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Derivatives, Portfolio Composition and Bank Holding Company Interest Rate Risk Exposure

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Derivatives, Portfolio Composition and Bank Holding Company Interest Rate Risk Exposure [1]

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Abstract: This paper examines the role played by derivatives in determining the interest rate sensitivity of bank holding companies' (BHCs') common stock, controlling for the influence of on-balance sheet activities and other bank-specific characteristics. The major result of the analysis suggests that derivatives have played a significant role in shaping banks' interest rate risk exposures in recent years. For the typical bank holding company in the sample, increases in the use of interest rate derivatives corresponded to greater interest rate risk exposure during the 1991-94 period. This relationship is particularly strong for bank holding companies that serve as derivatives dealers and for smaller, enduser BHCs. During earlier years, however, there is no significant relationship between the extent of derivatives activities and interest rate risk exposure. There are two plausible interpretations of the relationship between interest rate derivative activity and interest rate risk exposure in the latter part of the sample period: one interpretation suggests that derivatives tend to enhance interest rate risk exposure for the typical BHC in the sample, while the other suggests that derivatives may be used to partially offset high interest rate risk exposures arising from other activities. The analysis provides support for the first of these two interpretations.

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Section 1: Introduction

Interest rate risk is one of the most important forms of risk that banks face in their role as financial intermediaries. Broadly speaking, interest rate risk is the risk that a bank's income and/or net worth will be adversely affected by unanticipated changes in interest rates. This risk arises directly from banks' traditional role as financial intermediaries that accept interest-sensitive liabilities and invest in interest-sensitive assets. In its most basic form, interest rate risk arises through mismatches in the maturity of assets, liabilities and off-balance sheet positions that can lead to volatility in income and net worth as interest rates rise and fall. More comprehensively, banks' income and net worth can be affected by changes in the slope as well as the level of the yield curve, by changes in spreads between different interest rates, and by changes in the volatility of interest rates. Finally, interest rate risk can also arise through changes in the timing of payments in response to changes in the interest rate environment.

An important question that has arisen in the discussion of banks' exposure to interest rate risk concerns the role played by derivatives. The prevalence of derivatives usage by banks has increased dramatically in recent years, raising questions about the risks that banks face from these activities. In particular, derivatives provide a relatively inexpensive means for banks to alter their interest rate risk exposures. In the absence of an active derivatives market, banks would be able to adjust their interest rate risk exposures mainly by altering the composition of their assets and liabilities. In this situation, the costs of achieving any given level of interest rate risk exposure could be high, since adjusting the composition of a bank's portfolio could disrupt the bank's underlying business strategy. [1] In addition, it might be difficult for a bank to adjust its interest rate

[1] For instance, it could be difficult and costly for the bank to lengthen the duration of its loan portfolio if many of its customers want short-term or variable-rate loans.

risk exposures quickly, since certain portions of the balance sheet could be difficult to alter over a short time horizon.

Derivatives provide a means for banks to more easily separate interest rate risk management from their other business objectives. In theory, the existence of an active derivatives market should increase the potential for banks to move toward their desired levels of interest rate risk exposure. This potential has been widely recognized, and the question that has arisen in consequence is whether banks have used derivatives primarily to reduce the risks arising from their other banking activities (for hedging) or to achieve higher levels of interest rate risk exposure (for speculation).

It is not clear ***a priori*** which of these two alternatives is more likely. Indeed, the contribution of derivatives to banks' interest rate risk exposures could vary significantly across institutions and over time, reflecting differences in factors such as the interest rate environment, customer preferences, and desired levels of interest rate risk exposure. The evidence on this point from previous studies is somewhat mixed, although several studies have found evidence consistent with the idea that derivatives have been used by banks to enhance interest rate risk exposure.

This paper examines the role of derivatives in determining interest rate sensitivity of bank holding companies' (BHCs') net worth, controlling for the influence of on-balance sheet activities and other BHC-specific characteristics. The major result of the analysis suggests that derivatives have played a significant role in shaping BHCs' interest rate risk exposures in recent years. For the typical bank holding company in the sample, increases in the use of interest rate derivatives corresponded to greater interest rate risk exposure during the 1991-94 period. This relationship is particularly strong for bank holding companies that serve as derivatives dealers and, to a somewhat lesser extent, for smaller, end-user institutions. During earlier years, however, there is no significant relationship between the extent of derivatives activities and interest rate risk exposure.

The positive relationship between interest rate derivatives and interest rate risk exposures appears to be consistent with the idea that the typical BHC in the sample used derivatives to enhance these exposures. However, an alternative interpretation of the results exits. Specifically, the positive correlation could reflect the influence of portfolio characteristics that are not controlled for in the regression specification. To the extent that BHCs use interest rate derivatives to hedge high interest rate risk exposures arising from these unobserved factors, this could result in the observed positive relationship. While it is difficult to definitively reject this second interpretation of the results, the paper presents evidence in support of the first interpretation.

The remainder of this paper is organized as follows. The next section reviews previous work that has examined the relationship between derivatives and banks' interest rate risk exposure, and motivates the empirical work in the subsequent sections. Section 3 describes the data set and the measure of BHCs' interest rate risk exposure used in the analysis. Section 4 describes the cross-sectional regressions relating BHCs' portfolio characteristics and derivatives activities to their interest rate risk exposure. The final section of the paper contains summary and conclusions.

Section 2: Previous work on banks' interest rate risk exposure

A number of recent papers have examined the relationship between interest rate risk exposure and banks' derivatives usage. Several of these papers have found results consistent with the idea that increased use of derivatives by banks tends to result in higher levels of interest rate risk exposure.[2] For instance, Sinkey and Carter (1994) and Gunther and Siems (1995) found a significant, negative relationship between the balance sheet "gap" measures of interest rate risk exposure -- the difference between assets and liabilities that mature or reprice within specified time horizons -- and the extent of derivatives usage by banks. These papers argue that this finding is consistent with the idea that banks use derivatives as a substitute for on-balance sheet sources of interest rate risk exposure, rather than as a hedge. In contrast, Simons (1995), using a similar empirical approach, finds no consistent relationship between on-balance sheet gaps and derivatives usage.

While these results point to a significant relationship between derivatives and banks' interest rate risk profiles, the empirical specifications used in these papers raise questions about the robustness of their findings. In particular, these papers use interest rate gap measures as explanatory variables in regressions describing the extent of derivatives usage for a large panel of banks. However, both derivatives and on-balance sheet positions can be seen as "inputs" that can be used by banks to achieve a desired level of interest rate risk exposure. In fact, the conclusions drawn by some of these papers -- that derivatives are used as a substitute for on-balance sheet interest rate exposures -- are consistent with this view. If this view is correct, however, then derivatives usage and on-balance sheet gaps are determined jointly by banks, and regressions using one of these as an explanatory variable for the other will suffer from simultaneity bias.

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[2]In contrast, papers examining the relationship between derivatives activity and interest rate risk exposures among thrifts have found that greater use of derivatives has tended to be associated with lower risk exposures. See Brewer, Jackson and Moser (1996) and Schrand (1996).

