit, sometimes referred to as sample selectivity or Heckit, model is required for the statistical analysis.

The derivative use by bank holding companies is explored using a framework that separates the participation decision from the extent of use decision. Carter and Sinkey (1998) use a similar framework to investigate the use of interest-rate derivatives by U.S. commercial banks. In our empirical investigation the decision to use derivatives is evaluated using a probit model, while the extent of derivative use is analyzed using a regression model corrected for selectivity bias for the banks that have made the decision to use derivatives.

In the model, a bank makes two decisions: 1) whether to use foreign exchange derivatives and 2) if so, how many to use. The extent of their use may depend on a different set of factors than their likelihood of use and leaves room for the possibility that there are common factors that affect both decisions that are not explicitly accounted for in the model. Estimation of this type of censored regression (commonly referred to as Heckit) model is relatively straightforward if all regressors are exogenous (e.g., see Greene (2002)). However, in our model it is likely that some of the regressors are endogenously determined, in particular capital, option awards, and bonuses. To correct for endogeneity we use Amemiya's AGLS estimator of the probit model with endogenous regressors to obtain valid standard errors. The STATA version 9.2 software is used for the results presented below and relies on Newey's (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 the two decisions. Several instruments are available in the data. CEO compensation is likely to be a function of the CEO's human capital (age and experience), and the size and scope of the firm (number of employees, number of offices and subsidiaries). Capital might also be related to the scope of the firm and the 12-month maturity mismatch (GAP).[2] The ratio of the market value of equity to its book value is also used as an instrument. This variable is sometimes used to proxy the firm's growth opportunities, and though we make no such claim about the validity of this, the market to book ratio is expected to be predetermined with respect to the model's errors and be correlated with the compensation and the capital variables. The latter claim is supported by the reduced form results found below. Finally, a dummy variable is created that equals 1 if the bank holding company earns any foreign interest income and is zero otherwise.

Consistent estimation of an endogenous Heckit model can be done in three steps and asymptotically valid confidence intervals constructed using a bootstrap estimator. First, we estimate reduced form equations for each of the right-hand-side endogenous variables using all exogenous variables and instruments. Next, we estimate the selection equation using probit, replacing the endogenous variables with predictions. Finally, we 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 linear regression.

Bootstrapping has been shown to perform well in Heckit type models (Hill et al. (2003)) and it is used here to obtain 90% bias-corrected confidence intervals for the model's parameters. A total of 1000 bootstrap samples are taken for each model. Not all bootstrap samples converge and hence the actual number of bootstrap samples on which the intervals are computed is smaller. The number of samples that converge for each model appears in the appropriate column at the bottom of the table.

**Hypothesized Relations and Variable Definitions.** We use two measures of foreign-exchange derivative usage as dependent variables in this investigation. The dependent variable in the likelihood of use equations is a dummy variable that indicates that the bank holding company is a user of non-trading currency derivatives; it 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

[2]GAP is defined as 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.

(scaled by total assets) is used as the dependent variable in the extent of use equation to capture end-user behavior.[3]

*Ownership by Insiders.* As discussed earlier in this article, there are two possible relations between hedging behavior and ownership by insiders. The first possibility is that risk-averse managers with poorly diversified portfolios will hedge to reduce the riskiness of the firm (Smith and Stulz (1985)). Alternatively, as managerial ownership increases, managers may have incentive to increase the risk of the firm to increase the value of the call option associated with their equity (Saunders et al. (1990)). We use the natural logarithm of the percentage of total shares outstanding that are owned by officers and directors to measure managerial ownership. We include this variable as an independent variable in both the likelihood and extent of use models.[4]

*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 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 use 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

[3]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.

[4]We assume that insider ownership is predetermined with respect to hedging behavior. We thank an anonymous referee for pointing this out.

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 some elements of CEO compensation are endogenous in that successful hedging activity could in turn lead to higher executive compensation. In particular, we expect the value of options awarded and bonuses to be endogenously determined.[5] Base salary is likely to be predetermined with respect to the firm's current performance and is not likely to be endogenous. This follows since CEO salary for the current year is usually set at the end of the preceding year, in light of the firm's recently completed performance. Below, the endogeneity of base salary is specifically tested and the data do not support its endogeneity in our models.

