Bank Risk, Financial Stress, and Bank Derivative Use

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Abstract

This paper distinguishes hedging from speculative derivative usage by U.S. bank holding companies (BHCs), and the apparent purpose of the derivative position has implications for future bank holding company stock returns. This is accomplished by implementing a multi-step procedure that relates the implied volatility from traded options on these banks, broad components of the Cleveland Fed Financial Stress Index, and off-balance sheet derivatives. Our results indicate that BHCs with positive risk exposure to various financial stresses generally use interest rate, foreign exchange, equity, commodity, and credit derivatives to reduce their risk exposure to these financial stresses. Additionally, positively exposed BHCs that use credit and equity derivatives to reduce interbank stress risk have stock performance that bests that of BHCs which do not use such derivatives.

1. Introduction

This paper addresses four critical issues in bank performance and regulation. The first issue is the assessment of bank risk. The second issue is the sensitivity of bank risk to important financial stress factors. The third issue is the ability of inter-bank differences in derivatives positions to explain cross-sectional variation in the sensitivity of bank risk to specific financial stress factors. The fourth issue concerns whether the financial markets assess the information in banks' derivatives positions to infer hedging or speculative behavior, and whether this perception is reflected in bank stock returns.

The traditional role for banks is the reduction of transactions costs in matching savers and borrowers and the provision of information. Banks serve the role of financial intermediaries in facilitating exchange and providing liquidity (Bencivenga and Smith, 1991). However, financial innovation over the last few decades has spurred value creation in the forms of risk sharing and risk management in the banking sector. Allen and Santomero (1997) and Scholtens and van Wensveen (2003) argue that these changes have increasingly shifted banks away from their traditional activities. Instead, they suggest that banks are making increasing use of the financial markets to transfer, transform, and redistribute risk. Thus, the financial markets' perception of bank activities has taken on increasing importance in evaluating the riskiness of banks.

To facilitate risk management and sharing, U.S. commercial banks increasingly rely on financial derivatives. According to the Office of the Comptroller of the Currency's Quarterly Report on Bank Derivatives, U.S. banks held notional derivatives positions totaling $16.8 trillion at the end of the fourth quarter of 1996. By the first quarter of 2014, the total U.S. bank notional derivatives holdings reached $230.6 trillion. For comparison, in 2014 the notional derivatives positions exceeded the on-balance sheet assets of banks with derivatives by a factor of 17.5.

Initially, the use of derivatives by banks as risk management tools was heralded by the Federal Reserve System as contributing to a more flexible financial system that can more easily disperse risk (Greenspan, 2004). However, the popular press quickly began to question the use of derivatives as hedging instruments and pointed out the moral hazards associated with the derivatives along with their potential to increase systemic risk.[1] Additionally, academic research to date has not found evidence supporting the Fed's view, as previous studies have found either no link between banks' derivative use and risk (e.g. Hentschel and Kothari, 2001) or, perhaps even more troubling, banks act as derivative dealers without thought to the consequences of their positions (Minton, Stulz, and Williamson, 2009).

The importance of banks as risk managers as well as the importance of the markets' perception of bank risk is clearly reflected in the Basel II Accord. Basel II not only requires that a bank's capital position reflect its credit risk exposure to on- and off-balance sheet activities, but also requires banks to measure and hold capital against market and operational risks. Furthermore, the third pillar of Basel II attempts to strengthen the market discipline of banks by increasing the transparency of each bank's risk profile and risk policy. Under Basel II, the importance of market discipline is likely to play an increasing role in bank regulation.

In this paper, we use implied volatilities from options traded on U.S. bank holding companies (hereafter BHCs) as a proxy for capital markets' perception of future bank risk. The implied volatilities are used to estimate the sensitivities of perceived bank risk to four financial stress factors that comprise the Cleveland Federal Reserve Bank's Financial Stress Index (CFSI). These estimated sensitivities are then used to identify if BHCs are hedging or speculating by how the sensitivities react to the banks' position in traded and non-traded derivatives as well as

[1] See, for example, "Credit derivatives play a dangerous game," by F. Partnoy and D. Skeel, Financial Times, July 16, and "Credit default swaps: The next crisis," by J. Morrissey, Time, March 17, 2008.

specific derivative positions. Our results indicate that the relationship between risk sensitivity and derivative usage depends on if the BHC's implied volatility has a positive relation with the financial stress factors or not. Generally, it is the BHCs with a positive relation between implied volatility and financial stress factors that use interest rate, foreign exchange, commodity, or equity derivatives to reduce (e.g. hedge) their risk sensitivities to the financial stresses. Additionally, we find robust evidence that these BHCs use credit derivatives to hedge against the CFSI stress factors. Further, portfolio analyses reveal that these particular BHCs generate value to investors through their use of equity and credit derivatives to manage interbank stress.

