Derivatives-Hedging, Risk Allocation, and Cost of Debt: Evidence from Bank Holding Companies

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Abstract

Consistent with Froot and Stein's (1998) model and Schrand and Unal (1998), we find evidence supporting the risk allocation hypothesis in bank holding companies (BHCs). Banks reduce their exposure to tradable risk (interest rate and foreign currency risks) via derivatives-hedging and simultaneously extend more loans and take greater credit risk in lending (their main area of expertise). This risk allocation strategy is associated with an increase in overall bank risk, measured by the cost of debt, before the 2007-2009 financial crisis but this relationship breaks down during the crisis. Moreover we find that hedging allows banks to extract greater rents from their bank-dependent borrowers, conditional on bank reputation and lending relationship.

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Derivatives can be described as double-edged swords as they can be used for both hedging and speculation. Earlier literature suggests that hedging may be used as a risk reduction tool to minimize cash flow volatility in order to enhance shareholder value (Smith and Stulz, 1985; Froot, Scharfstein, and Stein, 1993). Some recent studies such as Schrand and Unal (1998) demonstrate, however, that hedging is used as a risk allocation technique by thrift institutions. Specifically, in a world of capital market imperfection where increasing total risk is costly, hedging allows these institutions to reduce their exposure to tradable (homogenous) risk, (e.g., interest rate and exchange rate risks), that yields low or no economic rents, and to simultaneously increase their exposure to the types of risk in which they have a comparative advantage (e.g., credit risk) and from which they can earn high economic rents. We denote this risk substitution practice as "risk allocation". Along similar lines, Froot and Stein's (1998) theoretical model suggests that active risk management through unloading of tradable risk allows banks to hold less capital and to invest more aggressively.

As financial intermediaries, banks face many types of risk such as interest rate, foreign currency and credit risks, and are subject to capital requirement and other restrictions imposed by the regulators. In this study, we employ the risk allocation framework discussed above to empirically investigate whether derivatives-based hedging allows banks to allocate risk across different risk categories. In particular, we examine how derivatives-based hedging affects banks' total risk as reflected in the cost of debt, and whether it enables banks to engage in lending activities in a larger scale, to take on greater credit risk and to extract higher economic rents from

their lending business.[1] Lastly, we investigate whether the risk allocation mechanism held up or was altered in nature during the 2007-2009 financial crisis.

We focus on the banking industry for the following reasons. First, U.S. banks are major users of financial derivatives; they held notional derivatives of $16.8 trillion in 1996 and $213 trillion in 2009, demonstrating a twelvefold increase over this period.[2] Second, banks are required by the regulators to report their derivatives usage in significantly more detail than non-financial firms, providing a rich source of data for analysis of the subject. Third, derivatives usage of banks has major risk implications on their own stability, stability of the financial system as a whole and, consequently, performance of the entire economy.

Several interesting results are obtained, all consistent with the risk allocation paradigm. First, we find that hedging-derivatives are not related to the cost of debt financing in bank holding companies (BHCs) if the data for the entire sample period of 1996-2008 are used, suggesting that derivatives-hedging does not reduce banks' overall risk. Further sub-sample analysis shows, however, that hedging-derivatives had a positive effect on the cost of debt during the period prior to the financial crisis of 2007-2009 but a negative effect afterwards. Second, we find that greater derivatives-hedging is associated with greater overall lending relative to the banks' total assets and a greater fraction of commercial and industrial (C&I) loans in total bank loans. We also document that derivatives-hedging allows banks to take on greater credit risk in lending. These findings suggest that banks allocate risk between tradable interest/exchange rate risks and their core-business risk (credit risk) in order to further their intermediation activity (their main area of expertise). Third, we document that hedging allows banks to extract higher

[1] High economic rents in the credit market are attributed to the fact that, as delegated monitors, banks have comparative advantages in the lending market (Diamond, 1984). Banks are also considered to be "unique", allowing them to charge higher loan rates (e.g., Fama, 1985).

[2] These figures are based on the Office of the Comptroller of the Currency's Quarterly Report on Bank Trading and Derivatives Activities for the 4th quarter of 2009.

reputation and lending-relationship rents, manifested as greater loan-spreads charged to bank-dependent borrowers, namely those who do not have access to the public debt market and are, hence, subject to greater information monopoly problems described in Rajan (1992). These findings may explain why banks held derivatives-based hedging positions in the pre-crisis period in spite of the fact that these derivatives raised their cost of debt. The rationale is that hedging-derivatives allow banks to benefit from greater economic rents extracted from a larger scale of lending and lending to borrowers with poorer credit quality.

Fourth, and more interestingly, we find that the risk allocation channel broke down after the onset of the 2007-2009 crisis, unraveling the pre-existing channel of association between hedging, lending and credit risk. During the pre-crisis period, hedging-derivatives enabled banks to increase lending and to lend to poorer quality borrowers, with the increase in lending risk more than counter-balancing the reduction in the interest and exchange rate risks associated with hedging. This risk substitution practice resulted in a significantly positive relation between BHC hedging and its cost of debt. During the crisis period, this dynamics broke down because credit risk became the dominant concern of the banks and the rising counterparty risk cast a shadow of doubt over the reliability of the hedging positions, rendering the credit supply channel of derivatives-hedging ineffective, and disallowing an increase in the lending level and lending credit risk through the hedging channel. As a result, the force of increasing credit risk due to hedging became smaller than the reduction in interest rate and currency risks associated with hedging, leading to a negative relationship between hedging and cost of debt.

There are several studies which are related to our research. Schrand and Unal (1998) conduct an empirical test of 'risk allocation' theory based on a sample of mutual thrifts that converted to stock institutions. They find that after conversion, stock thrifts exhibited a greater

level of total risk and the increase was achieved by hedging interest rate risk and elevating credit risk. Similarly, Brewer, Minton, and Moser (2000), and Cebenoyan and Strahan (2004) find that banks with active risk management through interest rate derivatives or loan sales, hold a greater level, and experience a greater growth rate, of C&I loans. These results all suggest that hedging leads to improved intermediation efficiency, allowing banks to increase their lending and elevating their credit risk.

Our paper differs from the above studies in the following ways. First, we employ a comprehensive methodology which controls for endogeneity of BHC derivatives positions within a risk allocation framework. In this framwork, we examine how hedging affects a BHC's cost of debt (a measure of BHC risk), its total lending level and its credit risk structure (lending mix).[3,4] Second, we go beyond the extant studies by examining how hedging allows banks to extract higher economic rents from lending to bank-dependant borrowers, conditional on bank reputation and lending relationship. Third, we investigate whether and how the risk allocation mechanism breaks down during the 2007-2009 financial crisis, namely whether the credit supply channel of derivatives-hedging becomes ineffective.

The remainder of paper is organized as follows: Literature review and hypotheses are presented in section 1, data, sample selection, and methodology are described in section 2, and empirical results are presented in section 3. Section 4 examines how the relationships investigated were altered during the financial crisis and section 5 concludes.

[3] Brewer, Minton and Moser (2000) control for endogeneity of derivative use but focusion the relationship between interest rate derivatives and C&I loan growth. Cebenoyan and Strahan (2004) do not control for endogeneity when testing how loan sales are used as a risk management tool. Schrand and Unal (1998) test the risk allocation paradigm in a unique setting when mutual thrifts convert to become stock thrifts.

[4] Cost of debt has an advantage over other risk measures in that it is market-based and forward looking in assessment of banks' overall risk. Book-based measures are backward looking and fail to reflect future changes in risk. In addition, the debt market is chosen over the equity market because bank debt securities play a major role in financing BHC activities and also because the corporate debt market is among the largest securities markets in the world. Moreover, bonds have more precise payouts and are less subject to the criticism that their pricing may be affected by misspecification of the asset pricing model employed (Elyasiani, Jia, and Mao, 2010).

1. Literature Review and Hypothesis Development

Market imperfections such as taxes, agency costs, information asymmetry, regulatory burden, and costly financial distress provide a rationale for firms to manage their risk exposure (e.g., Smith and Stulz, 1985; Geczy, Minton and Schrand, 1997). Empirical evidence on corporate use of derivatives to hedge risk is limited due to the lack of data on derivatives (Hentschel and Kothari, 2001). Banks, however, are an exception in this regard since they are required to report their derivatives activities in detail when they file the Call Reports. Bank managers have incentives to manage risk through derivatives positions and other strategies because they must comply with regulatory requirements and they also wish to strengthen depositors' confidence. Moreover, banks can potentially use derivatives as a technique to curtail tradable risk to be able to raise their core-business risk, where they can earn higher rents, as a way of ameliorating performance. In this study, we take advantage of the data availability on derivatives in the banking industry to empirically investigate whether hedging-derivatives alter bank risk as reflected in the cost of debt, and whether they allow banks to alter their risk composition in order to extract additional economic rents from their activities.

Smith and Stulz (1985) show that hedging reduces firm's cash flow volatility, and, consequently, lowers the expected financial distress costs, resulting in a lower cost of debt. Froot, Scharfstein and Stein (1993) theorize that hedging can curtail the under-investment problem when a firm faces growth opportunities, and a high cost of external financing, because it can free the hands of the managers to pursue optimal investment and higher growth objectives by generating sufficient internal funds. Froot and Stein (1998) argue that, due to market frictions, it is costly for banks to raise new external funds on short notice. Hence, they should hedge any risks that can be offloaded on fair market terms, i.e., interest rate risk, exchange rate risk, etc., to

facilitate external fund raising. These factors can reduce bank risk, and, thereby, the cost of debt. Thus we propose the following hypothesis (H_{1A}):

H_{1A}: Hedging-derivatives are negatively associated with the cost of debt in BHCs.

However, hedging may also lead to an increase in banks' risk, and, thereby, an increase in their cost of debt, because of the banks' desire to allocate risk so as to maximize returns. Well-hedged-banks may take greater credit risk in lending markets in order to better exploit their comparative advantage as delegated monitors (Diamond, 1984). Schrand and Unal (1998) argue that when increasing total risk is costly due to regulatory constraints, financial firms optimally reallocate risk by reducing (increasing) exposure to risks that provide zero (positive) economic rents.[5] Along these lines, banks earn rents for bearing risks related to activities in which they have a comparative advantage (core-business risk), e.g., lending in C&I loans.[6] By contrast, they earn zero economic rents in efficient markets for bearing financial or commodity risk (homogeneous risk). Thus, we also propose the following hypothesis (H_{1B}). Due to the counter-balancing forces leading to these two hypotheses, how hedging affects the cost of debt in BHCs is an empirical question.