*Foreign Exchange Risk.* 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. Chow et al. (1997) document the existence of exchange rate exposure for U.S. multinational firms. Géczy et al. (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 (Choi et al. (1992); Wetmore and Brick (1994)).

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.

*Other Independent Variables.* A number of other independent variables are included in our empirical model. These variables are included because they tend to be correlated with our other independent variables and may affect hedging behavior. The variables include size, measured by the natural logarithm of total assets; profitability, measured by return on equity; capital, measured by the ratio of equity capital to total assets; a derivatives dealer activity dummy, coded as one if the bank engages in the trading/dealing of derivatives, and zero otherwise; and dividends paid. Yearly dummy variables are included to control for differences in behavior that may be time dependent.

[5]Borokhovich et al. (2004) and Rogers (2002) address the issue of endogeneity with respect to risk management for nonfinancial firms.

The ratio of equity capital to total assets (Capital) is also included 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 (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 CEO bonuses and options, we expect capital to be endogenously determined. In fact, Graham and Rogers (2002) support the notion that hedging allows firms to increase debt capacity.

## IV. Empirical Results

Table 3 contains results from the reduced form equations. Because capital and two of the CEO compensation variables are believed to be endogenous, instrumental variables estimation is used in subsequent regressions to ensure that consistent parameter estimates are obtained. We report a p-value associated with the hypothesis that each coefficient is zero, the $R^2$ from each regression and the F-statistic of the joint test of instrument significance. There appears to be a high probability that one or more instruments in each equation is significantly correlated with the endogenous variable. Each of the instruments appears to be relevant in that each is significantly different from zero at the 10 percent (p-value $< 0.1$) in at least one equation. The number of employees, number of subsidiaries, and market to book ratio are significant in two equations, while the number of offices is significant in all three equations.

The F statistic associated with joint instrument significance is often used to determine the overall strength of the instruments. Staiger and Stock (1997)) suggest the rule-of-thumb that $F > 10$ indicates instruments are relatively strong. The $F$ statistic for the equity ratio equation is 9.57, which is slightly less than 10; the others indicate a very strong set of instruments. Eliminating the number of employees as an instrument in this equation boosts the joint test to 11.16. Still, it is conventional to use all instruments in each equation and we have followed that here.

**Probability of Derivative Use.** We report the coefficient estimates for the instrumental variable estimation of the probability that a firm will use foreign exchange derivatives for hedging in Table 4. Columns (1), (2), and (3) of Table 4 show the instrumental variable

estimates of the decision equation parameters under several specifications. The first column contains the unrestricted estimates of the probability of derivative use equation. Columns (2) and (3) report restricted versions where sets of statistically insignificant variables are omitted from the model. We also report F-statistics for the null hypothesis that zero restrictions hold and Rivers-Vuong tests of exogeneity. Rivers and Vuong (1988) propose a simple two-step procedure to test the exogeneity of regressors in a probit model. We first obtain residuals from each reduced form equation; next we add the residuals to the probit model and test their joint significance using a Wald test. Based on this test, we reject the null hypothesis that capital, bonus, and option awards are exogenous. However, we do not reject the null hypothesis of exogeneity for base salary. Therefore, we treat capital, bonus, and option awards as endogenous in our estimation procedure.

In general, the instrumental variables probit results we present in Table 4 for each of the three models are qualitatively very similar. Each coefficient has the same sign and in most cases the same statistical significance. The results for several of the variables are statistically significant and offer insight into the factors that affect the decision by the bank to use derivatives. We find significant, negative coefficient estimates for option awards in all three model specifications. The inverse relation between option awards and the use of derivatives is consistent with the theory proposed by Smith and Stulz (1985) and suggests that the more option-like features present in a manager's compensation contract, the greater the incentives to increase firm risk, thereby increasing the value of the option awards. The estimated coefficient for the percentage of ownership by insiders is positive and significant at the 5 percent level or better in all three of the model specifications. This result provides support for the hypothesis that risk-averse managers, who are not likely to hold well diversified portfolios, use derivatives to hedge as their ownership of the bank increases (Smith and Stulz (1985)) and is consistent with prior research on risk taking and managerial ownership (Chen et al. (1998)). We also find significant, positive estimates in all three models for the percentage of ownership by institutions supporting the notion that managers hedge to avoid being disciplined by institutional owners for poor performance. Additionally, we find a statistically significant, positive relation between the likelihood of using derivatives and annual cash bonuses. Finally, we do not find a statistically significant relation between the probability of foreign-exchange derivative use and the CEO base salary.