Section 2 of the paper briefly reviews the literature pertaining to the capital markets' ability to assess bank risk and bank derivative usage. Section 3 presents the empirical methods that we employ in the paper. Section 4 discusses the data used in the analyses and Section 5 presents and discusses the empirical results. The final section of the paper concludes the study.

2. Prior Evidence on Bank Risk and Derivative Use

2.1 Assessing Bank Risk

In many ways the assessment of bank risk is more important than traditional corporate risk because of the critical role that banks play as financial intermediaries. If a bank has excessive exposure to market, foreign exchange, interest rate or other risks, not only does the bank and its customers potentially suffer, but capital markets stand to lose additional access to financing through decreased market liquidity. One critical concern regarding bank risk is the usage of derivative securities. One main question is if banks are using their derivatives positions to shift risk or to produce trading income? One approach to answering these questions is to let the data tell us how capital markets perceive the risk associated with bank derivatives positions.

Using the capital markets to assess the risk of a bank is not unique. Papers by Flannery and Sorescu (1996), Sironi (2003), and De Young et al. (2001) suggest that subordinated debt yields incorporate information from banks' financial reporting statements. However, this may not be the most efficient way to gain valuable information about bank risk. A 2000 study by the US Department of the Treasury suggests that subordinated debt yields have an inconsistent relationship with bank financial distress. This does not mean that capital markets are unable to assess risk correctly; however, it is possible that the focus is on the wrong risk measure(s).

The evidence presented in Cooper, Jackson, and Patterson (2003) suggests that there is predictability in bank stock returns, and most notably, that this predictability is not related to traditional Fama and French (1993) risk-factors. Specifically, Cooper et al. (2003) document that non-interest income and off-balance sheet items are significantly related to future stock returns. This may not be surprising given the increase in activity in non-interest income shown in Rogers and Sinkey (1999) and the ability to reduce risk using off-balance sheet products in Grammatikos et al. (1986).[2] These results suggest that the market does appear to respond to the off-balance sheet information reported in bank financial statements, which includes information on the notional and fair-value of select derivatives positions.

Similar to non-financial firms, the firm's individual implied volatility, measured through option prices, provides efficient estimates of future realized volatility, and highly informative of in predicting future returns (Banerjee, Doran, and Peterson, 2007). Additionally, Swindler and Wilcox (2002) find that implied volatility provides a better forecast of future volatility than past realized volatility, and is correlated with market volatility for a subset of bank stocks. This

[2] Brewer et al. (1996a) suggests that increases in non-traditional revenue products can lead to increases in market risk.

suggests the useful nature of implied volatility, which is immediately accessible to all market participants.

Banking firms provide a unique setting to use implied volatility to assess bank risk due to the significant detail that is required for reporting purposes regarding derivative usage. The greater transparency in the derivative positions reported by banks should provide a cleaner link between bank implied volatility and derivative usage.

2.2 Bank Derivative Usage

There is a substantial literature examining the relationship between firm derivative use and firm risk. Specifically, Guay (1999) uses several different types of analyses to investigate whether firms use derivatives to reduce risk, with mixed results. Hentschel and Kothari (2001) show no evidence to support a finding that estimated market, interest or currency betas differ between derivative users and non-users, for both non-financial and financial firms. More recently, Minton, Stulz, and Williamson (2009) examine the link between net purchased credit derivatives (the difference in notional value between purchased and sold credit derivatives) and loan hedging and find little evidence of hedging activity. Rather, they conclude banks are acting as dealers and not as hedgers.

Most papers that examine bank derivative usage take one of four approaches.[3] One approach is to compare the characteristics of those banking organizations that use derivatives with those that do not. Examples of this literature include Sinkey and Carter (2000) and Brewer, Jackson and Moser (2001). Sinkey and Carter find that in comparison with non-user banks, user

[3] Note that, until recently, the use of derivatives was captured either by a (0, 1) dummy variable or by the total notational value of derivatives holdings

banks tend to be larger, have riskier capital structures, larger maturity mismatches between assets and liabilities, greater net loan charge-offs, and lower net interest margins.