H_{1B}: Hedging-derivatives are positively associated with the cost of debt in BHCs.

According to Schrand and Unal (1998), hedging may allow banks to shift interest rate and foreign exchange risk to credit risk in lending markets to better exploit their comparative advantage as delegated monitors (risk allocation). Froot and Stein's (1998) theoretical model also

[5] Schrand and Unal (1998) find that as mutual thrifts convert to stock institutions (or their risk-bearing abilities and incentives increase), they raise their total risk by hedging interest rate and increasing credit risks. Brewer, Minton, and Moser (2000) show that banks using interest-rate derivatives, experience greater growth in their C&I loans.

[6] Banks use limited credit default swap (CDS) to hedge credit risk. According to Minton, Stulz, and Williamson (2009), only 23 large banks out of 395 sample banks used CDS during 1999-2005 and most of their derivatives positions were held for dealer activities, rather than for hedging of loans. The net notional amount of credit derivatives used for hedging of loans in 2005 represents less than 2% of the total notional amount of credit derivatives held by banks and less than 2% of their loans. Stulz (2010) suggests that a possible reason why banks' use of CDS to hedge is limited is that, while the CDS market is very liquid for large companies, it is usually not liquid for small companies to which banks lend.

suggests that active risk management in unloading tradable risk allows banks to hold less capital and to invest more aggressively. Purnanandam (2007) finds that when there is a macroeconomic shock, such as a contraction in money supply, banks using derivatives continue to lend, while derivative non-user banks cut their lending activities significantly, suggesting that hedging improves a bank's intermediation capability. Along these lines, Brewer, Minton, and Moser (2000) point out that, according to Diamond (1984) model, usage of derivatives allows banks to hedge the systematic risk in their loan portfolios, enabling them to reduce their delegation costs and, as a result, to intermediate more effectively. As such, we propose:

> *H_2: Hedging-derivatives allow banks to engage in their area of expertise (lending) more aggressively.*
>
> *H_3: Hedging-derivatives allow banks to take on greater credit risk in lending.*

To further test the risk allocation hypothesis, we investigate whether hedging allows banks to earn higher economic rents in lending. According to Rajan (1992), private lenders such as banks have monitoring advantages over dispersed arm's-length debt-holders.[7] These lenders may take advantage of this monopoly position to "hold up" their borrowers and to collect greater informational rents (greater loan-spreads) from the borrowers through this channel.[8] On the other hand, banks with a stronger lending relationship with the borrowers can better monitor the borrowers, reduce the lender-borrower information asymmetry, and, thereby, limit the consequent moral hazard problem and riskiness of the loans.[9] Therefore, the association between prior relationship lending and loan-spread reflects two countervailing forces: cost saving due to

[7] Specifically, the private information that the bank gains through monitoring offers it some monopoly power over the borrowers, allowing it to "hold up" these borrowers as captive customers.
[8] Santos and Winton (2008) document evidence that banks earn informational rents through this "hold up" channel.
[9] Petersen and Rajan (1994) and Berger and Udell (1995) find that repeated lending reduces information asymmetry between the lender and the borrower, leading to a lower loan-spread. Ivashina (2009) also documents that prior relationship lending is associated with a lower loan-spread.

relationship lending, and rent extraction due to hold-up power. The net effect is to be determined empirically.

Purnanandam (2007) suggests that hedging enhances firm value by allowing banks to maintain their core business in lending under adverse macroeconomic environments (i.e. tightened monetary policy), while non-hedged-banks are forced to curtail their loans. We argue that this feature also makes hedged-banks more desirable to borrowers because borrowers want reliability with loan renewals and problem loan workout arrangements and hedged-banks are more likely to provide them. As a result, hedged-banks will have a greater "hold up" power and a stronger ability to earn a relationship rent in the form of a higher loan spread. Borrowers will be willing to pay the higher relationship rents because of the desirable features of the hedged-banks. Accordingly, we propose:

H_4. Hedging allows banks to earn a larger relationship rent (loan-spread).

Dennis and Mullineaux (2000), and Lee and Mullineaux (2004) argue that more reputable lead-arrangers may command a lower loan-spread (offer a reputation discount) due to their wider network of contacts and better skills in extracting and assessing private information and monitoring the borrowers, resulting from their specialization and stronger negotiating power with the syndication. Hence, they can monitor at a lower cost and can pass on some of the savings to the borrowers. On the other hand, Chemmanur and Fulghieri (1994) argue that just as lenders look for safe and sound borrowers, borrowers also look for sound lenders that can be helpful at the time of the borrowers' financial distress, in the form of debt renegotiation or providing additional funding to help them overcome their financial difficulties. Borrowers are willing to pay these lenders higher interest rates (reputation premium) to benefit from these privileges.

Thus, the impact of bank reputation on loan-spread also reflects two countervailing forces: lower costs associated with higher reputation and better skills in information collection, and higher costs associated with commitment for debt renegotiation and future lending when borrowers are in financial distress. Since derivatives-hedging allows banks to extend more loans and to sustain their lending level when it matters most (under tighter market conditions and borrowers' financial distress, according to Purnanandam, 2007), hedged-banks are likely to demand a larger reputation premium. Therefore, we present the following hypothesis:

H_5. Hedging allows banks to earn a larger reputation rent (loan-spread).

In Rajan (1992), informational monopoly is due to the information advantage that an "insider" bank gains via prior lending-relationship over an "outsider" bank (or other types of lenders) that did not work with the borrower before. The information advantage is smaller for borrowers with access to the public debt market (bank-independent borrowers) because these borrowers can, at least partially, substitute public debt for bank loans, as a result of which they display a more price-elastic demand for loans. Compared to bank-independent borrowers, banks can leverage their insider position (lending-relationship) to offer less discounts, or to extract greater informational rents from bank-dependent borrowers who have no access to the public debt market. Bank-dependent borrowers may still have access to other banks and they will choose the bank which will be there for them when they are in need, and they will be willing to pay a higher rate to such a bank. Thus, we reformulate the above propositions as follows:

H_6. Hedging allows banks to earn greater reputation and relationship rents from bank-dependent borrowers.

2. Data, Sample Selection, and Methodology

2.1. Data and Sample Selection for the Analysis of the Lending Mix

We start with a dataset on publicly traded banks and BHCs complied by the Federal Reserve Bank of New York. This dataset documents the historical linkage between regulatory

entity codes from the BHC database, or Bank Call Report, and the permanent company number (permco) from the CRSP database. There are a total of 887 publicly traded banks and BHCs from this dataset between 1990 and 2007. We use the permco from this dataset as an input to extract data from the CRSP database for 1990-2007, and obtain 871 permnos associated with 895 unique entity codes.[10] The analysis on lending mix, e.g., percentage of lending in C&I loans and real estate (RE) loans, is based on all the bank holding companies that have relevant data available from Bank Call Report during 1996-2008. There are a total of 798 unique BHCs and 23,593 bank quarter observation in our final sample.

2.2. Data and Sample Selection for the Analysis on Cost of Debt

To construct a sample of corporate bonds issued by BHCs, we match the 895 banks and BHCs with the Mergent Fixed Investment Securities Database (FISD) using CUSIP, and obtain 136 unique banks and BHCs that have bond information available in FISD. Since our study focuses on BHCs, we drop the 20 publicly traded banks and are left with 116 BHCs.

Mergent's Fixed Investment Securities Database (FISD) is a comprehensive collection of publicly offered U.S. Corporate bond data, which is divided into two major parts. The first part includes issue-specific and issuer-specific information (e.g., callability, sinking fund provision, credit rating) on all U.S. corporate bonds maturing in 1990 or later. The second part offers trading information from the National Association of Insurance Commissioners (NAIC) on buy and sell transactions by life and property/casualty insurance companies, and Health Maintenance Organizations (HMOs) starting 1994.[11] According to the Flow of Funds Accounts published by

[10] The reason we have more entity codes than permnos is that some financial firms have the same permno and permco, but different entity codes due to merger and acquisition or BHC/subsidiary relationship. For example, Franklin Bank, N.A. and Franklin Bancorp, Inc. have the same permno and permco but different entity codes, because the former is the banking subsidiary of the latter. Another example is Bay View Capital Corporation and Great Lakes Bancorp, Inc. that share the same permno and permco but different entity code, because Great Lakes merged with Bay View in 2005, and the merged institution retained the name Bay View Capital Corporation.

[11] We do not use the TRACE bond transaction database since it covers bond transactions starting in the year of 2002.

the Federal Reserve, insurance companies hold about one-third of the corporate bonds outstanding in the U.S. (Schultz, 2001). Thus, the NAIC database is adequately representative of corporate bond transactions (Campbell and Taksler, 2003).

Following Bessembinder et al. (2009), we compute the daily bond price as the weighted average of all buy and sell transaction prices on a given day with each transaction being weighted by its size. This approach puts more weight on the institutional trades that incur lower execution costs and, hence, should reflect the underlying price of the bond more accurately. The bond prices so constructed allow us to compute the daily bond yield, given the bond's coupon rate and frequency, par value and time to maturity.[12] Since the BHC database is on quarterly frequency, we need to identify quarter-end transactions for each bond issued by the 116 BHCs. Since many bonds are not traded every day, and liquidity varies across bonds, we employ various windows to identify quarter-end prices. For each bond, we try to identify a transaction price that is within a (-30, 30) window (30 days before and after the quarter-end) and closest to each quarter-end during 1996-2008. We also try different time windows such as (-15, 15) and (-10, 10), and find qualitatively similar results. Our results, reported in the next sections, are based on the (-30, 30) window and trade-size weighted prices described above. To be included in the analysis, we require that each bond has issue-specific information, credit rating, and sufficient price information around the quarter end. These requirements reduce our sample size of BHCs from 116 to 66. >>> Finally, we retrieve derivatives usage and other bank-specific information from the BHC database during 1996-2008, and daily stock returns from the CRSP database. Our final sample of analysis on cost of debt contains 4,582 bond-quarter observations of 556 bonds

[12] An alternative way for construction of daily bond prices is to eliminate all trades under $100,000 that tend to be non-institutional trades, and then weigh each trade by its size across the trades of $100,000 or more that occurred in the day. Bessembinder et al. (2009) document that trades of $100,000 or more account for 96.7% of bond trading volume. We follow the approach above because it allows us to retain a larger number of observations. We exclude bonds that are convertible, private placement, or in bankruptcy.

issued by those 66 BHCs.[13] A list of the 66 BHCs is provided in the appendix A1. Since many BHCs do not have public bonds outstanding or bond pricing information available and, therefore, are not included in the cost of debt analysis, this sample is much smaller than the sample used for the lending mix analysis.