With respect to the non-managerial variables, we note that, consistent with virtually all prior research, the estimated coefficient for bank size is positive and significant in all three models. In addition, we find a significant, positive relation between the probability of derivative use and capital in two of the three reported models (models (2) and (3)). While this

result does not support the hypothesis that firms hedge to avoid bankruptcy, it may reflect capital required by risk-based capital standard to support the derivative instruments, which is consistent with Merton and Bodie (1992). Finally, and somewhat surprisingly, we do not a find statistically significant relation between the likelihood of derivatives use and the ratio of foreign interest income to total interest income, our measure of foreign-currency exposure.

Overall, the results in Table 4 provide evidence of the importance of managerial incentives in the decision to use foreign-exchange derivatives for hedging purposes. Further, the empirical results are consistent with the predictions and suggest that option-like features in a managerial contract provide incentives to not hedge. However, monitoring by institutional shareholders may provide incentive for a manager to hedge. Finally, as managerial ownership increases, managers are more likely to hedge using derivatives.

**Extent of Derivative Use.** Table 5 reports the results from the estimation of the instrumental variables Heckit model of the bank holding company's decision as to the extent of derivative use.[6] The results of the endogenous Heckit model of the extent of foreign exchange derivative use are similar to those of the probit model, with a few exceptions.

Using different subsets of variables in the probit and regression equations of Heckit estimators improves identification of the model and often improves the statistical performance of the usual two-step estimator. So, several specifications of the model are estimated. On the left hand side of the table (labeled '**unrestricted, model (1)**', the unrestricted probit model which appears in column (1) of Table 4 is used in the probit stage of the Heckit estimator. The 90 percent bias corrected confidence intervals are given for each parameter. If a positive (negative) coefficient falls between two positive (negative) numbers, then it is statistically significant at the 10 percent level; if the confidence interval includes positive and negative numbers then it is not significant. The instrumental variables Heckit is estimated with two other, more restricted versions of the probit models in the first stage. In the three columns labeled '**restricted, model (2)**', the restricted probit model which appears in column (2) of Table 4 is used in the probit stage of the IV Heckit estimator. Finally, the probit from column 3 of Table 4 is used as the first stage of the Heckit model reported under '**restricted, model (3)**'.

[6]Each of these equations was estimated with a constant and the four yearly dummy variables; to conserve space the estimates are omitted from the table. Only one of the time dummies was significant at the 10% level and this occurred in 1998 using the restricted, model (2) probit. Another IV Heckit model was estimated with the time dummies omitted from the model. The results were substantively similar to those in model (2) and model (3) and hence are not reported.

The coefficients reported in Table 5 reveal that several of the variables are statistically significant in all three model specifications. In particular, the variables related to managerial compensation and governance (option awards, bonus, insider ownership, and institutional ownership) are all significant and have the same signs as the probit results reported in Table 4. As before, the estimated coefficient for base salary is not statistically significant. Additionally, both capital and bank size are positive and significant as before. We do not find a positive relation between our measure of foreign-currency exposure and the extent of derivatives use; instead we find a significant, negative coefficient.

Overall, the results suggest the same set of managerial compensation and governance variables affects both the extent of derivatives used, as well as the decision to use derivatives. While this might argue for a simpler model specification, we note the significant coefficient for the inverse Mills ratio reported in Table 5 for all models, suggesting that the two-step Heckit estimation procedure is necessary to obtain consistent estimation of the model's parameters and standard errors.

## V. Conclusion

In this paper, we investigate managerial incentives and the use of foreign-exchange derivatives by large U. S. bank holding companies, as end users, over the period of 1996-2000. Our data allow us to separate derivatives used for purposes other than trading (e.g., hedging) from derivatives used for trading. This enables us to examine derivative use in a hedging framework without the elimination of large dealer banks, as has been done in some previous investigations. We use a Heckit model that permits us to investigate separately factors underlying the likelihood that bank holding companies will use foreign-exchange derivatives and the extent of foreign-exchange derivative use given that there may be common factors influencing both decisions that are unobserved.