Gorton and Rosen (1995) use a different approach to this question that avoids the difficulties of working with balance-sheet based maturity gap data. Specifically, they use the limited data available from banks' Reports of Condition and Income (the Call Reports) on the maturity distribution of interest rate derivatives to derive estimates of the direction of interest rate risk exposure arising from these positions. Their conclusion is that the interest rate exposures arising from interest rate swaps tend to be mostly, though not completely, offset by exposures from other bank activities. Further, they find that the extent of offsetting varies with bank size, with large dealer banks experiencing the greatest amount of offset. Thus, Gorton and Rosen's results can also be interpreted as suggesting that the net impact of banks' interest rate swap activity is to increase interest rate risk exposures.

In order to extend this earlier work on derivatives and interest rate risk exposure, it is helpful to consider another body of work that has examined the general nature of banks' interest rate risk exposures. In particular, these studies have used stock market data to measure the interest rate sensitivity of banks' common stock.[3] These papers use two-factor market models that relate the return on the equity of individual banks to the return on the market and a term designed to capture interest rate changes. The coefficient on the interest rate term (the interest rate "beta") can be interpreted as a measure of interest rate risk exposure.

Most of these studies have examined the time series properties of the interest rate betas, attempting to assess whether these coefficients are stable over time. In general, the papers have found that the coefficients on both the market rate of return and the interest rate term vary

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[3]Another group of papers has used Call Report data to estimate the duration of banks' net worth (see Wright and Houpt (1996), Neuberger (1993)).

significantly over time (Kane and Unal (1988), Yourougou (1990), Neuberger (1991), Song (1994), Robinson(1995), and Hess and Laisathit (1996)). A few papers have attempted to explain the variation in the interest rate sensitivity measure across banks by using balance sheet data to account for differences in banks' activities (Flannery and James (1984a, 1984b), Kwan(199 l)). These papers find a significant relationship between balance sheet characteristics and banks' interest rate risk exposure.

The market-model approach to interest rate risk measurement provides a way to assess the relationship between derivatives and interest rate risk exposure that avoids the simultaneity difficulties of some of the earlier work in this area.[4] The market-based measure of interest rate risk exposure can be seen as the "output" of banks' attempts to manage their interest rate risk exposure, using the "inputs" of balance sheet positions and derivatives. In other words, the interest rate risk measures captured by the market model take into account the banks' joint decision-making process concerning the on- and off-balance sheet components that contribute to overall interest rate risk exposure. Thus, the simultaneity problem in using both balance sheet gap measures and measures of derivatives usage in a single regression is avoided. The next sections of the paper describes the approach in greater detail.

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[4] Choi, Elyasiani and Saunders (1996) use a three-factor model that incorporates changes in both interest rates and exchange rates to examine the relationship between derivatives and interest rate and exchange rates exposures. They estimate the model for a sample of 59 large U.S. banking companies and find a significant relationship between the resulting interest and exchange rate betas and the banks' interest rate and exchange rate derivatives usage. Because the focus of their analysis is on the joint impact of interest and exchange rate derivatives on risk exposure, it is difficult to derive a clear indication of the net impact of derivatives on interest rate risk exposure from their results.

Section* 3: *Market Model Regressions and Interest Rate Sensitivity

The foundation of the empirical analysis in this paper is a series of annual market model regressions relating the return on a bank holding company's common stock to the return on the market and a term designed to capture changes in interest rates. The basic form of the regression is:

$$r_{kt} = \beta_{k0} + \beta_{k1} r_{mt} + \beta_{k2} di_t + \varepsilon_{kt} , \qquad (1)$$

where r_{kt} is the return on BHC k's stock in week t, r_{mt} is the return on the S&P 500 index in week t, and di_t is the interest rate term, defined as:

$$d\,i_t = -(i_t - i_{t-1})/(1 + i_{t-1}) , \qquad (2)$$

where it is the yield on the constant maturity ten-year Treasury bond. [5] Note that di_t is the ***negative*** of change in the total return on the Treasury security, so that an increase in yield results in a decrease in di_t.

The coefficient on the interest rate term, β_{k2}, measures the sensitivity of the return on BHC k's stock to changes in interest rates, controlling for changes in the return on the market. In that sense, it can be interpreted as a measure of BHC k's interest rate risk exposure. In particular, the coefficient is an estimate of the modified duration of the BHC's equity. A positive interest rate beta implies that the value of the BHC's equity tends to decrease when interest rates rise, while a negative beta implies the opposite. Thus, the sign and magnitude of the interest rate beta

‘The analysis described in this and the subsequent sections of the paper was also performed using a range of alternative Treasury rates. The results for yields on Treasury securities ranging from 2 to 30 years were similar to those discussed in the text.

give an indication of the direction and extent of the repricing mismatches inherent in a BHC's on- and off-balance sheet positions. (Note that a positive beta corresponds to the traditional view of banks as borrowing short-term and lending long-term.)

As specified in equation (1) above, however, the interest rate beta is only a *partial* measure of interest rate risk exposure. Changes in the interest rate environment may also affect the return on the market and, through that channel, BHC equity values. In order to get a *total* measure of each BHC's interest rate risk exposure, the market return variable, r_{mt}, was decomposed into two portions by regressing it on a constant and di_t. The residuals from this regression capture the portion of r_{mt} that is uncorrelated with the interest rate term, di_t. By substituting these residuals for r_{mt} in the market model equation, the coefficient on di_t will reflect both the direct influence of changes in interest rates on BHC equity values and the indirect influences working through changes in the market rate of return.[6]

The data used in these regressions consist of weekly stock return data for 139 BHCs whose stock traded publicly at some point during the period 1986 to 1994.[7] The sample was constructed by matching bank holding companies listed in the 1985 Bank Compustat database with stock return data from the Center for Research in Securities Prices (CRSP). The 139 BHCs in the resulting sample have a median asset size of just over $9 billion (see Table 1), so they are significantly larger on average than the population of U. S. BHCs as a whole. The sample includes

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[6]This approach was also taken in Flannery and James (1984a, 1984b), among others.

‘Note that this is the same basic data set used in the two Demsetz and Strahan (1995, forthcoming) papers. A full description of the construction of the weekly stock return data set is included in Demsetz and Strahan (forthcoming).

nearly all the largest U.S. bank holding companies, as well as many smaller ones (the smallest BHC in the sample has total assets of just over $240 million).

The market model regressions were estimated annually between 1986 and 1994 for each BHC whose stock traded publicly for at least 30 weeks in a given year. This process results in a separate interest rate sensitivity beta, β_{k2}, for each BHC for each year that the BHC is in the sample. Given the method of constructing the sample, a number of BHCs drop out of the sample going forward from 1986, due primarily to mergers and to failures. This means that the number of BHCs for which the market model regression is estimated varies over the sample period, from a high of 134 in 1986 to a low of 76 in 1994. In total, there are 944 BHC/year observations.