2.3. Model Specification and Variable Construction

We examine the effect of hedging-derivatives on BHCs' cost of debt, lending activities, and credit risk taking associated with lending. The choice of a bank's derivatives position, however, is an endogenous decision and must be modeled accordingly. Sinkey and Carter (2000) show that banks using derivatives are riskier in their capital structures, have larger maturity mismatches between their assets and liabilities, possess greater net loan charge-offs, and earn lower net interest margins. Derivatives and bank risk may display mutual interdependence because, on one hand, increased use of derivatives for hedging or speculation purposes affects bank risk, and in turn, the cost of debt; and on the other hand, bank risk level may affect the choice of the scale of derivatives usage. Specifically, the use of derivatives for hedging may result in a lower or a higher level of risk. The risk level, however, may also encourage banks to take additional derivative positions in order to achieve the target level of risk.

To address the endogeneity problem, we employ a simultaneous equations system framework in which derivatives and cost of debt (or lending variables) are both treated as endogenous variables. Following Purnanandam (2007), we use "derivatives skills" of a bank as the instrumental variable for its derivatives position. If a bank uses credit derivatives as a guarantor, then derivatives skill takes the unit value, otherwise zero. The choice of this

[13] The analysis on asset mix is based on all the BHCs that have relevant data available from Bank Call Report during 1996-2008. As such, the number of observations for asset mix analysis in section 3.3 is 23,593, much larger than the sample of 4,582 observations for cost of debt analysis in section 3.2. This is because many BHCs do not have public bonds outstanding, and, therefore, are not included in the cost of debt analysis in the previous section.

instrument is motivated by the fact that BHCs with positions in credit derivatives market as guarantors are most likely to have all the skills needed to engage in interest rate and foreign currency derivatives. We also carry out our tests using several other instruments. For example, we use the median and 75% value of credit derivatives as guarantor as cutoff points to define derivatives skill. We also use the lagged market share (with one quarter lag) of a bank's notional value of non-trading derivatives as an alternative instrumental variable. The main results are similar to what we have reported here. Yield-spread is instrumented by its own one quarter lagged value. We estimate our system of equations, described below, using a two-stage least square (2SLS) technique:

(1A)

(1B)

In Equation 1A, derivatives are modeled as a variable to be predicted by its determinants. In Equation 1B, the predicted value of the derivatives from equation 1A is used as a regressor to determine the bond yield-spread. In addition to yield-spread and derivative market share, following Sinkey and Carter (2000), we also include the BHC size (Size), stock return volatility (Volatility), net interest margin (NIMargin), capital adequacy ratio (Capratio), and a dummy variable for being a derivative dealer (Dealer) as determinants of derivatives use in Equation 1A. The Dealer dummy takes the unit value if the notional amount of derivatives contracts held for trading purpose is equal to or greater than 75 percentile of the sample BHCs in each sample year, and zero otherwise (threshold values other than 75% produced similar results). We also control for time fixed effects by using year dummies in the model. In Equation 1B, Yield-spread is

defined as the difference between bond yield and the yield of a matched Treasury security with similar coupon rate and maturity. Bond yield is computed based on quarter-end bond prices. Following Angbazo (1997), Sinkey and Carter (2000), and Purnanandam (2007), we use notional values of derivatives for purposes other than trading scaled by total assets as a proxy for hedging.[14, 15]

Following Deng, Elyasiani, and Mao (2007) we include the following firm-specific variables in the model: Firm-size, Profitability, Leverage and Earnings Volatility. Firm- size is the logarithm of total assets, Profitability is measured by return on assets (ROA), Leverage is total debt divided by total assets, and Earnings Volatility is the standard deviation of quarterly ROA based on a 5-year rolling window. Bond-specific variables include Issue-size, Credit rating, Maturity, and Bond age. Issue-size is the logarithm of the amount of bond outstanding (in thousand dollars). Credit rating is based on Moody's or Standard and Poor (S&P)'s credit rating.[16] Similar to Reeb, Mansi and Allee (2001), we adopt a conversion scale in which D-rated bonds receive a value of 1 and AAA+ rated bonds are assigned a value of 23. As such, the lower the numerical value, the poorer the credit quality, and the higher the bond yield-spread is expected to be. Maturity is the length of time in years before the bond matures. Based on the liquidity premium theory, securities with longer maturities are expected to have greater risks and larger premiums. Therefore, we expect a positive relationship between maturity and yield-spread. Bond age is the length of time (in years) since the bond was issued.

[14] Based on OCC's Quarterly Report on Bank Trading and Derivatives Activities, derivatives contracts are concentrated on interest rate products; they comprise 84% of total derivatives' notional value. It is also notable that banks often use other risk management tools that are not included in these data (e.g., interest rate caps).

[15] Hentshel and Kothari (2001) have pointed out that the notional values of derivatives positions are only approximate proxies for the size of the exposures. Two examples clarify this point. First, in these measures call options deep in the money and those deep out of the money are treated similarly, although the former denotes a much higher exposure. Second, in these measures, swaps with different maturities are treated similarly, although longer term swaps have higher exposures.

[16] For the credit rating data, Moody ratings, if unavailable, S&P ratings, and if unavailable, Fitch ratings are used.

In addition to the above bond-specific variables, following Bhojraj and Sengupta (2003), we also include three dummy variables to control for bond-specific features: callable, putable, and covenant. Each of these variables takes a value of one, respectively, if the bond is identified, in the Mergent FISD, as callable, putable, and subject to covenant restriction, and zero otherwise. Since investors demand a call interest premium, we expect a positive relationship between the call dummy and the yield-spread. Put provision allows bondholders to sell bonds to the issuer at pre-specified strike prices. Thus, it lowers the yield-spread. Bonds with covenants are expected to reduce default risk and, hence, to be negatively related to the bond yield-spread. We also include year dummy variables in the model to control for any time fixed effects.

3. Empirical Results

3.1. Sample Statistics

Table 1 presents summary statistics for the sample of the lending mix analysis. The mean (median) value of total assets is $10.1258 (0.4382) billion, and the average (median) of total equity value is $0.8379 ($0.039) billion. The average (median) of total loan (TLoan) to asset ratio is 63.02% (64.49%), and the average commercial & industrial (C&I) loan ratio and real estate (RE) loan ratio to total loans (TLoan) is 17.79% (63.8%). Nonperforming loans (loans past due 90 days or more), on average, constitute 0.93% of total loans. The corresponding figures for C$ILoans and RELoans are about 1.33% and 0.96%, respectively.

---Insert Table 1 about here

Table 2 reports summary statistics for the sample used for the cost of debt analysis. Among the bond-specific variables, reported in Panel A, the average bond yield (yield-spread) of our sample is 5.79% (1.05%). The yield-spreads here are smaller than those of a broader sample of industrial firms used in Reeb, Mansi, and Allee (2001), whose average stands at 2.17%. This is because BHCs benefit from FDIC insurance, they are considerably larger and better-rated

(with an average credit rating of 'A+') than industrial firms, and the biggest ones enjoy the 'too big to fail' provision. The average maturity of the bonds in our sample is 10.5 years, the average issue-size is $646.74 million, and the average bond age is about 3 years.

Panel B reports summary statistics on firm-specific variables included in the cost of debt analysis. Our sample is populated mostly with very large and highly leveraged BHCs. The mean (median) of total assets is $212.11 ($65.12) billion, and the average (median) of total equity is $16.47 ($6.06) billion. The average (median) of capital to asset ratio is 9.21% (8.31%), the average (median) standard deviation of daily stock return (Return Volatility), measured quarterly, is 1.89% (1.62%) and the average (median) net interest margin (NIMargin) is 2.4% (2.19%). As for the derivatives usage, the mean (median) of gross notional amount of derivative contracts held for non-trading purpose (Hedging-derivatives) is $61.70 ($5.82) billion. Our derivatives figures are much larger than those reported in Clark, Delisle, and Doran (2008), in which the mean of non-trading derivatives is $18 billion. The difference is due to the facts that the BHCs in our sample are much larger than theirs, with average total assets of $212.11 billion, compared to $70.3 billion, and that large BHCs tend to engage more heavily in derivatives activities.

---Insert Table 2 about here

3.2. Derivatives Hedging and BHCs' Cost of Debt

The 2SLS estimation results of the simultaneous equation system are reported in Table 3.[17] Panel A shows the results on the determinants of hedging-derivatives. In this panel, we find that hedging-derivatives are negatively and significantly related to yield-spread, suggesting that riskier BHCs (BHCs with a higher cost of debt) engage in less derivatives hedging. The significance of the coefficient estimates on yield-spread in equation 1A confirms that it is

[17] While we use 2SLS as an estimation method, 3SLS procedure offers similar results.

important to take into account the bidirectional relationship between yield-spread and banks' derivatives usage. Derivatives skill, the instrumental variable, is significantly and positively related to hedging-derivatives providing support for the use of the former variable as an instrument for the latter.

Regression results describing the cost of debt as functions of derivatives used for hedging purposes (equation 1B) are reported in panel B. We find that, interestingly, the cost of debt is insignificantly associated with hedging-derivatives. This supports hypothesis H_1, purporting that the two variables are unassociated. One explanation is that while hedging via derivatives reduces the interest rate and currency risks of the banks, it might also increase some other sources of risk, such as credit risk, by allowing banks to make more loans and to choose loans with greater credit risk, with the purpose of better exploiting their comparative advantage in information collection and effective monitoring. These countervailing forces cancel out one another, rendering an insignificant association between the cost of debt and hedging-derivatives. We will explore the impact of bank hedging on bank credit risk in the subsequent sections.

The positive and significant coefficient estimate of the lagged yield-spread in equation 1B indicates positive serial correlation in bond yield-spread. Cost of debt is found to be insignificantly related to both bank size and profitability. The coefficient estimate of earnings volatility is significantly positive as expected, indicating a higher cost of debt for firms with more volatile earnings. Consistent with our expectations, yield-spread is also positively related to bond maturity and bank leverage because they are associated with higher risk. Issue-size is insignificant. The coefficient estimate on bond credit rating is negative and significant, as better-rated bonds have lower default risks and, hence, command a lower rate of return. Bond age also exerts a negative effect. The coefficient estimates on the callable dummy is significantly

positive, as expected, indicating a call interest premium. The putable dummy is significantly negatively associated with the cost of debt. The explanation is that putable bonds give bondholders the option of selling the bonds back to the issuers which puts the bondholders at advantageous positions. Therefore, investors are willing to hold these bonds with a lower return (cost of debt). Covenant dummy is negative but insignificant. In summary, we find that hedging-derivatives have an insignificant impact on the cost of debt when the entire sample is used.