The second approach uses the total notional value of banks' derivatives positions as a proxy for hedging and constructs various proxies for the on-balance sheet maturity gap as alternative dependent variables in regression analyses. They generally find a positive relationship between the notional value of the derivatives activities and the proxies for on-balance sheet interest rate risk exposure, regardless of which is used as the dependent variable. Because the notional value of derivatives is assumed to be a proxy for hedging, they infer that banks use derivatives to hedge their on-balance sheet interest rate risk.[4] However, banks could augment on-balance sheet risk-taking with their derivatives activities.

A third approach used event study methods to examine the stock market's reaction to losses incurred by end users of derivatives transactions undertaken with Bankers Trust. Clark and Perfect (1996) report that Bankers Trust incurred significant abnormal returns on four event days in which information on client losses first became public. In addition, the authors report that eight other bank derivatives dealers suffered small negative abnormal returns on these same days. Further they find that the negative abnormal returns experienced by the dealers differed according to the market or replacement value of each banks exposure. Sinkey and Carter (1999) extend the work of Clark and Perfect to include a set of non-dealer banks. The authors report that the replacement cost of the derivatives positions of non-dealer banks was also useful in explaining stock price reaction to the announcement of client losses. Thus their results provide additional support for rational pricing by the stock market.

[4] Obviously there is a potential simultaneity bias and it is highly questionable whether the notional value of derivatives is a reasonable proxy for hedging. Papers in this category include Angbazo (1997), Sinkey and Carter (2000) and Purnanandam (2007).

The fourth approach examines the potential relationship between the cross-sectional variability of stock returns of publicly traded banks and the use of derivatives. Generally a two-step procedure is utilized in which bank stock returns are regressed on a measure of market returns and an interest rate variable. The estimated sensitivities are then regressed on set of bank characteristics and either a dummy variable denoting that the bank is a derivatives user or the total notional value of the bank's derivatives holdings. Hirtle (1997), Schrand (1997), Choi and Elyasiani (1997), Brewer, Jackson and Moser (2001), and Cyree and Huang (2005), generally report that the use of derivatives or the notional value of the derivatives position is positively related to the estimated interest rate sensitivity. This is interpreted as indicating that increasing use of derivatives increases interest rate risk. Minton, Stulz, and Williamson (2009) report a similar result for a small number of banks that utilize credit derivatives.

Our research design is similar to the fourth approach, except that we wish to empirically distinguish between hedgers and speculators by using market information, and also relate these characteristics to future stock performance.

3. Research Methodology

To relate bank risk, derivative positions, and future performance, a three-step procedure is implemented. The first step requires linking bank implied volatility and potential financial stress factors that affect bank risk. Hanweck and Ryu (2005), document that banks respond in predictable but unique ways to credit, interest, and term-structure shocks, depending on their product line. In particular, large banks are sensitive to credit shocks, and all banks are not able to fully hedge against interest rate volatility. If banks are sensitive to rate changes, and are unable to hedge these positions, then large derivatives positions could contribute to overall bank volatility.

The second step relates each bank's sensitivities to their specific derivatives positions. As a result, the sensitivities will indicate whether the bank is hedging or speculating with its derivatives. This intermediate step is crucial, since directly testing the relationship between derivatives usage and implied volatility would not distinguish between hedging or speculative activity. The final step assesses whether there is a difference in the market performance of hedgers and speculators.

3.1 Bank Implied Volatility and Financial Stress Factors

Implied volatility is by definition a forward-looking measure since it is inferred from option prices with expiration in the future. This measure of risk captures the market's expectation about future bank risk, encompassing both systematic and idiosyncratic risk. Our focus is on the systematic component of risk know to affect banks, for example, macroeconomic factors such as interest rates, market returns, foreign exchange rates, and commodity returns. Given a bank's core competency as a financial intermediary, it is reasonable to assume that a bank would manage its exposure to any or all of these factors. For example, a bank could limit the exposure of its cash flows to an unexpected increase in interest rates structuring its balance sheet so that its assets and liabilities reprice at a similar rate. Alternatively, entering into a long position in an interest rate futures contract would also reduce cash flow uncertainty to changing interest rates. However, it is also possible that a bank would be willing to speculate on interest rate movement, believing it has superior information to other market participants.