Table 1 presents aggregate information on the interest rate betas that result from these annual regressions. The table presents information for the sample as a whole (1986 to 1994) and for two sub-periods, 1986-90 and 1991-94. In each of the two sub-periods and overall, the average interest rate beta is positive, suggesting that an increase in interest rates (a decrease in di_t) leads to a decrease in BHC equity values. This is consistent with the traditional view of banks as borrowing short-term and lending long-term. In fact, more than 80 percent of the interest rate betas in the sample are positive, suggesting that BHCs with this profile dominate the sample.

Table 2 presents a more detailed annual breakdown of the market model regressions. The results reported in this table are from regressions of the average return (equally weighted) for all BHCs in the sample in a given year on the return on the market and the interest rate term. The regression for 1987 also contains a dummy variable for the week of the stock market crash. These regressions are representative of the results across the BHCs contained in the sample for a given year. Consistent with the findings of earlier studies, there is considerable variation across years in both the coefficients on the market return and on the interest rate term.* In seven of the nine years, the interest rate beta from these aggregate regressions is positive and significant different from zero. Again, this finding is consistent with the idea that a typical bank in the sample has the traditional profile of borrowing short-term and lending long-term.[9]

Section 4: Derivatives, Portfolio characteristics and Interest Rate Risk Exposure

In this section, we examine the relationship between the interest rate betas estimated above and BHCs' on- and off-balance sheet activities to get a sense of derivatives' contribution to BHCs' interest rate risk exposures. The approach used is based on the methodology developed in Flannery and James (1984b), with extensions to take account of BHCs' derivatives activities. In particular, the interest rate betas are regressed on a series of variables that reflect the composition of the BHCs' balance sheets and the scope of their derivatives activities. This analysis can provide insight into the relative interest rate sensitivity of various categories of assets and liabilities. as well as into the contribution that interest rate derivatives make to the BHC's overall interest rate risk exposure.

Overview of the data set

The first step in constructing the data set was to gather information about the balance sheet composition and derivatives activities of the BHCs in the sample. In particular, data from

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[8]The hypothesis that the coefficients on these aggregate regressions are stable over time is strongly rejected. The hypothesis is also strongly rejected when the sample is limited to those 75 BHCs that appear in each year.

[9]In interpreting the betas, it is important to note that they are estimates that are subject to measurement error. In particular, it is not clear how much of the year-to-year variation in the betas is indicative of actual changes in interest rate risk exposure, and how much reflects changes that arise from other sources. As discussed in the next section, the possibility of random year-to-year variation in interest rate betas is in part the motivation for including annual fixed effects in the second-stage regressions.

the June “Consolidated Financial Statements for Bank Holding Companies” (Federal Reserve Y-9C reports) were collected for each BHC for each year in the sample. These data consist of information about the BHCs’ major balance sheet positions and derivatives exposures, as well as some limited information about the repricing and maturity characteristics of certain interest-earning assets and liabilities.

Specifically, the Y-9C reports contain information about the amount of interest-earning assets (primarily loans and securities) whose maturity or next repricing date is within one year. In addition, the report also divides time deposits into those that reprice or mature within and beyond one year.[10] Using these data, it is possible to construct a rough measure of the one-year interest rate “gap” for each BHC as the difference between assets and liabilities that reprice or mature within one year. This measure is an approximation because it omits deposits in foreign offices and because the maturity/repricing information does not take into account expected prepayments or withdrawals. Table 3 summarizes this “gap” measure along with the other balance sheet

[10] In fact, this variable turned out to be mis-reported for a large number of BHCs in the sample in that the “less than one year” component was larger than total time deposits as reported in the balance sheet portion of the financial statement. In order to correct for this mis-reporting, bank-level data were used. Specifically, data on the maturity/repricing characteristics of domestic time deposits for each commercial bank within a BHC were collected from bank-level Call Reports (examination of these data suggest that they do not suffer from the same reporting problems as the BHC-level data). These data were aggregated across banks within a holding company, and the ratio of time deposits under one year to total domestic time deposits was calculated. This ratio was then applied to total domestic time deposits for the BHC to obtain an estimate of total domestic time deposits under one year for the consolidated BHC. Note that this figure is an estimate because it does not take proper account of any intra-BHC deposits nor does it incorporate deposits at thrift subsidiaries in the calculation of the under-one-year ratio. Nonetheless, it seems a reasonable approach; for several of the BHCs in the sample, the approach precisely replicates the volume of under one year time deposits reported on the Y-9C reports.

categories used in the analysis. To provide a sense of scale, each variable is reported as a share of total assets. [11]

Aside from the one-year “gap” variable (reported in the table as Net Assets< 1 Year), the asset variables include net assets over 1 year, positions in cash, trading account assets, mortgage servicing rights (a component of intangible assets), and net other assets. The categories on the liability side of the balance sheet primarily reflect so-called core deposits. These categories include demand deposits, NOW account deposits and savings account deposits, all of which have undetermined maturities and thus uncertain interest rate risk characteristics. Finally, the table also reports summary statistics for foreign deposits. Since these deposits may be denominated in currencies other than the U.S. dollar, their interest rate risk characteristics may differ significantly from domestic deposits. Thus, they are treated as a separate balance sheet category in the analysis.

The Y-9C reports also contain information about the notional principal amount of interest rate swaps held by BHCs. These data are available for the entire sample period. In addition, beginning in 1990, the reports contain information on the notional principal amounts of BHCs' total interest rate derivatives (including swaps, forwards, future and options) and overall derivatives positions (swaps, forwards, futures and options based on interest rates, exchange rates, equity prices, commodity prices and other underlying instruments).

Summary statistics for these variables are reported in the final panel of Table 3. As the table indicates, about 70 percent of the observations have positive levels of interest rate swaps,

[11] As discussed below, these variables will be scaled by the market value of equity in the regressions. However, using total assets as a scaler provides a more intuitive sense of the variables for summary purposes.

with a somewhat higher fraction in the 1991-94 period. This rate of derivatives usage is considerably higher than for the banking system as a whole[12], reflecting the predominance of larger bank holding companies in the sample. While the notional principal amounts of interest rate swaps are as high as **6** times total assets for some BHCs in the sample, the average level is considerably lower (about 25 percent of total assets among those observations that have positive notional values). The figures for all interest rate derivatives and for total derivatives for the second half of the sample are similar.

Derivation of the regression model

The basic estimation model is a cross-sectional regression that decomposes the duration of each BHC's equity -- as calculated in the market model regressions -- into the contributions made by the various on- and off-balance sheet positions described above. This approach was used in Flannery and James(1984b) to assess the "effective maturity" of core deposits, and can be extended to take account of the full range of BHCs' on- and off-balance sheet activities.

To begin, assume that a BHC has m types of assets (e.g., loans, leases, securities) and n types of liabilities (e.g., demand deposits, savings deposits, etc.). In this case, the following relationship holds:

$$\textbf{(3)} \qquad \beta_{P_k} = \beta_{A1_k} * \frac{A1_k}{P_k} + \beta_{A2_k} * \frac{A2_k}{P_k} + \ldots + \beta_{Am_k} * \frac{Am_k}{P_k} + \beta_{L1_k} * \frac{-L1_k}{P_k} + \ldots + \beta_{Ln_k} * \frac{-Ln_k}{P_k} \, ,$$

[12] See Simons(1995) for a description of the rate of interest rate derivatives usage among U.S. commercial banks. She find that in 1993, about 17 percent of banks with assets greater than $100 million reported using interest rate derivatives. Among banks with assets greater than $500 million, the rate of usage was 55 percent.