---------Insert Table 3 about here----------

3.3. Hedging and BHCs' Lending

Froot and Stein (1998) present a theoretical model on how financial market frictions affect banks' lending and risk-taking decisions. The implication of their model is that active risk management (i.e., unloading the tradable risk on fair terms by hedging transactions) allows banks to invest more aggressively. In this section, we examine how BHC hedging affects its loan level, loan mix and credit risk.

3.3.1. *Hedging and Lending Mix*

According to our hypothesis H_2, we expect the loan to asset ratio, and the share of C&I loans in total loans, to increase at the expense of liquid assets and/or other loan categories, as a result of hedging. The point here is that hedging allows banks to switch to their area of greatest expertise (C&I loans) where their comparative advantage is strongest. To address the endogeneity of hedging, we estimate a system of simultaneous equations (2A-2B) using the 2SLS technique:

(2A)

(2B)

In equation 2B, the asset mix variables include the share of total loans in total assets and the shares of C&I and RE loans in total loans, used alternatively. Based on the FDIC loan portfolio breakdown data, the largest categories of loans are RE and C&I Loans, accounting for 53% and 20%, respectively, of the total loans for the large banks in 2007 (Saunders and Cornett, 2008). Besides, C&I loans constitutes the main area of expertise of the commercial banking enterprise. Hence, we focus on the shares of these two types of loans in the total loan portfolio, and the share of total loans relative to total assets.

Following Brewer, Minton, and Moser (2000), we include the following regressors as the determinants of the asset mix variables; size, deposits, trading activity, capital, net interest margin, funding gap and GDP growth. Size is the BHC asset size. We expect larger BHCs to lend more relative to their total asset size, at the expense of liquid assets and other loan categories such as RE Loans. Deposit is the ratio of deposits over total assets. BHCs with more deposits usually make more loans because core deposits are highly reliable as a source of funding. Trading is the ratio of trading account assets over total assets. There is a substitution effect between trading assets and loans, as trading, lending, and cash assets add up to total assets. Hence, we expect the coefficient of Trading to be negative. RiskCapRatio is the ratio of risk-based capital over total assets. If BHCs with low capital ratios adjust their lending to meet some target capital ratio in order to fulfill regulatory requirement, we would expect a positive relationship between capital ratio and lending.

We expect BHCs with greater net interest margin (NIMargin, net interest income/earning assets), to lend more, and, hence, we expect a positive coefficient for this variable. GAPRatio is the short-term (one-year) funding gap ratio (rate-sensitive earning assets less rate-sensitive interest bearing deposits and debt)/total assets. BHCs with higher GAPRatio have better liquidity

positions and can lend more. Therefore, we expect a positive coefficient for the GAPRatio. GDPGrowth is the quarterly GDP growth rate and is included to control for macroeconomic effects. For brevity, we only present the results for equation 2B in Panel A of Table 4.

We find that total loans as a ratio of total assets, and C&I loans as a share of total loans, are both positively and significantly related to hedging-derivatives, while the reverse holds for RE loans as a share of total loans. These findings indicate that hedging leads to more total lending and, in particular, more C&I loans, which is the main area of expertise of commercial banks, at the expense of liquid assets and other loan categories including real estate loans, which are long-term and collateralized. Moreover, the decline in the share of RE loans is highly desirable to banks, when a better opportunity arises, because these loans constitute by far the largest share of the loans and the longest in terms of term to maturity, and, therefore, their relative reduction lowers the concentration risk, as well as interest rate risk of the bank. These results support our hypothesis H_2 suggesting a shift to more lending activities and greater share of C&I loans in total loans in response to hedging. The regulatory implication is that excessively restrictive regulations on derivatives used for hedging might limit bank lending, especially in the area of C&I loans, contributing to tight monetary conditions in the market place (credit rationing) and higher frequency of credit crunches.

The positive effects of derivatives on totals and C&I loans, showing that hedged-banks make a greater amount of loans for a given asset size and more C&I loans for a given level of total loans, indicate that banks likely hedge their exposures to interest rate and currency risks to be able to expand more loans and to switch to the area of lending where their expertise lies. The findings of increase in C&I and decline in RE loans are consistent with Lummer and McConnel (1989) who find that banks are unique but their advantage occurs at the time of loan renewal,

rather than at the initial stage of lending and new loans. It follows from their findings that bank superiority is applicable only to commercial loans, which are based on customer relationship and are subject to ongoing renewals, rather than RE loans which are long-term single-case transactions.[18]

The magnitude of the coefficient estimates on hedging-derivatives are 0.1297, 0.1414, and −0.1687 in total loans, C&I and RE loans, respectively, suggesting that an increase of one standard deviation in hedging-derivatives leads to an increase of 3.99% and 4.36% in total loan and C&I loan ratios, and a decrease of 5.2% in RE loan ratio.[19] Since the average total assets of the sample BHCs is $9.963 billion,[20] this is equivalent to an increase of $397.52 million and $434.38 million in total loans and C&I loans, and a decrease of $518.08 million in RE loans for a BHC. This indicates that the impact of hedging-derivatives on bank lending is not only statistically significant, but also economically significant.

Among the control variables, size is positively associated with both total loans and C&I loan ratio, but negatively associated with RE loan ratio. These findings indicate that large banks make more loans, and a bigger (smaller) share of their loans is in C&I (real estate) loans. This is indeed what we observe with the largest banks, and in particular the money center banks (Cornett and Saunders, 2008), as they orient themselves towards wholesale and large commercial loans. The deposit/asset ratio (Deposits) is positively associated with total loans and C&I loans, indicating that BHCs with more deposit financing make more C&I and total loans. BHCs with larger trading assets positions are found to make more C&I loans but less RE and total loans.

[18] The idea of banks being "unique" or "special" was proposed in a theoretical paper by Fama (1985) and then tested by James (1987). Lummer and McConnell (1989) distinguished between new loans and loan renewals.

[19] These figures are computed by multiplying the STD of hedging-derivatives (0.308) by the coefficient estimates (0.1297, 0.1414, and −0.1687) in the models, giving the economic impacts of 3.99%, 4.36% and −5.2%.

[20] Note the sample size for the loan mix analysis is larger than that of the cost of debt sample, but the average bank size in the loan mix sample (average total assets is $9.963 billion) is smaller than that in the cost of debt analysis (average total assets is $212.211 billion), as only larger banks issue bonds.

This group of BHCs is generally among the largest in size and oriented more towards large C&I loans and non-traditional activities.

BHC risk-based capital ratio is negatively associated with total loans but has no significant impact on C&I or RE loan ratios, areas of special expertise and loan concentration of the banks. These banks may be the ones which are more heavily engaged in wholesale activities such as off balance sheet products and guarantee services. BHCs with higher net interest margin make more total loans and less C&I loans and RE loans. The higher net interest margin is an indication of greater profitability of lending and, hence, conducive to increased loans in general. However, this increase is found not to occur in either C&I or RE loans. BHCs with higher interest rate risk, as measured by wider 12-month repricing gaps, make less RE loans, but more C&I loans as well as total loans. This result is intuitive; BHCs with wider repricing gap try to shorten the gap by making less long-term (RE) loans and more short-term (C&I) loans, in order to limit their interest risk exposure. GDP growth is negatively associated with RE and total loans, and positively associated with C&I loans. This latter result is an indication that the boom phase of the business cycle leads to larger C&I loans because of higher loan demand and lower borrower default expectations.

---------Insert Table 4 about here----------

3.3.2. Hedging and Credit Risk

In the previous section, we found that hedging allows banks to lend more for a given level of assets and to increase the share of their C&I loans. Growth in loans is known to raise the riskiness of banks (Foos, Norden and Weber, 2010). In this section we take a step further to investigate how financial hedging affects the quality of loans in terms of credit risk. In other words, we investigate whether hedging allows banks to allocate risk by offloading tradable risk

and taking a greater level of credit risk, as argued in our hypothesis H_3. The underlying assumption is that in this way banks might be able to extract greater economic rents in lending not only by making more loans but also by making loans with greater credit risk in which they have a comparative advantage in information gathering and monitoring (Diamond, 1984).

We use non-performing loan ratios as proxies for BHC credit risk. Non-performing loans include loans past-due 90 days or more and still accruing, and nonaccrual loans. We construct the non-performing total loan, C&I loan, and RE loan ratios (Nonperform, C&INonperform, and RENonperform) to proxy for the credit risk of total, C&I, and RE lending, respectively. As in the previous section, we then assess how hedging affects each of the bank credit risk variables using a simultaneous equations framework shown below:

(3A)

(3B)

This system of equations is estimated using the 2SLS technique. Results of equation 3B are reported in Panel B of Table 4. According to the figures in this table, nonperforming total loans and nonperforming C&I loans are both significantly positively related to hedging-derivatives but nonperforming RE loans are unassociated with these derivatives. These findings indicate that BHCs with larger hedging positions take on greater credit risk in general and greater credit risk from C&I loan market in particular. Banks seem to take more aggressive lending positions in order to raise their credit risks, in the hope of increasing their rent revenues. These findings support our hypothesis H_3, suggesting that hedged-banks take higher credit risk.

The magnitude of the coefficients on hedging-derivatives in total credit risk and C&I loan credit risk, proxied by nonperforming loan ratios, is 0.0098 and 0.0171, suggesting that an

increase of one standard deviation in hedging-derivatives leads to an increase of 0.3% and 0.5% in total non-performing loan ratio and C&I nonperforming loan ratio, respectively.[21] Given that the sample mean of total loans is $5.367 billion, the 0.3% (0.5%) total non-performing loan ratio (C&I nonperforming loan ratio) is equivalent to $16.1 ($26.84) million total non-performing loans (C&I nonperforming loans), which is also economically significant. According to these results, derivatives-hedging serves as a vehicle for banks to allocate risk by switching from tradable risks, such as interest rate and exchange rate risk, to credit risk where they have a niche and, hence, an opportunity to extract greater rent as discussed below (risk substitution).