We restrict our focus to macroeconomic factors captured in the broad index components of the Federal Reserve's Cleveland Financial Stress Index (CFSI): credit, equity, foreign exchange, and interbank stress. While there are many other potential factors that affect bank risk, such a political risk, they are not easily hedged with financial instruments.[5] Other regional Federal Reserve Banks also issue their own financial stress indexes (e.g. St. Louis, Kansas City, Chicago, etc.), but the CFSI has the major advantage of being released daily. To estimate the sensitivity of a bank's implied volatility, *IV,* to each of the macroeconomic factors, we specify regression model for each bank *i* on day *t*. Equation (1) is a log-difference specification. A log specification is used because volatility is log-normally distributed and differences are used because we are interested in how changes in the macroeconomic conditions affect the change in banks' implied volatilities.

$$\ln\left(\frac{IV_{i,t}}{IV_{i,t-1}}\right) = \alpha_i + \beta_{CS,i}\ln\left(\frac{CS_t}{CS_{t-1}}\right) + \beta_{ES,i}\ln\left(\frac{ES_t}{ES_{t-1}}\right) + \beta_{FXS,i}\ln\left(\frac{FXS_t}{FXS_{t-1}}\right) + \beta_{IBS,i}\ln\left(\frac{IBS_t}{IBS_{t-1}}\right) + \beta_{VIX,i}\ln\left(\frac{VIX_t}{VIX_{t-1}}\right) + \varepsilon_{i,t} \quad (1)$$

The independent variables in the regression model are the broad-level sector indexes that contribute to the CFSI:[6]

- *CS* is the contribution to the CFSI from the credit markets and incorporates the covered interest spread, the corporate bond spread, the three-month Treasury liquidity spread, the commercial paper-Treasury bill spread, and the Treasury yield curve spread;
- *ES* is the contribution to the CFSI from the equities market and incorporates the current level of the S&P500 relative to its 365-day high and expectations about the future conditions of the financial services industry;

[5] While it may be possible to buy a futures contract on potential political outcomes through the Iowa electronic exchange, it not a viable hedging market due to size and liquidity.
[6] A white paper on the construction and components of CFSI is found https://www.clevelandfed.org/~/media/content/newsroom%20and%20events/publications/economic%20commentary/2012/ec%20201204%20the%20cleveland%20financial%20stress%20index/ec%20201204%20the%20cleveland%20financial%20stress%20index%20pdf.pdf?la=en.

- *FXS* is the contribution to the CFSI from the foreign exchange market and incorporates a measure of demand for liquidity from the domestic financial system;
- *IBS* is the contribution to the CFSI from interbank market and incorporates financial betas, bank bond spreads, interbank liquidity spreads, and interbank costs of borrowing;
- *VIX* is the model-free implied volatility of the S&P 500, and is included in the model to capture the portion of banks' IV that is related to the systematic IV of the market.

The ex-ante expectations are that $\beta_{CS}, \beta_{ES}, \beta_{FXS}, \beta_{IBS}, \beta_{VIX} > 0$ for an average bank. That is, bank risk (as measured by the implied volatilities) should increase with increases in the stress components of the CFSI and VIX. A net exposure may be due to speculation or an under-hedged on-balance sheet position. If the banks are hedging then the signs of these implied volatility betas should either be reversed or indistinguishable from zero. We define any bank whose volatility β is statistically significant and has the expected positive sign as being "exposed" to the respective CFSI factor. A bank whose estimated volatility β to a CFSI factor is in the opposite direction or statistically is insignificant is classified as "unexposed."

3.2 Risk Sensitivities and Derivatives Positions

The IV betas are estimated each quarter using daily observations. This produces time-series beta estimates for each bank. These estimates are then related to the current quarter's notional and fair value of the bank's derivatives. Using the notional or fair value is not ideal, since it reveals nothing about the direction of the derivative position. If direction was observable, then it would be easier to interpret which banks are speculating or hedging. However, since this is not reported, this relationship is inferred by linking the risk sensitivities found equation (1) to the derivative positions.