Equation (3) simply says that the duration of BHC k's equity is the duration of its assets minus the duration of its liabilities, where assets and liabilities are weighted by their proportional shares of equity.

Equation (3) holds for any particular BHC for a given point in time. Looking across BHCs over time, and making some further adjustments to reflect the nature of the data available from BHC regulatory reports, the regression equation that results is:

$$\textbf{(4)} \qquad \beta_{k2,t} = \theta_1 + \theta_2\left(\frac{a2}{P}\right)_{k,t} + \ldots + \theta_m\left(\frac{am}{P}\right)_{k,t} + \theta_{m+1}\left(\frac{-\ell 1}{P}\right)_{k,t} + \ldots + \theta_{m+n}\left(\frac{-\ell n}{P}\right)_{k,t} + \epsilon_{k,t}\ ,$$

where the theoretical interest rate beta, β_{Pk}, has been replaced by its estimated value, $\beta_{k2,t}$, and the subscript k,t indicates BHC k in year t of the sample.[12] This form of the equation replaces the market values of the various categories of assets and Inabilities with the corresponding book values (a2 to am for assets, and $\ell 1$ to ℓn for liabilities), reflecting the fact that only book value data are reported in BHC regulatory reports. In addition, the equation imposes the balance sheet identity that equity equals assets minus liabilities, and omits one asset category. Thus, the

[12]The error term, ϵ_{kt}, in equation (4) emerges from two sources. The first component of the error term arises from measurement error in the estimation of the betas in the market model regression. The second component is produced by the aggregation of equation (3) across BHCs and over time. In equation (4), the coefficients θ_1 to θ_{m+n} are averages over BHCs and over time. This means that the error contains terms that reflect the deviation of the BHC/year-specific coefficients from the average. These deviation terms mean that the error, ϵ_{kt}, will be heteroskedastic since the variance of the error will be a function of the squares of the balance sheet weights. This is the standard "random coefficients" model (see Judge et. al. (1980) for a discussion). Given this structure, it is possible to use an iterative weighted least squares technique to account for the heteroskedasticity introduced by these terms. However, the results of that technique proved to be unstable. Instead, the correction for generalized heteroskedasticity in White (1980) was used in the estimates.

intercept term, θ_1, reflects the duration of the omitted balance sheet category (β_{A1}), while the slope coefficients, θ_2 to θ_{m+n}, reflect the difference between duration of the balance sheet category in question and the duration of the omitted asset category (β_j - β_{A1}) *times* the ratio of market to book value for that balance sheet category. Because the equation has been pooled, all the coefficients represent average values across BHCs and over time.

Finally, this equation can be augmented to introduce variables to control for factors beyond basic portfolio composition that influence a particular BHC's interest rate risk exposure:

$$\textbf{(5)} \qquad \beta_{k2,t} = \theta_1 + \theta_2\left(\frac{a2}{P}\right)_{k,t} + \ldots + \theta_m\left(\frac{am}{P}\right)_{k,t} + \theta_{m+1}\left(\frac{-\ell 1}{P}\right)_{k,t} + \ldots + \theta_{m+n}\left(\frac{-\ell n}{P}\right)_{k,t} + \chi_{k,t}\,\theta_M + \mu_{k,t}\,,$$

where $X_{k,t}$ is a vector of BHC-specific variables, Θ_M is the corresponding coefficient vector and $\mu_{k,t}$ is the residual once these additional factors have been taken into account. In the empirical work that follows, the primary variable introduced in this fashion is the extent of each BHC's interest rate swap activity,

As a last point, it is important to note that the regression preserves the sign (positive or negative) of the interest rate betas. The sign of the interest rate beta provides an indication of the direction of a BHC's interest rate risk exposure. In measuring the extent of interest rate ***risk,*** however, both positive and negative betas can imply significant interest rate risk exposure. Thus, in interpreting the coefficients, it is important to remember that a coefficient indicating that an increase in a particular balance sheet category increases the interest rate beta does not necessarily indicate an increase in interest rate risk. Only for those BHCs with positive interest rate betas --

about 80 percent of the observations -- does an increase in the interest rate beta correspond to an increase in interest rate risk exposure. [13]

Estimation results

The first two columns of Table 4 present the results of the basic regression described in equation (5). Two sets of estimates are presented: one set including year dummies to control for variation across time (in the first column), and a second set including both year and BHC-level dummies (reported in the second column). The regression results in these columns cover the entire sample period (1986 to 1994).

The specification of the regression equation incorporates on-balance sheet share variables that reflect the asset and liability categories discussed above. The omitted balance sheet category is net assets under 1 year, so the coefficients can be interpreted as providing an indication of the duration of the particular balance sheet category relative to positions under 1 year.

The regressions also incorporate two variables intended to control for other BHC-specific factors: the notional principal amounts of interest rate swaps (scaled by the market value of equity) and the log of BHC asset size (in 1994 dollars). BHC asset size is included to control for differences in interest rate risk exposure that might be caused by differences in the types of businesses and customers at large and small banks. In addition, large bank holding companies may have access to markets and products (e.g., wholesale or foreign deposits) that significantly alter their interest rate risk profiles as compared to smaller institutions. Banks of different sizes

[13]The regressions reported in the paper were also run using the absolute value of the interest rate beta as the dependent variable. The results concerning derivatives are similar to those reported below, although the explanatory power of the balance sheet variables is significantly reduced. This last result is not surprising since the balance sheet variables retain the direction of interest rate risk exposure.

may also have differing appetites for risk. [14] Finally, since derivatives usage tends to be positively correlated with asset size, it is important to control for asset size in the regression to ensure that the coefficients on the derivatives variable are not capturing the effects of other size-related factors.

Turning first to the balance sheet variables, the results suggest that, as anticipated, portfolio composition is a significant determinant of a BHC's interest rate risk exposure. The hypothesis that the coefficients on the portfolio share variables are equal to zero is strongly rejected. On the liability side, the results suggest that demand deposits have a duration that exceeds the duration of the under one year category. [15] Several asset categories also have effective maturities that differ significantly from the duration of the under one year category. In particular, cash positions appear to have an effective maturity that exceeds that of net assets under one year. [16] As would be expected, net assets over 1 year also exhibit a higher duration than under one year positions. The results for the remaining balance sheet categories tend to be sensitive to whether the BHC-level fixed effects are included in the specification. The hypothesis that the BHC dummies are equal to zero is strongly rejected, suggesting that there may be important

[14] See Demsetz and Strahan (1 995, forthcoming) for a discussion of the relationship between bank holding company asset size and risk.

[15] The finding for demand deposits is consistent with the findings in Flannery and James (1984b). Flannery and James also found evidence that savings deposits had longer effective maturities than positions under one year, but the results in Table 4 do not support this conclusion: the coefficients on both NOW accounts and savings accounts are not significantly different from zero.