3.4. Hedging and Loan-Spread: The Role of Bank Reputation and Lending-Relationship

The results above support the risk allocation proposition purporting that banks hedge their tradable risk and simultaneously increase their lending and take on greater credit risk by choosing riskier borrowers. A related question is whether these lending activities do indeed generate greater economic rents in the form of greater loan-spreads. We investigate this issue by examining the association between hedging and the loan-spread charged by the banks making syndicated loans. We obtain syndicated loan data from the Dealscan database provided by the Loan Pricing Corporation, which contains detailed information on bank loans worldwide (including term-loans and lines of credit), such as borrower and lender identities, loan amounts, LIBOR spread, issuing and maturity dates, financial and general covenants, etc.[22] Lenders in a syndicated loan include lead-arrangers and participant banks. All lenders are bound by a single loan contract and subject to identical loan terms. We link the Dealscan and the Compustat

[21] This figure is computed by multiplying the STD of hedging-derivatives in the sample (0.308) by the coefficient estimate (0.0107) in the regressions, which gives the economic impact of about 0.33%.

[22] About 60% of Dealscan data are collected from Security Exchange Commission (SEC) filings and the rest are obtained from direct contact with borrowers and lenders. According to Carey and Hrycay (1999), the Dealscan database covered between 50% and 75% of commercial loans in the U.S. by 1992, and a greater fraction by 1995.

database using a name link file compiled by Chava and Roberts (2008).[23] Loan-specific, borrower-specific and bank-specific information (e.g., the amount of derivatives) are obtained, respectively, from Dealscan, Compustat, and the BHC data bases. Since syndicate structure and loan contract terms (e.g., loan amount, maturity, pricing) differ across different facilities in a deal, our analysis is conducted at the facility level. After merging the three databases and deleting the observations with missing values, we end up with a sample of 4,442 facilities during the sample period 1996-2008.

Bank loan-spreads are determined by a number of borrower-specific, loan-specific and lender-specific characteristics. Hence, following Ivashina (2009), we employ the model below (equation 4B) to describe the loan-spread, measured by the All-In-Drawn Spread over LIBOR (Loan-spread) obtained from the DealScan database.[24]

(4A)

(4B)

Since the lead-arranger(s) makes the most important decisions about the loans, in this model lender-specific variables are based on lead-arranger(s) characteristics including Hedging-derivatives, Leadshare, Reputation, and LendingRelation.[25] Hedging-derivatives are again measured by the predicted notional value of derivatives used by the lead-arranger for non-trading purpose, as estimated from equation 4A. Leadshare is the percentage of loans retained by the lead-arranger (s) in the syndicated loans. Following Bharath, Dahiya, Saunders, and Srinivasan

[23] We would like to thank Michael R. Roberts for kindly providing us the Dealscan-Compustat link file.
[24] All-In-Drawn Spread is the amount a borrower pays the lender each year in basis points over LIBOR for each dollar borrowed from term loans, and for each dollar drawn down a credit line from loan commitments.
[25] In cases when there are several lead-arrangers, we use the lead-arranger with the largest market share.

(2007), we measure Reputation by the lead-arranger's market share (loans arranged by the lead-arranger divided by total loans issued in the entire market) in the prior year. LendingRelation is the strength of the lender-borrower relationship, measured by a particular lender's share of a particular borrower's borrowing (loans arranged by bank i and its predecessors for borrower j/total borrowing by borrower j) during the prior five-years.

As argued in the description of hypotheses H_4, H_5, and H_6, hedged-banks can maintain their core business in lending under adverse macroeconomic shocks, while un-hedged banks have to curtail their lending (Purnanandam, 2007). This feature makes hedged-banks more desirable to borrowers because borrowers want reliability with loan renewals and problem loan workout arrangements and hedged-banks are more likely to provide them. As a result, hedged-banks are in a better position to extract a reputation and/or relationship rent in the form of a higher loan spread, in particular for bank-dependent borrowers that do not have access to the public debt market. To examine the above hypotheses, we introduce an extended model by including interaction terms, Derivative×Reputation and Derivative×LendingRelation, in equation 4B. We expect a significantly positive coefficient on these interaction terms, particularly in bank-dependent borrowers.

Among the control variables, Firm-size is the natural logarithm of the book value of assets; Leverage is computed as the book value of debt divided by total assets; Profitability is net income divided by total assets (ROA); and Insolvency risk is the Altman (1968) Z-score.[26] Loan-specific variables include Loansize, Maturity, Secured status, Seniority, FinCovenant, GenCovenant, and PerformPricing. LoanSize is the logarithm of the dollar amount of the loan; Maturity is the logarithm of the loan maturity in years; Secured and Seniority are dummy

[26] Following Altman (1968), Z-score is computed based on Compustat items as follows: 1.2*data179/data6 + 1.4*data36/data6 + 3.3*data178/data6 + 0.6*(data199*data25/data181) + data12/data6.

variables indicating whether the loan is secured or has a senior status; FinCovenant and GenCovenant are the number of financial and general covenants in the loan; and PerformPricing is a dummy variable for loans with performance pricing scheme (loan-spread tied to a firm's performance measure, e.g., credit rating). In addition, we also include a set of year dummies to control for any time effects.

The regression results for equation 4B are presented in Table 5. As shown in column 1, the significantly negative coefficient estimate of Leadshare is consistent with prior studies indicating that a larger share of the lead-arranger is associated with a lower loan-spread. The coefficient estimate of the LendingRelation is also significantly negative, suggesting that the strength of prior lending-relationship between the BHC and the borrower reduces information asymmetry, resulting in a lower loan-spread. However, neither the hedging variable nor the lead-arranger's reputation is significantly associated with the loan-spread (column 1). One explanation may be that these variables exert non-linear effects on the spread (e.g., in the form of interaction with other variables) so that the model is subject to the omitted variable problem.

----------Insert Table 5 about here----------

To investigate the non-linearity issue, in column (2) of Table 5, we introduce interaction terms between hedging and reputation (Hedging×Reputation) and hedging and lending-relationship (Hedging×LendingRelation**).** This extended model demonstrates how the effect of hedging-derivatives on the loan-spread may vary conditional on the lead-arranger's reputation and prior lending-relationship. We find that, both interaction terms are positive and significant, suggesting that hedging is associated with a greater economic rents (loan spread), conditional on bank reputation and lending-relationship. This result supports our hypotheses H_4 and H_5.

To investigate hypothesis H_6,we partition our sample into two subgroups of loans to bank-dependent and non-bank-dependent borrowers. Bank-dependent borrowers are those that have never issued public debt before, and non-bank-dependent borrowers are those who did. Results are presented in columns (3) and (4) of Table 5, respectively. Interestingly, the coefficient estimates for the interaction terms (Hedging×Reputation), and (Hedging× LendingRelation) are found to be both significantly positive for the bank-dependent sub-sample but not for the bank-independent sub-sample. This indicates that hedging allows more reputable banks, and banks with stronger prior lending-relationship, to extract greater informational rents, but only from bank-dependent borrowers.[27] These results lend support to our hypothesis H_6. The results on the control variables are in general consistent with prior studies (e.g., Berger and Udell, 1990; Beatty, Ramesh, and Weber, 2002; Santos and Winton, 2008; Ivashina, 2009).

4. The Effect of Hedging Before versus After the Onset of the Financial Crisis

The U.S. economy experienced a major financial crisis between the second half of 2007 and summer of 2009. Since our sample period partially overlaps with the financial crisis period, one intriguing question is whether the risk allocation mechanism held up during the financial crisis. More specifically, whether hedging continued to allow banks to unload tradable risk and take on greater credit risk during the crisis, and how hedging affected firm risk, lending level and mix and credit risk discussed earlier. We examine these issues below.

4.1. Financial crisis, hedging and cost of debt

In this section, we examine how hedging affects firm risk, proxied by cost of debt, during the financial crisis. To this end, we introduce a crisis dummy, which takes the unit value for the

[27] More specifically, hedging-derivatives have a negative effect on the loan-spread but this effect grows smaller in magnitude as banks reach higher and higher levels of relationship lending, possibly becoming positive at a certain point as they feel more confident about their monopoly power over the clients and charge greater and greater spreads. Higher and higher levels of reputation also increase the loan–spread in a similar manner

time period between July 2007 and December 2008 (end of the sample period), and zero otherwise. This serves as an intercept shift in the cost of debt equation in response to the crisis. We also include an interaction term between derivatives and the crisis dummy in order to capture the difference in the impact of hedging on the cost of debt before and after the onset of the crisis (slope shift).

The results on the model of determinants of bond yield-spread are reported in Table 6. The crisis intercept dummy is positive and significant, suggesting that banks' cost of debt increased during the crisis period, because of changes in risk as well as increased risk premia. More interestingly, the coefficient estimate on hedging-derivatives is significantly positive with the interaction term Hegding×Crisis Dummy being negative and significant. These findings suggest that hedging increased the cost of debt during the period prior to the financial crisis but the positive association between the two attenuated after the crisis began. To assess the overall effect of derivatives on the cost of debt during the crisis period, we test whether the sum of the coefficients for hedging-derivatives and (hedging-derivatives×Crisis dummy) is significantly different from zero using an F-test. We find this sum to be negative and statistically significant (F value of 10.00), implying that, during the crisis period, derivatives-hedging is associated with a significant reduction in the cost of BHC debt.

----------Insert Table 6 about here----------

The increase in the cost of debt in the pre-crisis period in response to hedging stands in contrast to Froot et al. (1993) who argue that corporate firms hedge in order to avoid costly external financing. We find that increased hedging not only fails to reduce the cost of external financing, it even increases it. As we discussed earlier, the overall impact of bank hedging on the cost of debt is dependent on two countervailing forces: the reduction in banks' tradable risk such

as interest rate and currency risks, and the increase in credit risk of the lending portfolio. The significant difference in the impact of hedging before and after the crisis, documented in Table 6, reflects a change in the relative strength of these two driving forces during the financial crisis. From the financial system point of view, our results suggest that regulatory concerns over banks' use of derivatives are valid because a by-product of financial hedging is banks' steps to increase credit risk, which heightens their overall risk and could destabilize the financial system. In the next section, we explore how the effects of derivatives-hedging on the lending level and the loan mix change when we enter the financial crisis period.