Bank derivatives are separated into four basic types (interest rate contracts, foreign exchange contracts, equity derivative contracts, and commodity and other contracts) and two classifications (derivatives used for trading and non-trading). This is a slight misnomer, as "trading" does not necessarily imply speculation and "non-trading" does not necessarily imply hedging. Derivatives used for trading can also include derivatives used for market making purposes. Similarly, non-traded derivative may indicate that a portion of the contracts are used for non-market making purposes. Therefore, a bank can hedge and/or speculate under both categories. However, the trading (non-trading) accounts should be highly correlated with speculative (hedging) activities.

Not all banks in the sample are derivatives users, therefore a simple OLS regression may be susceptible to selection bias when using derivative positions as the dependent variable. A Heckman (1979) two-stage model is employed to correct for any sample selection bias, and uses maximum likelihood estimation to fit the model. In the first stage, the fixed effects Probit regression, motivated by studies such as Ashraf, Altunbas, and Goddard (2006), Mahieu and Xu (2007) and Minton et al. (2009), is specified as:

$$P(D\_USER_{i,q} = 1) = \Phi(\alpha + \gamma_1 EA_{i,q} + \gamma_2 GAP12_{i,q} + \gamma_3 EQWAR_{i,q} + \gamma_4 NPLR_{i,q} + \gamma_5 FXDAR_{i,q} + \gamma_6 FXDLR_{i,q} + \varepsilon_{i,q}) \quad (2)$$

D_USER is set to one for banks who use any type of derivative reported in the FR Y9C report, and is equal to zero otherwise. The independent variables appearing in equation (2) have been identified in previous research as being associated with bank derivative usage. *EA* identifies the earning assets of the bank *i* in quarter *q* and is used as a proxy for size. *GAP12* is the 12-month repricing gap and used to proxy on-balance interest rate risk. *EQWAR* is the ratio of tier one equity to risk weighted assets and is used to proxy insolvency risk. *NPLR* is the ratio of non-performing loans to total assets and is used to proxy credit risk. *FXDAR* is the ratio of foreign currency denominated assets to dollar denominated assets and is used to proxy the foreign exchange risk associated with the bank's assets. *FXDLR* is the ratio of foreign currency denominated liabilities to dollar denominated liabilities and is used proxy the foreign exchange risk embedded in the bank's liabilities. Thus, in each case, these variables are included to capture on-balance sheet risk that may lead to increased derivative usage. The increased derivative usage may be to hedge or to augment risk of each type. Therefore, these variables could be considered the bank's on-balance sheet exposure to financial stress risk factors. From the Probit estimation, we construct the inverse Mills ratio (IMR) for each firm in each quarter. As per the Heckman procedure, the IMR is used in the remaining OLS regressions to control for sample selection bias.

The following fixed-effects panel regression is specified as the second stage, which tests the relationship between estimated quarterly volatility betas and derivative positions,

$$\begin{aligned}\tilde{\beta}_{k,i,q} = \alpha &+ \delta_{DT,j}\ln(D\_Traded_{j,i,q}+1) + \delta_{DNT,j}\ln(D\_NonTraded_{j,i,q}+1) + \delta_{DTP,j}\ln(D\_Traded_{i,q}+1)*Exposed \\ &+ \delta_{DNTP,j}\ln(D\_NonTraded_{j,i,q}+1)*Exposed + \ln(ASSETS_{i,q}) + IMR_{i,q} + \varepsilon_{i,q}\end{aligned} \tag{3}$$

For each quarter, *q*, there are five estimated vectors of volatility betas, $\tilde{\beta}_k$, for each bank i where k the CFSI factor *CS, ES, FXS, IBS,* or *VIX*. There are four *j* types of derivatives traded include interest rate, foreign exchange, equity, and commodity. *D_Traded* represents either the notional or fair value of derivatives used for trading while *D_NonTraded* represents either the notional or fair value of derivatives used for non-trading. *Exposed* is a dummy variable that takes on a value of 1 when the respective estimated volatility betas for the CFSI factors are positive and statistically significant. In all other cases the dummy variable is assigned a value of zero. The dummy variable is then interacted with derivatives values to capture the differences in use across those banks that are exposed to the macroeconomic factor risk and those that are unexposed. *ASSETS* are the value of the bank's assets.