[16] This finding is also consistent with the results in Flannery and James(1984b).

cross-sectional differences in BHC interest rate risk exposure that go beyond basic portfolio composition.

The coefficients on the interest rate swaps variable are not significant in either specification of the equation. Unfortunately, given the nature of the derivatives data used in the analysis, it is difficult to interpret this result. On the one hand, the insignificant coefficients could signal that the extent to which BHCs use interest rate swaps has no bearing on their interest rate risk exposure, once portfolio characteristics and asset size have been controlled for. On the other hand, the shortcomings of the available data could be masking an important contribution by these derivatives positions.

Specifically, the notional principal amounts available on the Y-9C reports give no indication of the sensitivity of a particular bank's derivatives contracts to interest rate movements. The impact of a given bank's derivative contracts on its interest rate risk exposure depends crucially on whether the contracts tend to be "pay fixed' or "receive fixed", as well as on other characteristics such as the maturity of the contract and the frequency of the payments. The regression coefficients tend to reflect the average of these characteristics across bank holding companies. Thus, to the extent that BHCs differ in the nature of their derivatives usage, it is possible that the interest rate swaps variable might not enter a regression significantly, even if derivatives play an important role in banks' interest rate risk management.[17]

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[17] It is also worth noting that derivatives enter the regression through another channel. In the Y-9C data, the net marked-to-market value of derivative contracts across all counterparties is included in trading account assets, if the net amount is positive. If the net amount is negative, it is included in other liabilities, a component of net other assets. However, since the contribution of derivatives to these items cannot be broken out separately for most of the sample period, it is difficult to develop a systematic analysis of their influence through this channel.

It is also possible that the coefficient on interest rate swaps fails to enter the equation significantly because the way that banks use such instruments has changed over the course of the sample period. It is certainly the case that the prevalence of derivatives usage by banks increased markedly during the years in question: the notional value of all derivatives held by U. S. commercial banks increased from 38 percent of total assets in 1986 to nearly 400 percent of total assets in 1994 (Berger, Kashyap and Scalise(1995)). This growth is paralleled in the regression sample, where the percentage of observations with positive notional principal amounts for interest rates swaps rose from 63 percent in 1986 to 83 percent in 1994, and the average notional value increased from 42 percent to 100 percent of total assets over the same period.

The growth of derivatives usage by banks suggests that the role played by derivatives in interest rate risk management may have changed over this period. In order to capture these effects, the basic regression analysis is also conducted for each of two sub-periods (1986-90 and 1991-94) that divide the sample period approximately in half. These results are presented in the third through eighth columns of Table 4. The regressions for the later period are also estimated using the notional amounts of all interest rate derivatives and all derivatives (scaled by the market value of equity) as the measures of a BHC's derivatives activities. Given the statistical significance of the BHC-level fixed effects, the discussion that follows will concentrate primarily on the regression specification that includes the fixed effects (the fourth and sixth to eighth columns). Both specifications are reported in the tables, however.

Turning briefly to the results concerning BHCs' on-balance sheet activities, the results suggest that the relationship between these activities and interest rate risk exposures may have changed over the sample period. Overall, the hypothesis that the coefficients on the balance sheet share variables are constant between the two sub-periods is strongly rejected. Changes in the coefficients over the sample period may reflect developments in financial markets that have altered the general interest rate sensitivity of the broad balance sheet categories used in the analysis. [18] For instance, the rise in alternative deposit-like investments such as mutual funds has altered the ability of retail depositors to react to changes in the interest rate environment, which may have affected the interest rate sensitivity of the various core deposit categories.

Turning to the derivatives variables, the regression results suggest that derivatives may have played a significant role in determining BHCs' interest rate risk exposures for at least part of the sample period. As with the results for the entire sample, there is no evidence of a significant relationship between the scale of a BHC's derivatives usage and its interest rate risk exposure during the 1986-90 period. However, the results suggest that increases in the notional amounts of interest rate derivatives at a given BHC were associated with higher interest rate betas during the 1991-94 period. The coefficients on both interest rate swaps and all interest rate derivatives are positive and statistically significant in the 1991-94 regressions. In contrast, the coefficient on total derivatives -- including derivatives based on equity prices, foreign exchange rates, commodity prices and other underlying instruments -- does not enter the equation significantly (though it is positive).

Although the coefficients on the interest rate swaps variable are statistically significant, they suggest that derivatives usage may have had only a marginal impact on the size of the interest

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[18] Note that linking changes in the coefficients with changes in the duration of the various balance sheet categories (relative to under one year positions) assumes that the average ratio of the market to book value for these categories remained relatively constant between the two periods. If this is not the case, then the change in magnitude of the coefficients could be attributable to changes in the market-to-book ratio.

rate betas. In particular, an increase in the interest rate swap variable from the median to the 75th percentile value implies an increase in the interest rate beta of just over 3 percent relative to the average. The impact of an increase of the interest rate swap variable to the 90th percentile value is somewhat larger -- 27 percent of the average interest rate beta. The figures for the equation involving all interest rate swaps are quite similar. These results suggest that although the impact of the derivatives on interest rate risk exposure is meaningful in statistical terms, it might be the case that its economic significance is fairly small.

The figures cited above reflect the average impact of interest rate swaps across all BHCs in the sample. There is reason to believe, however, that the relationship between interest rate risk exposure and interest rate swaps may vary across BHCs of different size groups. Gorton and Rosen (1995), for instance, find that the relationship between the interest rate risk exposures arising from banks' swaps portfolios and from the rest of their activities differs significantly by asset size group. Specifically, their finding that banks' swaps portfolios tend to be hedged by other activities pertains primarily to derivatives dealer banks and other very large (top 30) institutions. More generally, it seems important to consider potential differences in the behavior of the very large institutions that are significant users and dealers in derivatives and other bank holding companies. As discussed above, derivatives activities at U. S. commercial banks are heavily concentrated in a comparatively small number of institutions that serve as dealers to other banks, to non-bank financial institutions and to non-financial end-users. Most of these dealer institutions are included in the sample of 139 BHCs that form the basis of this analysis.

In order to assess the impact of derivatives dealers on the results discussed above, the regressions were run allowing separate coefficients on the interest rate swap variable for bank holding companies of different sizes. Specifically, the observations were segregated into four groups: the nine BHCs with heavy concentrations in derivatives activities[19], BHCs with assets greater than $25 billion but not among the nine dealer BHCs, BHCs with assets between $5 and $25 billion, and BHCs with assets less than $5 billion (all asset figures are in 1994 dollars). The results of these regressions are reported in Table 5. As the table indicates, there appears to be variation across size categories in the impact made by derivatives on interest rate risk exposure in the 1991-94 period. In particular, the coefficients on the interest rate swap variables are significant only for the dealer BHCs and for BHCs with assets under $5 billion. For the intermediate size categories, the coefficients are not statistically significant, although they are positive. Thus, these results suggest that the aggregate findings reported in Table 4 may have been driven primarily by the largest and smallest BHCs in the sample.