The ability to investigate the incentives for the use of derivatives separately from the factors that affect the amount of derivatives used has important implications for our results. We find that managerial incentives are important in both the decision to use derivatives and in the extent of their use. The evidence supports the importance of managerial incentives in a bank holding company's derivative decisions. The result that higher option compensation discourages the probability of using derivatives for hedging is consistent with previous research for both financial and non-financial firms. Our evidence on the bonuses paid to holding company managers suggests that managers prefer to reduce variations in cash flows

by hedging to assure good performance because the managers have little diversification in personal wealth and human capital.

The nature of the firm's ownership is also found to influence the use of foreign currency derivatives. Higher ownership positions of insiders in a holding company is associated with higher levels of hedging which is consistent with theory (Smith and Stulz (1985)). Finally, higher ownership positions by institutional investors in bank holding companies were associated with more derivative use which is consistent with the incentive for large investors to more carefully monitor and emphasize stable cash flows.

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Table 4: **IV Probit Estimates of the Probability of Foreign-Exchange Derivatives Use By Large U.S. Bank Holding Companies (1996-2000)**. This table contains estimates for the probability of foreign-exchange derivative use by U.S. bank holding companies over the period of 1996-2000. To control for endogeneity with respect to compensation and capital, we use an instrumental variable probit estimation procedure. The dependent variable in the probit estimations (i.e., probability of use) is coded as 1 if the bank reports the use of foreign-exchange derivatives for purposes other than trading. The data are taken from the Federal Reserve System's Consolidated Financial Statements for Bank Holding Companies (FR Y-9C), the *SNL Executive Compensation Review*, and the *SNL Quarterly Bank Digest*, compiled by SNL Securities. Asymptotic t-ratios are reported in parentheses beneath the parameter estimates. Significance at the 10 and 5 percent levels is indicated by * and **, respectively.

| | **Instrumental Variables Probit** | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Capital | 34.013 | 27.994* | 21.158* |
| | (1.56) | (1.81) | (1.87) |
| Option Awards | -9.62E-08** | -8.47E-08** | -6.05E-08** |
| | (-2.04) | (-2.20) | (-2.58) |
| Bonus | 1.73E-06** | 1.50E-06** | 9.26E-07** |
| | (2.17) | (2.42) | (3.76) |
| CEO Base Salary | -4.43E-07 | -3.15E-07 | - |
| | (-0.62) | (-0.52) | - |
| Total Assets | 0.414** | 0.426** | 0.356** |
| | (2.60) | (2.89) | (3.87) |
| Insider Ownership % | 0.298** | 0.267** | 0.229** |
| | (2.18) | (2.30) | (2.44) |
| Institutional Ownership % | 0.376** | 0.363** | 0.355** |
| | (2.57) | (2.64) | (2.93) |
| Return on Equity | -0.042* | -0.037 | -0.020 |
| | (-1.61) | (-1.58) | (-1.30) |
| Foreign to Total Interest Income Ratio | -3.315 | -2.438 | - |

Continued from preceding page

| | **Instrumental Variables Probit** | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| | (-0.97) | (-0.88) | - |
| Derivative Dealer Activity Dummy | -0.240 | -0.251 | - |
| | (-0.92) | (-1.05) | - |
| Dividends Paid | -7.41E-07 | -6.57E-07 | - |
| | (-1.39) | (-1.41) | - |
| D=1 if 1997 | -0.137 | - | - |
| | (-0.49) | - | - |
| D=1 if 1998 | -0.283 | - | - |
| | (-1.04) | - | - |
| D=1 if 1999 | -0.036 | - | - |
| | (-0.12) | - | - |
| D=1 if 2000 | -0.004 | - | - |
| | (-0.01) | - | - |
| Constant | -11.713 | -11.43032 | -9.949 |
| | (-3.64) | (-4.18) | (-5.22) |
| Rivers-Vuong Test–$\chi^2_3$ | 11.36** | 12.63** | 21.88** |
| (Ho: Capital, Bonus, Options Exogenous) | | | |
| Rivers-Vuong Test–$N(0,1)$ | 1.50 | 1.08 | 1.23 |
| (Ho: Base Salary Exogenous) | | | |
| F-test of Restrictions | - | 1.52 | 4.03 |
| Sample size | 794 | 794 | 794 |