4.2. Financial crisis, hedging and asset mix

Results on the differential effects of hedging on bank asset mix before versus after the onset of the financial crisis are presented in Panel A of Table 7. The coefficient estimates of the hedging variable in the Total loan to asset ratio (TLoan), and C&I loan as fraction of total loans are positive and significant, while the coefficient of RE loan as a share of total loans is negative and significant. These results are similar to those reported in Table 4 indicating that hedging is associated with higher total loan to asset and higher C&I loan to total loan ratios prior to the financial crisis. The crisis intercept dummy is insignificant in all the regressions, indicating the absence of a one-time shift in these three variables during the crisis. The interaction term between the hedging variable and the crisis dummy is significantly negatively associated with total loans and C&I loans but it is positive and significant for RE loans, indicating that the positive (negative) effects of hedging on the total and C&I loans (RE loans), found for the pre-crisis period, all weaken during the crisis.

To assess the overall effect of hedging on loans during the crisis period, we test whether the sum of the coefficients for Hedging-derivatives and the interaction term (Hedging×Crisis

dummy) differs from zero. This sum is found to be positive and significant for the total loan (Tloan), but insignificant for the C&I loan and RE loans (F values of 6.53, 0.92 and 0.16, respectively). These findings suggest that during the crisis period, hedged-banks could make more loans for a given asset size, than the unhedged-banks, but not to the extent they could before the crisis.[28] Nevertheless, it is notable that in the light of the rising loan to asset ratio in response to hedging, the quantities of hedged-bank C&I and RE loans do rise during the crisis, even though their shares in total do not, because total loans increase and the latter two ratios remain unchanged.

One possibility is that the state of crisis made the interest rate and exchange rate hedging positions less effective in boosting loans because these positions did not cover credit risk, which was the key concern of banks and dominated all else during the crisis period. With millions of mortgages defaulting or becoming of little value, and the economy believed to be headed towards recession, banks predicted that the same could happen to their commercial loans. Given the depth of the crisis, the magnitude of the credit risk was perceived to be so huge that hedging of the interest and exchange rate risks seemed small consolation in the eyes of the bankers. Moreover, the counterparty risk in the over-the-counter derivatives positions, e.g., interest rate and exchange rate swaps, increased during the crisis period as the counter parties, including other commercial banks, saving banks and insurance companies, were in financial distress. This made the derivatives positions less reliable and even suspect as a vehicle for hedging, rendering them ineffective.[29] As a result, hedging with over-the-counter derivatives might not have been

[28] One possibility for the weaker association between hedging and lending is that firms might use far less derivatives to hedge during the crisis period. However, we find that the extent of derivative usage is similar before and after the crisis. The mean of derivatives for non-trading purpose before the crisis is $1,632 billion or 1.47% of total assets, while the mean value during the crisis is $1,841 billion or 1.69% of total assets.

[29] It is notable that swaps constitute a large share of the derivatives used by banks. Specifically, data for the 4th quarter of 2008 show that the 75% quartile of the interest rate and exchange rate swaps out of total gross notional amount of derivative contracts held for both trading and non-trading purposes stood at 85%.

perceived to reduce as much risk, thus banks may not have increased lending or taken on greater credit risk in lending to the same degree during the crisis as during normal economic times. This explains why the impact of hedging on lending and credit risk weakened during the crisis.

To understand the lack of a decline in total loans, relative to total assets, given the generally observed unavailability of credit during the crisis, we have to distinguish new loans, which did fall, from the overall loans reported on the balance sheet. This is because the latter reflect the loans based on loan commitments, as well as the inability of banks to securitize and to sell their loans. In this context, Chari, Christiano, and Kehoe (2008) document that, from September to mid-October 2008, while syndicated lending did fall, C&I loans reported on the aggregate balance sheet of the U.S. banking sector actually rose by about $100 billion from a base of about $1.5 trillion. Ivashina and Scharfstein (2009) find that this increase was not driven by an increase in new loans, but rather by an increase in draw-downs by corporate borrowers on existing credit lines or loan commitments. Cornett et al. (2011) also report that banks with stable sources of funding (core deposits and capital) did indeed increase lending during the crisis, though the same was not true of banks relying on wholesale sources of funding (debt financing). Takedowns from outstanding loan commitments also strengthened during this period, in effect displacing new credit origination.[30]

4.3. Financial crisis, hedging and credit risk

In Panel B of Table 7, we examine the effect of the financial crisis on the association between credit risk and hedging by introducing intercept and slope dummies for the crisis period. The coefficient estimates of the hedging variable remain significantly positively related to total nonperforming loans and C&I nonperforming loans, but are insignificantly related to RE

[30] These authors provide an example; American Electric Power drew down $3 billion from a credit line issued by J.P. Morgan and Barclays to increase its cash holding as a precautionary step and to achieve flexibility.

nonperforming loans. The crisis intercept dummy is not significantly associated with any of the three credit risk measures, suggesting the lack of a one-time shift in credit risk in response to the crisis. The interaction term between derivatives and crisis dummy, however, is negative and significant for total nonperforming loans, suggesting that hedging is less effective in emboldening BHCs to take additional credit risk during the crisis, than in the pre-crisis period. In other words, the power of derivatives in persuading BHCs to take advantage of their expertise in monitoring, or in encouraging banks to make riskier loans weakens significantly during the crisis, further contributing to liquidity problems and distress for the type of businesses who need it most. This in turn results in curtailment of economic activity and furthering of unemployment.

Additional F-tests indicate that the sum of Hedging-derivatives and Hedging×Crisis dummy coefficients is insignificant for all three models (F-values are 0.24, 2.24 and 0.38, respectively). These results suggest that during the crisis period, hedging of the interest rate and exchange rate risks indeed failed to exert an impact on the BHC credit risk level for all three credit risk measures used here because hedged-banks were reluctant to lend to borrowers with greater credit risks or counterparty risk.

Our findings of the impact of derivative hedging on banks' lending pattern in Table 7 offer a rationale for the differential impact of hedging we observed on the cost of debt before versus after the financial crisis. During the period prior to the crisis, derivative hedging allowed banks to allocate risk by unloading tradable risk while conducting more lending activities and taking on greater credit risk in the lending market. As a result, the higher lending risk dominated the reduction of banks' cash flow volatility due to financial hedging, leading to a significant positive relation between hedging and the cost of debt in BHCs. However, due to the dramatic changes in the credit market and the rising counterparty risk during the crisis, the risk allocation

mechanism broke down in that hedging of interest rate and currency risks did not permit banks to conduct more lending activities or take on greater credit risk as they did before the crisis. As a result, the force of increasing credit risk through hedging became smaller in the crisis period than the reduction in cash flow volatility, leading to a negative relationship between hedging and the cost of debt.

----------Insert Table 7 about here----------

5. Conclusions

In this study, we empirically test the risk allocation hypothesis using a sample of publicly traded BHCs. In particular, we examine how derivatives-hedging affects banks' total risk as reflected in the cost of debt, and whether derivatives-hedging enables banks to engage in lending activities in a larger scale, to take on greater credit risk, and to extract higher economic rents from their lending business, conditional on their reputation and relationship lending. Lastly, we investigate whether the risk allocation mechanism held up during the recent 2007-2009 crisis.

We document that, in general, derivatives-hedging allows banks to unload tradable risk and to take on more credit risk in the lending market, which is consistent with the risk allocation predictions in Froot and Stein (1998) and Schrand and Unal (1998). Moreover, we find that, better-hedged banks with higher reputation or prior lending relationship extract greater economic rents from bank-dependent borrowers. Interestingly, the risk allocation mechanism broke down during the financial crisis in that hedging did not allow banks to increase their lending to the same extent as it did prior to the crisis, or to take on greater credit risk. As a result, the credit risk increase through hedging became smaller than the reduction in cash flow volatility in the crisis period, leading to a negative relationship between hedging and the cost of debt. Our findings suggest that banks do not hedge to reduce risk as often argued in the literature, instead

they use derivatives-hedging as a technique to allocate risk, namely to shift risk from tradable risk to credit risk, which is their niche and allows them to extract rents from their clients. These channels of effect, however, weaken or vanish during the crisis because of greater uncertainties faced by the BHCs and heightened counter-party risk.

Several implications can be drawn from our menu of findings. First, BHCs have to take into account the effect of their hedging-derivatives activities on their cost of debt because the market does incorporate this information in pricing of their debt. Second, derivatives are not necessarily a pure menace as sometimes pictured; not only they can be used to help improve the soundness of the banking institutions, if bank managers choose to do so, they can also help the availability of loans overall as well as loans to borrowers with greater credit risk. On the other hand, derivatives positions designed for hedging have a potential to increase BHC risk and may harm the firm and even the system.

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Table 1. Summary statistics of the sample for lending mix analysis

This table reports sample statistics corresponding to the lending mix analysis. TLoan is loan to asset ratio (Total loans/Total assets); C&I loan is commercial & industrial loan ratio (Commercial and industrial loan/Total loans); RE loan is real estate loan ratio (Loans secured by real estate/Total loans); Nonperform is non-performing loan ratio, measured by loans and leases past due 90 days or more and still accruing and nonaccrual/total loans; C&INonperform is nonperforming C&I loan ratio (nonperforming C&I loans/total C&I loans); RENonperform is nonperforming real estate loan ratio (nonperforming real estate loans/ total real estate loans).

	Mean	Median	St.D.	Min	25th	75th	Max
Total assets ($bil)	10.1258	0.4382	74.7036	0.0378	0.2423	1.3536	2251.5
Total equity ($bil)	0.8379	0.039	6.229	-0.011	0.0227	0.1167	177
TLoan	0.6302	0.6449	0.1238	0.0517	0.5610	0.7161	1.1822
C&Iloan	0.1779	0.1534	0.1086	0.0000	0.1059	0.2239	0.8724
REloan	0.6380	0.6601	0.1680	0.0000	0.5441	0.7572	1.061
Nonperform %	0.0093	0.0066	0.0111	0.0000	0.0035	0.0115	0.3165
C&INonperform %	0.0133	0.0071	0.0217	0.0000	0.0023	0.0156	0.7428
RENonperform %	0.0096	0.0058	0.0139	0.0000	0.0026	0.0114	0.2666

Table 2. Summary statistics of the sample for the cost of debt analysis

This table reports summary statistics for our sample. Yield is the raw yield of the bond; Yield-spread is bond yield minus the yield of a treasury security with similar coupon rate and maturity. IssueSize is the amount of bond outstanding (in million dollars). We adopt a conversion scale in which Aaa+ (or AAA+) rated bonds are assigned a value of 23 and D-rated bonds receive a value of 1; Bond age is the length of time (in years) since the bond was originally issued; Maturity is the length of time (in years) before the bond matures. Call, put, redeem, and covenant are dummy variables that take a value of one if the bond is callable, putable, redeemable, and subject to covenant restrictions, respectively, and zero otherwise. Total assets are the book value of total assets (in million dollars); Total equity is the book value of total equity (in million dollars); Capratio is capital ratio, total equity/total assets; Volatility is the standard deviation of daily stock return over a quarter; Earning volatility is the standard deviation of ROA over a 3-year rolling window; NIMargin is net interest margin (Net interest income/Total earning assets); The hedging-derivatives variable, a proxy for hedging, is measured by total gross notional amount of derivatives contracts held for non-trading purposes, divided by total assets.