The results further suggest that there may be important differences in the magnitude of the impact of changes in interest rate swap usage on the size of the interest rate betas. In particular, an increase in the interest rate swap variable from the median to the 75th percentile value for the nine dealer banks implies an increase in the interest rate beta equivalent to nearly 24 percent of the average for the dealer banks. An increase to the 90th percentile value implies more than a 50 percent increase from this average. In contrast, the implied impact of an increase in derivatives usage is quite a bit smaller for the remaining BHC size categories. For the cohort with assets less than $5 billion, an increase to the 75th percentile value implies more than a 9 percent increase relative to the average beta for these observations. For BHCs with assets between $5 and $25

[19]These BHCs are BankAmerica, Bankers Trust, Chase Manhattan, Chemical, Citicorp, First Chicago, Manufacturers Hanover, J.P Morgan, and Security Pacific.

billion and non-dealer BHCs with assets greater than $25 billion, the comparable figures are 6 percent and 4 percent, respectively. Thus, these results suggest that both in terms of statistical significance and in terms of economic importance, the impact of interest rate swaps on interest rate risk betas appears to be most marked at the nine dealer BHCs and, to a somewhat lesser extent, at comparatively smaller, end-user institutions.

Interpretation of the interest rate swap coefficients

The results described above suggest that, at least for certain categories of BHCs, increases in interest rate swap activity were associated with higher interest rate risk exposures during the latter part of the sample period. At first glance, this result might seem consistent with the idea that for these BHCs, derivatives tend to enhance, rather than to hedge, interest rate risk exposures arising from other activities. This assertion would be consistent with the conclusions of some earlier studies (Gunther and Siems (1995) and Sinkey and Carter (1994)), which argue that banks view interest rate risk exposures arising from on- and off-balance sheet positions as substitutes for one another.

However, there is an alternative interpretation of these results that is consistent the idea that BHCs use derivatives to hedge interest rate risk exposure. Specifically, the positive correlation between interest rate swap activity and interest rate risk exposures could reflect the role of unobserved factors in the regression equation. In particular, there may be characteristics of a BHC's activities that are not captured by the fairly broad balance sheet categories used in the regression equation, but that have significant influence on interest rate risk exposure. If the interest rate risk exposures arising from these factors tend to be offset by the BHC's interest rate swap positions, then this could produce the positive correlation between interest rate swap activity and interest rate risk exposure reflected in the regression results.[20]

In contrast to the first interpretation, in this view the positive coefficients are consistent with the idea that interest rate swaps tend to hedge interest rate risk exposures arising from the BHC's other activities, albeit less than filly. The positive coefficient on the interest rate swaps variable could be interpreted as reflecting increases in the extent of swap activity by a particular BHC as its interest rate risk exposures from other sources increase. In this sense, the coefficient could actually be capturing the impact of other, unobserved portfolio characteristics.

The results in Tables 5 and 6 provide some insight into this issue. In particular, recall that the coefficients on the interest rate swaps variables increase in size and become statistically significant when the BHC-level fixed effects are included in the regression specification. This result is consistent with the idea that there are important BHC-specific characteristics that affect interest rate risk exposure ***and*** that the impact of interest rate derivatives is significant above and beyond these BHC-specific characteristics. Thus, the results suggest that the coefficient on interest rate swaps is not simply reflecting the impact of fixed BHC characteristics that tend to result in higher interest rate risk exposures.

However, these results still leave open the possibility that time-varying BHC factors could be driving the results. To gain further insight, the basic regression equations were re-estimated including a series of additional time-varying variables intended to capture factors aside from basic balance sheet composition that might contribute to changes in a BHC's overall interest rate risk

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[20]For this interpretation to be correct, it would have to be the case that interest rate swaps offset some, but not all, of the impact of the unobserved portfolio factors on the BHC's net interest rate risk exposure.

exposure. The idea behind this exercise is to see whether these additional risk variables eliminate the statistical significance or reduce the size of the interest rate swaps coefficients. In that event, it would be possible to conclude that the interest rate swap variable is indeed proxying for the effects of unobserved portfolio characteristics, and, thus, that the second hypothesis is a reasonable interpretation of the regression results.

These estimates are reported in Table 6. The regression specification includes five additional risk variables, each of which is intended to capture a factor that might contribute to a BHC's interest rate risk exposure. In particular, these additional variables are (1) the volume of 1-4 family mortgages; (2) the volume of the BHC's assets held in its Section 20 (securities underwriting and trading) affiliates; (3) the notional amount of loan commitments outstanding; (4) the volume of investment securities with remaining maturity greater than one year; and (5) the volume of non-performing loans. In the regression, each of these risk variables is scaled by the market value of equity.

As the results in Table 6 indicate, including these additional variables in the regression specification does not eliminate the significance of the interest rate swaps variables. Among the additional risk variables, only mortgage loans enters the equation with a statistically significant coefficient (the coefficient on Section 20 assets is marginally significant when the interest rate swap variable is not broken out by BHC asset size category).

These results fail to provide strong support for the second of the two interpretations discussed above. Even when the additional risk variables are included in the regression specification, the interest rate swaps variables continue to have positive and statistically significant coefficients. For the dealer BHC group, the size of the interest rate swap coefficient is essentially unaffected by the additional risk variables, a result consistent with the idea that swaps tend to enhance the interest rate risk exposures arising from other activities for the typical BHC in this group of institutions. The coefficients for the two intermediate size categories actually increase in this specification, though they remain at best marginally significant. Finally, even though the coefficient for the smallest size category declines sharply (by about 35 percent), it remains positive and significant.

Taken together, these results are consistent with the idea that swaps tend to enhance the interest rate risk exposure arising from other activities for the typical BHC in the sample. However, this conclusion must be tempered by the recognition that the list of additional risk variables included in the regression is hardly exhaustive (though it makes use of much of the relevant data available on the Y-9C reports). Thus, the idea that some other unobserved factor is driving the results cannot be completely dismissed.

Section 5: Summary and Conclusions

The analysis discussed above attempts to link banks' on-balance sheet positions and derivatives activities to their interest rate risk exposure. The main findings of the analysis is that there is evidence that increased usage of interest rate derivatives by a BHC is associated with higher interest rate betas in the 1991-94 period, controlling for balance sheet composition and asset size. This result is strongest for large, dealer BHCs and, to a somewhat lesser extent, for smaller, end-user bank holding companies. These findings are consistent with the results of earlier studies, both in the sense that there is a positive relationship between derivatives usage and interest rate risk exposure and that this relationship varies across banks in different size categories.

This evidence must be used cautiously in drawing conclusions about BHCs' behavior in using interest rate derivatives. On the one hand, this correlation could indicate that swaps are used to enhance interest rate risk exposure by the typical bank holding company in the sample. Alternatively, the positive correlation could reflect the use of swaps to hedge interest rate risk exposures arising from unobserved portfolio characteristics. In practice, it is difficult to conclusively distinguish between these two interpretations of the regression results, although an extended version of the basic regression equation provides support for the first interpretation.