TABLE 1. **Descriptive Statistics for Sample Bank Holding Companies (1996-2000)**. The data are taken from the Federal Reserve System's Consolidated Financial Statements for Bank Holding Companies (FR Y-9C), the *SNL Executive Compensation Review*, and the *SNL Quarterly Bank Digest*, compiled by SNL Securities. Sample average, standard deviation, median value and sample size are reported.

| Derivative Type | Mean | Std. Dev. | Median | N |
|---|---|---|---|---|
| FX Derivatives User Dummy | 0.235 | 0.424 | - | 795 |
| Equity/Total Assets (Capital) | 0.083 | 0.018 | 0.081 | 800 |
| Number of Employees | 7,619 | 20,328 | 1,411 | 800 |
| Number of Subsidiaries | 4.8 | 6.7 | 2 | 800 |
| Number of Offices | 221.7 | 455.4 | 66.5 | 800 |
| CEO Age | 56.12 | 7.20 | 56 | 800 |
| 12 Month Maturity Gap | 0.16 | 0.13 | 0.13 | 800 |
| Total Assets ($) | 25.7 Billion | 77.5 Billion | 3.9 Billion | 800 |
| Insider Ownership (%) | 13.2 | 14.3 | 8.2 | 800 |
| Institutional Ownership (%) | 27.7 | 18.8 | 24.3 | 800 |
| Return on Equity (%) | 14.7 | 5.2 | 14.9 | 800 |
| Market to Book Ratio | 2.33 | 0.94 | 2.18 | 800 |
| Foreign to Total Interest Income Ratio | 0.014 | 0.061 | 0 | 800 |
| Derivative Dealer Activity Dummy | 0.295 | 0.456 | - | 800 |
| Dividends Paid ($) | 114,359 | 319,837 | 15,427 | 800 |
| Base Salary ($) | 479,229 | 249,234 | 400,000 | 799 |
| Bonus ($) | 567,617 | 1,292,369 | 221,421 | 799 |
| Value of CEO Option Awards ($) | 1,612,678 | 12 Million | 178,223 | 799 |

TABLE 2. **The Notional Value of Foreign-Exchange (FX) Derivatives by Sample Bank Holding Companies (1996-2000)**. This table contains descriptive statistics for the notional value of foreign-exchange derivatives by sample bank holding companies over the period of 1996-2000. The data are taken from the Federal Reserve System's Consolidated Financial Statements for Bank Holding Companies (FR Y-9C). The mean and standard deviation for each derivative type are reported in $ Millions.

| Derivative Type | Mean | Std. Dev. | N |
|---|---|---|---|
| FX Futures | 81.43 | 706 | 882 |
| FX Forwards | 26,157 | 163,661 | 883 |
| FX Exchange Traded Options | 91.49 | 578 | 882 |
| FX OTC Options | 6,173 | 39,119 | 882 |
| FX Swaps | 3,869 | 31,421 | 884 |
| FX Derivatives Used for Trading | 35,457 | 219,377 | 882 |
| FX Derivatives Used for Other Purposes | 952.85 | 7,059 | 882 |
| Total Value of FX Derivatives | 36,409 | 225,580 | 882 |

TABLE 3. **Summary Results from Reduced-form Equations**. The table contains p-values for the instruments, $R^2$ for each reduced form regression, and the F-statistic associated with the hypothesis that the instruments are jointly zero. The data are taken from the Federal Reserve System's Consolidated Financial Statements for Bank Holding Companies (FR Y-9C), the *SNL Executive Compensation Review*, and the *SNL Quarterly Bank Digest*, compiled by SNL Securities.