Panel A. Bond-specific variables (N=4582)

	Mean	Median	St.d.	Min	25th	75th	Max
Yield (%)	5.7889	5.7734	1.2017	1.7207	5.0363	6.699	14.0111
Yield-spread (%)	1.0547	0.8411	0.7733	0.0006	0.5865	1.2900	9.3135
Issue size ($mil)	646.737	400	643.076	1.144	200	1000	4500
CreditRating (Aaa+=23)	17.8959	18	1.7142	11	17	19	21
Bond age (years)	2.9718	2.4438	2.4123	0	1.011	4.4082	14.7041
Maturity (years)	10.5018	10.0219	5.7119	3.0247	7.0219	10.0548	30.0658
Call	0.215	0	0.4108	0	0	0	1
Put	0.0199	0	0.1395	0	0	0	1
Covenant	0.8492	1	0.3579	0	1	1	1

Panel B. BHC-Specific variables (N=1091)

	Mean	Median	St.D.	Min	25th	75th	Max
Total assets ($bil)	212.211	65.124	377.172	0.688	29.1563	192.032	2,358.27
Total equity ($bil)	16.468	6.054	28.119	0.05	2.639	16.677	162.691
Capratio	0.0921	0.0831	0.0621	0.0301	0.0743	0.0941	0.7349
Return volatility	0.0189	0.0162	0.0115	0.0037	0.0117	0.0223	0.1210
Earnings volatility	0.0040	0.0037	0.0028	0.0000	0.0031	0.0044	0.0359
NIMargin	0.024	0.0219	0.0132	0.00341	0.0119	0.0322	0.101
Hedging-derivatives	0.1798	0.0832	0.308	0	0.0075	0.2132	2.7434

Table 3. Simultaneous equation system model of derivatives and cost of debt

This table reports the results of a system of simultaneous equations regressions on derivatives and bond yield-spread (Equations 1A-1B). Derivative skill is a dummy variable which takes the unit value if a BHC uses credit derivatives as guarantor, otherwise zero. Dealer is a dummy variable, which takes the unit value if the Total gross notional amount of derivative contracts held for trading is more than 75% of the sample each year, zero otherwise. Other variables are defined as in Table 2. T-statistics are reported in parentheses below each coefficient. *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

Panel A Determinants of hedging-derivatives		Panel B Determinants of yield-spread	
Variable	Hedging-Derivatives	Variable	Yield-spread
Intercept	0.0619 (0.67)	Intercept	0.4070 (0.81)
Yield-spread	-0.2035*** (-8.70)	Hedging-derivatives	0.0602 (0.56)
Derivative skill	0.1233*** (7.82)	Lagged yield-spread	0.2261*** (15.88)
Size	0.0062 (1.26)	Size	0.0094 (1.16)
Volatility	0.3117 (0.45)	ROA	2.4360 (1.31)
NImargin	4.5685*** (11.62)	Leverage	1.4613*** (3.02)
Capratio	-0.7530*** (-5.03)	Earnings Volatility	24.8473*** (2.77)
Dealer	-0.1836*** (-14.82)	Issue_size	-0.0046 (-0.41)
		Bondage	-0.0403*** (-10.57)
		Maturity	0.0169*** (9.64)
		CreditRating	-0.0879*** (-9.69)
		Callable	0.1292*** (4.85)
		Putable	-0.4744*** (-6.87)
		Covenant	-0.0205 (-0.82)
Year Dummies	Yes	Year Dummies	Yes
No. of Obs.	4582	No. of Obs	4582
Adj.R^2	0.2797	Adj. R^2	0.4935
F-value	94.58	F-value	179.49

Table 4. The effect of bank hedging on asset mix and credit risk

This table reports the results based on a system of simultaneous equations on derivatives and lending portfolio mix and credit risk. We only report the results on the regressions explaining asset mix (equation 2B) and credit risk (equation 3B). The hedging-derivatives variable is the predicted value estimated from equation 2A (not reported); Size is BHC size, measured by Log (1+total assets); Deposits is deposit asset ratio, measured by total deposits/total assets; Trading is Total trading assets/Total assets; RiskCapRatio is risk-based capital ratio, measured by Total risk-based capital/Total risk-weighted assets; NIMargin is net interest margin, measured by Net interest income/Total earning assets; GAPratio is the 1-year GAP ratio, measured by (Earning assets repriced within one year – Interest-bearing deposit liabilities repriced within one year – Long-term debt repriced within one year)/total assets; GDPGrowth is annual national GDP growth rate. All other variables are as defined in Table 1. T-statistics are reported in parentheses below each coefficient. *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

	Panel A Derivative hedging and bank lending			Panel B Derivative hedging and credit risk		
	1	2	3	4	5	6
Variable	Tloan	C&Iloan	REloan	Nonperform	C&INonperform	RENonperform
Intercept	0.0739***	-0.0361***	0.1840***	0.0075***	0.0231***	0.0072***
	(7.08)	(-3.95)	(13.36)	(6.87)	(10.00)	(3.47)
Hedging-Derivatives	0.1297***	0.1414***	-0.1687***	0.0098***	0.0171***	-0.0104
	(5.01)	(6.10)	(-5.04)	(3.53)	(2.91)	(-1.40)
Lagged loan Variable	0.7069***	0.7264***	0.7571***	0.6070***	0.5378***	0.6169***
	(160.08)	(163.59)	(179.21)	(119.14)	(98.17)	(81.99)
Size	0.0036***	0.0017***	-0.0006	-0.0003***	-0.0012***	0.0000
	(6.81)	(3.50)	(-0.91)	(-5.89)	(-9.64)	(0.10)
Deposits	0.0724***	0.0666***	0.0016	-0.0007	-0.0013	-0.0020
	(10.14)	(10.40)	(0.17)	(-0.91)	(-0.81)	(-1.33)
Trading	-0.6271***	0.1097***	-0.4470***	0.0192***	0.0575***	0.0520***
	(-23.23)	(4.58)	(-12.74)	(6.79)	(9.54)	(10.84)
RiskCapRatio	-0.0007**	0.0001	-0.0003	0.0000	0.0000	0.0000
	(-1.97)	(0.42)	(-0.62)	(0.69)	(0.21)	(0.77)
NIMargin	0.3884***	-0.0672**	-0.0960**	0.0691***	-0.0159*	0.0072
	(11.49)	(-2.22)	(-2.17)	(19.00)	(-1.79)	(1.06)
GAPRatio	0.0439***	0.0397***	-0.0043	-0.0003	0.0001	0.0020***
	(15.04)	(15.10)	(-1.13)	(-1.07)	(0.21)	(3.24)
GDPGrowth	-0.2279***	0.0976***	-0.3876***	-0.0329***	-0.0027	-0.0561***
	(-10.07)	(4.81)	(-13.09)	(-13.66)	(-0.53)	(-13.59)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	23593	23574	23593	23590	23536	10154
Adj-R^2	0.5824	0.5656	0.6150	0.4078	0.3020	0.4373
F-value	1567.79	1462.49	1795.63	774.63	486.02	376.74

Table 5. The effect of hedging, bank reputation and lending-relationship on loan-spread

This table reports the results of a system model describing how hedging-derivatives affect the spread banks charge on their loans. We only report the results on the regressions explaining loan-spread (equation 4B). The hedging-derivatives variable is the predicted value estimated from equation 4A (not reported). The dependent variable is all-in-drawn spread on bank loans. Leadshare is the percentage of loan committed by the lead-arranger (s) in the current syndicated loans; Reputation is lead-arranger's market share in the prior year, which is computed as dollar amount of loans arranged by the lead bank in a particular year as the fraction of the total amount of loans issued in the entire market in that year in the prior year; LendingRelation is the lender-borrower relationship during the prior five years. For a borrower j in a particular year, it is the amount of loans arranged by bank i and its predecessors during the previous 5 years divided by the total amount of loans borrowed by borrower j during the previous 5 years; FirmSize is Natural logarithm of the book value of assets; Leverage is computed as book value of debt divided by total assets; Profitability is net income divided by total assets; Insolvency risk is the Altman (1968) Z-score (computed as 1.2*data179/data6 + 1.4*data36/data6 + 3.3*data178/data6 + 0.6*(data199*data25/data181) + data12/data6); LoanSize is the logarithm of the dollar amount of the loan; Maturity is the logarithm of loan maturity in years; Secured and Seniority are dummy variables indicating whether the loans are secured or have senior status; FinCovenant is the number of financial covenants in the current loan; GenCovenant is the number of general covenants in the current loan; PerformPricing is a dummy variable for loans with a performance pricing provision. We define bank-dependent borrowers as the firms that had never issued public debt before, and non-bank-dependent borrowers as the firms which had issued public debt before. T-statistics are reported in parentheses below each coefficient. *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

	Entire Sample	Entire Sample	Bank-dependent borrowers	Bank-independent borrowers
Variable	1	2	3	4
Intercept	3.0785***	3.0745***	2.9439***	2.3969***
	(4.48)	(4.44)	(17.62)	(3.62)
Hedging-derivatives	-0.0990	-6.7573***	-10.5674**	-1.5675
	(-0.24)	(-2.40)	(-2.01)	(-0.66)
Lagged loan-spread	0.0308***	0.0320***	0.0236	0.0460***
	(2.95)	(3.04)	(1.63)	(3.08)
Leadshare	-0.1672***	-0.1596***	-0.1845***	-0.0054
	(-3.95)	(-3.73)	(-3.17)	(-0.08)
Reputation	-0.1516	-0.3510	-0.0807	-0.6605*
	(-0.61)	(-1.33)	(-0.23)	(-1.68)
LendingRelation	-0.1185***	-0.1367***	-0.1279***	-0.1886***
	(-3.45)	(-3.84)	(-2.94)	(-2.99)
Hedging×Reputation		416.2942**	776.3583**	-55.0125
		(2.26)	(2.05)	(-0.45)
Hedging×LendingRelation		4.2944***	6.6693**	2.3053
		(2.51)	(2.18)	(1.22)
FirmSize	-0.1743***	-0.1787***	-0.1836***	-0.1932***
	(-14.15)	(-14.23)	(-10.10)	(-9.89)
Leverage	1.0106***	1.0090***	1.0907***	0.8663***
	(17.13)	(16.94)	(12.51)	(10.19)
Profitability	-1.2808***	-1.2662***	-0.8596***	-2.1492***