In some sense, however, there may not be a economically meaningful distinction between these two interpretations. Even if the second interpretation is correct -- that interest rate swaps are used to hedge high interest rate risk exposures generated by other activities -- the results suggest that this hedging is not complete. For at least some BHCs in the sample, increases in derivatives usage continue to be correlated with higher-than-average interest rate risk exposures, given the BHC's basic portfolio composition. Whether this correlation results because BHCs deliberately use interest rate swaps to enhance interest rate risk exposure or because BHCs fail to use interest rate derivatives to reduce interest rate risk exposures fully back to “average” levels, the relationship between derivatives usage and interest rate risk exposure remains.

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Table 1
Descriptive Statistics of the Data Set

	1986-94	1986-90	1991-94
Interest Rate Beta			
Average	4.715	5.041	4.143
Standard Deviation	6.237	6.231	6.217
Percent > 0	82.0%	83.9%	78.7%
BHC Asset Size			
Median	9.014	7.848	10.843
Minimum	0.244	0.244	0.307
Maximum	259.5	259.5	254.2
# BHCs	139	139	97
# Observations	944	601	343

Note: BHC asset size is in billions of 1994 dollars.

Table 2
Aggregate Market Model Regressions
Annual Regressions

	1986	1987	1988	1989	1990	1991	1992	1993	1994
Constant	-0.0005 (0.0016)	0.0026 (0.0020)	0.0020 (0.0016)	0.0025 (0.0016)	-0.0083*** (0.0030)	0.0072** (0.0030)	0.0074*** (0.0020)	-0.0001 (0.0020)	0.0016 (0.0013)
Market Return	0.6804*** (0.0763)	0.5645*** (0.0738)	0.2751*** (0.0888)	0.5115*** (0.0856)	0.9242*** (0.1877)	1.0564*** (0.1657)	0.7883*** (0.1602)	1.0926*** (0.1966)	0.8912*** (0.1037)
Interest Rate Term	4.8330*** (0.8648)	6.1126*** (1.1827)	3.1667** (1.2518)	1.1812 (1.5193)	10.251*** (2.4025)	7.5181** (3.0254)	1.0904 (1.6166)	5.4239*** (1.7042)	4.4367*** (1.1246)
Stock Market Crash		-0.2247*** (0.0195)							
R-Squared	0.6932	0.8151	0.2423	0.4252	0.4642	0.4885	0.3303	0.4457	0.6462
# BHCs	134	130	120	112	105	97	89	81	76

•** Indicates Statistical Significance at the 1 percent level.

•* Indicates Statistical Significance at the 5 percent level,

Table 3
Descriptive Statistics
Major Balance Sheet Categories and Derivatives

	Assets				Liabilities		
	1986-90	1991-94	1986-94		1986-90	1991-94	1986-94
Net Assets < 1 Year				**Demand Deposits**			
Average	0.188	0.179	0.185	*Average*	0.160	0.146	0.155
Standard Deviation	0.131	0.135	0.132	*Standard Deviation*	0.051	0.045	0.050
Minimum	-0.438	-0.336	-0.438	*Minimum*	0.024	0.026	0.024
Maximum	0.565	0.560	0.565	*Maximum*	0.501	0.333	0.501
Net Assets > 1 Year				**NOW Accounts**			
Average	0.236	0.274	0.250	*Average*	0.068	0.084	0.074
Standard Deviation	0.107	0.115	0.111	*Standard Deviation*	0.034	0.041	0.038
Minimum	-0.044	-0.075	-0.075	*Minimum*	0.000	0.001	0.000
Maximum	0.819	0.781	0.819	*Maximum*	0.225	0.187	0.225
Cash				**Savings Accounts**			
Average	0.067	0.053	0.062	*Average*	0.199	0.223	0.208
Standard Deviation	0.022	0.018	0.021	*Standard Deviation*	0.066	0.070	0.068
Minimum	0.011	0.010	0.010	*Minimum*	0.008	0.007	0.007
Maximum	0.173	0.139	0.173	*Maximum*	0.410	0.451	0.451
Trading Assets				**Foreign Deposits**			
Average	0.007	0.017	0.011	*Average*	0.044	0.039	0.042
Standard Deviation	0.017	0.051	0.034	*Standard Deviation*	0.084	0.081	0.083
Percent > 0	0.760	0.793	0.772	*Percent > 0*	0.651	0.615	0.638
Maximum	0.173	0.476	0.476	*Maximum*	0.407	0.403	0.407
Mortgage Servicing							
Average	0.001	0.001	0.001				
Standard Deviation	0.001	0.002	0.002				
Percent > 0	0.517	0.685	0.578				
Maximum	0.015	0.017	0.017				
Net Other Assets							
Average	0.032	0.037	0.034				
Standard Deviation	0.017	0.023	0.019				
Minimum	-0.013	-0.119	-0.119				
Maximum	0.162	0.163	0.163				
# Observations	601	343	944		601	343	944

Note: All variables expressed as share of assets.
Net assets under and over 1 year equal loans and securities minus time deposits that reprice or mature In less than or more than 1 year, respectively.

Table 3 (Continued)
Descriptive Statistics
Major Balance Sheet Categories and Derivatives

	Derivatives		
	1986-90	1991-94	1986-94
Interest Rate Swaps			
Average	0.103	0.272	0.165
Standard Deviation	0.323	0.732	0.518
Percent > 0	0.664	0.758	0.698
Maximum	3.136	6.042	6.042
All Interest Rate Derivatives			
Average	n/a	0.638	n/a
Standard Deviation	n/a	1.763	n/a
Percent > 0	n/a	0.805	n/a
Maximum	n/a	13.856	n/a
Total Derivatives			
Average	n/a	1.159	n/a
Standard Deviation	n/a	3.143	n/a
Percent > 0	n/a	0.889	n/a
Maximum	n/a	21.074	n/a
# Observations	601	343	944

Note: All variables expressed as share of assets.