| | Reduced Form Equation | | |
|---|---|---|---|
| | Capital | Bonus | Options |
| Instruments | Coefficient P-values | | |
| Number of Employees | 0.695 | 0.000 | 0.000 |
| Number of Subsidiaries | 0.000 | 0.007 | 0.132 |
| Number of Offices | 0.100 | 0.000 | 0.000 |
| CEO Age | 0.093 | 0.727 | 0.668 |
| 12 Month Maturity Mismatch | 0.000 | 0.401 | 0.319 |
| Market to Book Ratio | 0.001 | 0.018 | 0.376 |
| Foreign Interest Income Dummy | 0.077 | 0.411 | 0.275 |
| R-Square | 0.192 | 0.607 | 0.698 |
| F(7,779) | 9.57 | 37.82 | 171.83 |

TABLE 5. **Instrumental Variables Heckit Estimates of the Extent of Foreign-Exchange Derivatives Use By Large U.S. BHCs (1996-2000)**. This table contains estimates for the extent of foreign-exchange derivative use by U.S. bank holding companies over the period of 1996-2000. Instrumental variables Heckit estimation is used to control for endogeneity with respect to compensation and capital. Precision is measured using bias-corrected 90 percent bootstrap confidence intervals. The dependent variable in the Heckit estimations (i.e., extent of use) is the notional value of foreign-exchange derivatives used for purposes other than trading scaled by assets. The data are taken from the Federal Reserve System's Consolidated Financial Statements for Bank Holding Companies (FR Y-9C), the *SNL Executive Compensation Review*, and the *SNL Quarterly Bank Digest*, compiled by SNL Securities. Significance at the 10 percent level is indicated by *. The results for the constant and yearly dummy variables are suppressed to make the table more readable.

| | **Instrumental Variables Heckit** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **First stage Probit:** | **unrestricted, model (1)** | | | **restricted, model (2)** | | | **restricted, model (3)** | | |
| | | 90% C.I. | | | 90% C.I. | | | 90% C.I. | |
| Variable | Coefficient | 0.05 | 0.95 | Coefficient | 0.05 | 0.95 | Coefficient | 0.05 | 0.95 |
| Captial | 3.423* | 5.196 | 17.164 | 3.136* | 4.305 | 15.456 | 2.992* | 3.367 | 13.324 |
| Base salary | -4.29E-8 | -5.15E-7 | 1.95E-8 | -3.51E-8 | -4.75E-7 | 4.67E-8 | -1.59E-8 | -2.02E-7 | 7.82E-8 |
| Option Awards | -1.05E-8* | -1.50E-7 | -3.56E-9 | -1.03E-8* | -1.69E-7 | -3.81E-9 | -8.65E-9* | -1.43E-7 | -2.40E-9 |
| Bonus | 1.90E-7* | 3.65E-7 | 3.65E-7 | 1.85E-7* | 2.85E-7 | 4.35E-7 | 1.50E-7* | 1.85E-7 | 6.18E-7 |
| Total Assets | 0.061* | 0.057 | 0.248 | 0.067* | 0.051 | 0.190 | 0.069* | 0.037 | 0.305 |
| Insider Ownership % | 0.036* | 0.045 | 0.102 | 0.036* | 0.039 | 0.130 | 0.037* | 0.032 | 0.246 |
| Institutional Ownership % | 0.058* | 0.041 | 0.219 | 0.063* | 0.046 | 0.295 | 0.068* | 0.041 | 0.320 |
| Return on equity | -0.006* | -0.019 | -0.004 | -0.006* | -0.019 | -0.004 | -0.005* | -0.019 | -0.002 |
| Foreign to Total Interest Ratio | -0.330* | -5.027 | -0.261 | -0.295* | -5.907 | -0.199 | -0.101 | -2.924 | 0.036 |
| Der. Dealer Activity Dummy | -0.036* | -0.188 | -0.015 | -0.040* | -0.190 | -0.019 | -0.007 | -0.039 | 0.029 |
| Dividends Paid | -1.22E-7* | -1.28E-6 | -9.95E-8 | -1.22E-7* | -1.29E-6 | -9.36E-8 | -8.86E-8* | -7.33E-7 | -4.02E-8 |
| Inverse Mills | 0.182* | 0.314 | 0.616 | 0.199* | 0.233 | 0.457 | 0.225* | 0.172 | 0.853 |
| N | 187 | | | 187 | | | 187 | | |
| Bootstrap N | 995 | | | 995 | | | 995 | | |