	(-10.44)	(-10.22)	(-5.34)	(-10.82)
Insolvency risk	-0.0175**	-0.0183**	-0.0182*	-0.0222
	(-2.08)	(-2.15)	(-1.74)	(-1.46)
LoanSize	-0.1532***	-0.1515***	-0.1577***	-0.1143***
	(-10.72)	(-10.50)	(-8.02)	(-5.45)
Maturity	0.0807***	0.0768***	-0.0419	0.1559***
	(4.46)	(4.20)	(-1.53)	(6.44)
Secured	0.5551***	0.5522***	0.4587***	0.6457***
	(21.15)	(20.85)	(13.10)	(16.06)
Seniority	-0.6315	-0.6277		-0.2286
	(-0.94)	(-0.92)		(-0.36)
FinCovenant	-0.0201*	-0.0165	-0.0487***	0.0186
	(-1.81)	(-1.46)	(-3.28)	(1.08)
GenCovenant	0.0416***	0.0404***	0.0352***	0.0463***
	(9.18)	(8.79)	(5.90)	(6.43)
PerformPricing	-0.1661***	-0.1649***	-0.0813**	-0.2544***
	(-6.30)	(-6.20)	(-2.27)	(-6.44)
Year Dummies	Yes	Yes	Yes	Yes
No. of obs.	4442	4442	2480	1961
Adj-R^2	0.5213	0.5174	0.4300	0.6063
F-value	173.79	159.75	65.52	101.68

Table 6. The effects of hedging and financial crisis on the cost of debt

This table reports the results of a system model describing how derivatives-hedging and the financial crisis affect bond yield-spread. The hedging-derivatives variable is the predicted value estimated from the system of equations (not reported). Crisis dummy is an indicator variable for the financial crisis, it takes the unit value during July 2007 and December 2008, zero otherwise. Other variables are defined as in Table 2. T-statistics are reported in parentheses below each coefficient. *, **, and *** indicate significance at 10%, 5%, and 1% level, respectively.

Variable	Dependent variable = Yield-spread
Intercept	1.0270**
	(2.07)
Hedging-derivatives	0.3491***
	(2.53)
Lagged Yield-spread	0.2194***
	(15.48)
Crisis Dummy	0.5350***
	(6.91)
Derivatives×Crisis Dummy	-0.5331***
	(-3.93)
ROA	-0.0432
	(-0.02)
Size	0.0070
	(0.88)
Leverage	1.0019**
	(2.13)
Earnings Volatility	22.8842***
	(2.67)
IssueSize	-0.0042
	(-0.37)
BondAge	-0.0382***
	(-9.77)
Maturity	0.0169***
	(9.58)
CreditRating	-0.0971***
	(-10.44)
Call	0.1627***
	(5.76)
Put	-0.4592***
	(-6.58)
Covenant	-0.0243
	(-0.96)
Year Dummies	Yes
No. of obs	4582
F-Value	165.84
Adj-R^2	0.4928

Table 7. The effects of hedging and financial crisis on lending patterns

This table reports the results of a system of simultaneous equations describing how derivatives-hedging and the financial crisis affect lending patterns. The hedging-derivatives variable is the predicted value estimated from the system of equations (not reported). Crisis dummy is an indicator variable for the financial crisis, takes the unit value during July 2007 and December 2008, zero otherwise. Other variables are defined as above. T-statistics are reported in parentheses below each coefficient. *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

	Panel A Effects of hedging and financial crisis on bank lending			Panel B Effects of hedging and financial crisis on credit risk		
	1	2	3	4	5	6
Variable	Tloan	C&I loan	RE loan	Nonperfom	C&INonperform	RENonperform
Intercept	0.0742***	-0.0358***	0.1826***	0.0075***	0.0231***	0.0072***
	(7.09)	(-3.91)	(13.20)	(6.88)	(9.99)	(3.48)
Hedging Derivative	0.1388***	0.1540***	-0.1909***	0.0106***	0.0181***	-0.0110
	(4.92)	(6.10)	(-5.24)	(3.53)	(2.83)	(-1.44)
Lagged loan	0.7068***	0.7264***	0.7576***	0.6070***	0.5379***	0.6169***
Variable	(160.02)	(163.45)	(178.73)	(119.12)	(98.16)	(81.98)
Crisis Dummy	0.0027	0.0023	-0.0030	0.0003	-0.0005	0.0005
	(0.66)	(0.61)	(-0.55)	(0.60)	(-0.52)	(0.57)
Derivative×	-0.0833***	-0.1353***	0.1794***	-0.0095***	-0.0107	0.0051
Crisis Dummy	(-2.54)	(-4.59)	(4.20)	(-2.71)	(-1.44)	(0.43)
Size	0.0036***	0.0017***	-0.0006	-0.0003***	-0.0012***	0.0000
	(6.79)	(3.51)	(-0.82)	(-5.88)	(-9.64)	(0.10)
Deposits	0.0720***	0.0659***	0.0022	-0.0007	-0.0014	-0.0021
	(10.12)	(10.32)	(0.24)	(-0.98)	(-0.85)	(-1.34)
Trading	-0.6305***	0.1048***	-0.4383***	0.0189***	0.0571***	0.0521***
	(-23.09)	(4.33)	(-12.34)	(6.60)	(9.37)	(10.85)
RiskCapRatio	-0.0007**	0.0001	-0.0003	0.0000	0.0000	0.0000
	(-1.97)	(0.42)	(-0.62)	(0.69)	(0.21)	(0.77)
NIMargin	0.3876***	-0.0686**	-0.0936**	0.0690***	-0.0162*	0.0072
	(11.46)	(-2.26)	(-2.11)	(18.96)	(-1.82)	(1.06)
GAPRatio	0.0439***	0.0398***	-0.0043	-0.0003	0.0001	0.0020***
	(15.06)	(15.13)	(-1.12)	(-1.04)	(0.22)	(3.24)
GDPgrowth	-0.2271***	0.0988***	-0.3892***	-0.0328***	-0.0026	-0.0561***
	(-10.02)	(4.85)	(-13.12)	(-13.61)	(-0.51)	(-13.60)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	23593	23574	23593	23590	23536	10154
Adj-R^2	0.5822	0.5651	0.6143	0.4077	0.3020	0.4371
F-value	1430.33	1332.78	1634.86	706.99	443.64	343.83

Appendix A1. List of 66 BHCs in the analysis of cost of debt {{put after tables>>}}

Obs	PERMNO	BHC Name
1	62770	AMSOUTH BANCORPORATION
2	15318	ASSOCIATED BANC-CORP
3	65138	BANC ONE CORPORATION
4	49656	BANK OF NEW YORK COMPANY, INC., THE
5	58827	BANKAMERICA CORPORATION
6	59408	NATIONSBANK CORP
7	48354	BANKERS TRUST NEW YORK CORPORATION
8	10906	BANKNORTH GROUP, INC.
9	61284	BARNETT BANKS, INC.
10	71563	BB&T CORPORATION
11	83115	BOATMEN'S BANCSHARES, INC.
12	81055	CAPITAL ONE FINANCIAL CORPORATION
13	20088	CCB FINANCIAL CORPORATION
14	22075	CENTRAL FIDELITY BANKS, INC.
15	47896	CHASE MANHATTAN CORPORATION, THE
16	47079	CITICORP
17	70519	CITIGROUP INC
18	23916	CITY NATIONAL CORPORATION
19	25081	COMERICA INCORPORATED
20	64565	COUNTRYWIDE FINANCIAL CORPORATION
21	79354	CRESTAR FINANCIAL CORPORATION
22	29488	DEPOSIT GUARANTY CORP.
23	12169	DORAL FINANCIAL CORPORATION
24	34746	FIFTH THIRD BANCORP
25	56450	FIRST CHICAGO NBD CORPORATION
26	35781	FIRST HAWAIIAN, INC.
27	35204	FIRST OF AMERICA BANK CORPORATION
28	36274	FIRST SECURITY CORPORATION
29	88050	FIRST UNITED BANCSHARES, INC.
30	36127	STAR BANC CORP
31	53209	FIRSTAR CORPORATION
32	47159	FLEETBOSTON FINANCIAL CORPORATION
33	37584	FRANKLIN RESOURCES, INC.
34	37699	FREMONT BANCORPORATION
35	83974	GREATER BAY BANCORP
36	80127	GREENPOINT FINANCIAL CORP.
37	42906	HUNTINGTON BANCSHARES INCORPORATED
38	48071	J.P. MORGAN & CO. INCORPORATED
39	64995	KEYCORP
40	51706	MARSHALL & ILSLEY CORPORATION

41	76557	MBNA CORPORATION
42	52821	MERCANTILE BANCORPORATION INC.
43	52840	MERCANTILE BANKSHARES CORPORATION
44	87842	METLIFE, INC.
45	56232	NATIONAL CITY CORPORATION
46	58094	NORTH FORK BANCORPORATION, INC.
47	58246	NORTHERN TRUST CORPORATION
48	59345	OLD KENT FINANCIAL CORPORATION
49	12068	OLD NATIONAL BANCORP
50	83835	PEOPLES HERITAGE FINANCIAL GROUP, INC.
51	16505	POPULAR, INC.
52	53938	REPUBLIC NEW YORK CORPORATION
53	66967	RIGGS NATIONAL CORPORATION
54	71686	SOUTHTRUST CORPORATION
55	68144	SUNTRUST BANKS, INC.
56	73809	SUSQUEHANNA BANCSHARES, INC.
57	20053	SYNOVUS FINANCIAL CORP.
58	78968	U.S. BANCORP
59	78263	UNION PLANTERS CORPORATION
60	20694	UNIONBANCAL CORPORATION
61	50200	WACHOVIA CORPORATION
62	10932	WEBSTER FINANCIAL CORPORATION
63	38703	NORWEST CORP
64	50024	WELLS FARGO & COMPANY
65	83030	WILMINGTON TRUST CORPORATION
66	84129	ZIONS BANCORPORATION