Table 4
Impact of Portfolio Composition on Interest Rate Sensitivity

	1986-1994		1986-1990		1991-1994			
Constant	-12.704***	-20.463	-16.012***	-5.762	-9.028**	-25.530	-31.773	-31.773
	(2.559)	(14.412)	(3.267)	(27.189)	(4.542)	(38.442)	(39.340)	(40.111)
Demand Deposits	1.553***	1.580***	1.972***	1.915***	-0.712	1.043	1.093	0.846
	(0.437)	(0.433)	(0.470)	(0.455)	(0.881)	(1.517)	(1.496)	(1.519)
NOW Accounts	-0.028	-0.801*	0.078	-0.454	-0.290	-2.264	-2.415	-2.513
	(0.392)	(0.478)	(0.475)	(0.604)	(0.929)	(2.681)	(2.714)	(2.729)
Savings Accounts	-0.268	-0.244	-0.278	-0.348	-0.236	-1.311**	-1.246**	-1.152**
	(0.244)	(0.293)	(0.217)	(0.223)	(0.495)	(0.573)	(0.547)	(0.550)
Interest-Bearing	0.078	-0.021	-0.027	-0.360	0.592**	0.544	0.464	0.431
Foreign Deposits	(0.124)	(0.210)	(0.117)	(0.301)	(0.263)	(0.453)	(0.458)	(0.495)
Cash	1.784***	2.199***	2.022***	2.411***	-2.698	-4.025	-4.044*	-3.952
	(0.490)	(0.348)	(0.524)	(0.366)	(2.121)	(2.481)	(2.465)	(2.463)
Trading Assets	0.051	-0.778*	0.634	0.557	0.147	-1.727	-2.499	-0.978
	(0.313)	(0.442)	(0.679)	(1.137)	(0.321)	(1.497)	(1.600)	(1.583)
Mortgage	-9.057	-15.807***	3.427	-10.853*	-20.244***	-23.183***	-24.579***	-22.819***
Servicing Rights	(5.610)	(5.373)	(4.741)	(5.875)	(7.066)	(8.812)	(8.898)	(8.650)
Net Earning Assets	0.292***	0.222**	0.321***	0.307***	0.320**	-0.158	-0.141	-0.156
Over 1 Year	(0.079)	(0.096)	(0.086)	(0.108)	(0.151)	(0.212)	(0.213)	(0.215)
Net Other Assets	0.740**	0.166	1.221***	0.419	0.219	0.674	0.678	0.443
	(0.303)	(0.311)	(0.419)	(0.545)	(0.427)	(0.769)	(0.800)	(0.815)
Log Asset Size	1.110***	1.586**	1.335***	0.751	0.936***	1.958	2.316	2.299
	(0.159)	(0.805)	(0.204)	(1.509)	(0.266)	(2.187)	(2.243)	(2.290)
Interest Rate Swaps	0.011	-0.012	0.027	0.010	0.025	0.122***		
	(0.485)	(0.033)	(0.024)	(0.030)	(0.033)	(0.044)		
All Interest Rate							0.065**	
Derivatives							(0.028)	
All Derivatives								0.014
								(0.019)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BHC Fixed Effects	No	Yes	No	Yes	No	Yes	Yes	Yes
R-Squared	0.401	0.512	0.474	0.627	0.368	0.548	0.547	0.544
# Observations	944	944	601	601	343	343	343	343

Note: Standard errors in parentheses. The standard errors have been corrected for generalized heteroskedasticity using the correction in White (1980).

***Significant at the 1% level. **Significant at the 5% level. * Significant at the 10% level.

Table 5
Impact of Portfolio Composition on Interest Rate Sensitivity
Interest Rate Swap Coefficients by Asset Size

	1986 - 1994		1986 - 1990		1991 - 1994	
Constant	-12.621***	-22.454	-15.499***	2.608	-9.167*	-19.630
	(2.627)	(14.158)	(3.280)	(26.927)	(4.725)	(36.297)
Demand Deposits	1.565***	1.568***	1.981***	1.838***	-0.732	1.129
	(0.440)	(0.438)	(0.462)	(0.478)	(0.877)	(1.489)
NOW Accounts	-0.068	-0.731	-0.071	-0.573	-0.283	-2.582
	(0.378)	(0.493)	(0.464)	(0.631)	(0.926)	(2.622)
Savings Accounts	-0.267	-0.247	-0.278	-0.347	-0.229	-1.282**
	(0.247)	(0.297)	(0.215)	(0.243)	(0.497)	(0.582)
Interest-Bearing Foreign Deposits	0.063	-0.056	-0.047	-0.471	0.597**	0.453
	(0.123)	(0.212)	(0.115)	(0.328)	(0.276)	(0.459)
Cash	1.816***	2.198***	2.087***	2.447***	-2.678	-4.003
	(0.484)	(0.356)	(0.496)	(0.372)	(2.115)	(2.601)
Trading Assets	0.010	-0.806*	0.573	0.058	0.145	-1.704
	(0.305)	(0.444)	(0.651)	(1.179)	(0.317)	(1.469)
Mortgage Servicing Rights	-9.252*	-15.538***	1.590	-14.241**	-21.336***	-23.304**
	(5.443)	(5.215)	(4.819)	(6.109)	(7.441)	(9.239)
Net Earning Assets Over 1 Year	0.293***	0.218**	0.322***	0.306***	0.314**	-0.149
	(0.078)	(0.094)	(0.085)	(0.105)	(0.151)	(0.222)
Net Other Assets	0.718**	0.210	1.085***	0.212	0.202	0.588
	(0.285)	(0.303)	(0.406)	(0.550)	(0.418)	(0.811)
Log Asset Size	1.103***	1.748**	1.295***	0.364	0.938***	1.598
	(0.163)	(0.793)	(0.206)	(1.491)	(0.278)	(2.050)
Interest Rate Swaps						
Nine Dealer BHCs	0.013	-0.009	0.032	0.021	0.025	0.106**
	(0.023)	(0.034)	(0.024)	(0.031)	(0.035)	(0.044)
BHCs with Assets Greater than $25 Bill	-0.045	-0.143	0.017	-0.218	0.094	0.166
	(0.130)	(0.153)	(0.123)	(0.177)	(0.197)	(0.293)
BHCs with Assets $5 to $25 Billion	0.154	0.273	0.489	0.963	0.104	0.346
	(0.199)	(0.219)	(0.546)	(0.672)	(0.227)	(0.299)
BHCs with Assets Less Than $5 Billion	-0.488	0.277	-0.779	-0.883	0.720	2.044***
	(0.645)	(0.680)	(0.478)	(0.793)	(0.729)	(0.792)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
BHC Fixed Effects	No	Yes	No	Yes	No	Yes
R-Squared	0.403	0.513	0.478	0.632	0.370	0.553
# Observations	944	944	601	601	343	343

Note: Standard errors in parentheses. The standard errors have been corrected for generalized heteroskedasticity using the correction in White (1980).

*** Significant at the 1% level, ** Significant at the 5 % level, * Significant at the 10% level.

Table 6
Impact of Additional Risk Variables on Interest Rate Swap Coefficients
1991 to 1994

Risk Variable		
Mortgage Loans	1.468** (0.748)	1.538** (0.739)
Section 20 Assets	2.278* (1.207)	1.288 (1.139)
Loan Commitments	-0.114 (0.179)	-0.176 (0.180)
Securities > 1 year	0.162 (0.494)	0.185 (0.498)
Nonperforming Loans	0.265 (0.427)	0.335 (0.432)
Interest Rate Swaps		
All BHCs	0.113** (0.047)	
Nine Dealer BHCs		0.099** (0.045)
BHCs with Assets Greater than $25 Bill		0.365 (0.287)
BHCs with Assets $5 to $25 Billion		0.482 (0.321)
BHCs with Assets Less Than $5 Billion		1.294* (0.786)
R-Squared	0.558	0.562
# Observations	343	343

Standard errors in parentheses. The standard errors have been corrected for generalized heterskedasticity using the correction in White (1980). All regressions control for portfolio shares and asset size, and include BHC and year fixed effects.

*** Significant at the 1 % level. ** Significant at the 5 %. level.
* Significant at the 10% level.