Credit derivatives are reported on the Y9-C differently than other derivatives. Rather than reported as "traded" or "non-traded," fair value and notional value of credit derivatives are reported as "sold" or "purchased." Since "purchased" refers to purchasing protection and "sold" refers to selling protection, we determine "sold" is analogous to "traded" and "purchases" is analogous to "non-traded." Thus, we modify equation (3) as:

$$\tilde{\beta}_{k,i,q} = \alpha + \delta_{DT,j} \ln(D\_Sold_{j,i,q} + 1) + \delta_{DNT,j} \ln(D\_Purchased_{j,i,q} + 1) + \delta_{DTP,j} \ln(D\_Sold_{i,q} + 1) * Exposed + \delta_{DNTP,j} \ln(D\_Purchased_{j,i,q} + 1) * Exposed + \ln(ASSETS_{i,q}) + IMR_{i,q} + \varepsilon_{i,q} \quad (4)$$

Time fixed effects are used since we focus on cross-sectional variation and standard errors are clustered by firm to control for intra-firm correlations from quarter to quarter. Assets are included as a control for bank size, since derivative use is proportional to the size of the bank. No other controls are included since our first stage estimation captures important on-balance sheet risk exposures and their relationship to derivative use.

After estimating equation (1), we estimate the δ_j coefficients using the estimated β's ($\tilde{\beta}$) as the dependent variables in the second-stage regression specified in equations (3) and (4). The joint examination of the signs of both δ_j and β_i reveal whether the market perceives that the bank is using derivatives for hedging or speculative purposes. There are four potential scenarios that can occur; (1) positive δ_j and exposed β_i, (2) negative δ_j and exposed β_i, (3) positive δ_j and unexposed β_i, and (4) negative δ_j and unexposed β_i.

Cases 1 and 3 are the easiest to interpret. If the δ_j are positive, there is a positive relationship between derivative use and the bank's volatility beta. If the corresponding β is exposed, then the bank has positive exposure to that specific financial stress risk factor, and increased derivative use increases the market perception of the bank's risk, i.e. the bank is speculating. If the β is unexposed, the bank has limited or negative exposure to the financial stress risk factor, but current derivative use increases the bank's risk exposure, implying the bank is also speculating with derivatives. The key distinction between the cases is that the banks in case 1 are strong speculators given their positive risk exposure while the banks in case 3 are weak speculators since they have non-positive risk exposure.

In cases 2 and 4, when δ_j is negative, derivative use reduces the bank's risk sensitivity. If β is exposed, then the bank has positive net exposure to the financial stress risk factors. However, the reduction in risk sensitivity implies a lowering of the bank's exposure to the risk factors. Thus derivatives are being used to soften the current speculative derivative position. These banks are considered weak-hedgers. If β is unexposed, derivative use further reduces risk sensitivity. These banks are considered strong-hedgers.

3.3 Implications for Future Returns

To check whether the use of derivatives has implications for future returns, long-short portfolios of banks are formed based upon whether they are derivatives users or not. The portfolio goes long derivative users and shorts non-users. Their classification is established in a given quarter *q*, and the returns are calculated in the following quarter, *q+1*. Next, long-short portfolios are formed with derivative users who have exposed and unexposed betas, where the exposed beta banks are long and the unexposed banks are short. The portfolios are rebalanced every quarter to account for banks switching from one category to another. This is done for each of the four CFSI risk sensitivities thereby allowing us to distinguish between the future bank portfolio performances of the five derivatives categories. If there are significant differences between the five categories for any of the four risk sensitivities, it will reveal not only how the market perceives the risk of the derivative positions, but whether or not the use of derivatives impacts future returns.

4. Description of the Data

To implement the empirical methods discussed above, it is first necessary to identify those banks that have options traded on their equity. The Federal Reserve Bank of New York provides a file that links banks' Federal Reserve identification number (RSSD ID) to the Center for Research in Security Prices' (CRSP's) PERMCO firm identifiers.[7] This dataset contains 1,312 unique banks based on the RSSD ID number. We merge this dataset with the Federal Reserve's FR Y-9C bank holding company (BHC) call reports via the RSSD ID and with the CRSP dataset via the PERMCO. CUSIP's provided by CRSP for these BHCs are used to retrieve daily implied volatilities for BHCs that have traded options from January 1996 through March 2014. This data is collected from Optionmetrics, and uses standardized at-the-money options. The use of standardized options helps to eliminate the measurement error that is typically associated with inferring individual implied volatilities using Black-Scholes (1973) formula. As

[7] https://www.newyorkfed.org/research/banking_research/datasets.html

Hentschel (2003) points out, averaging all options across strike price and maturity can reduce the problems associated with non-synchronous timing and model misspecification. This provides a daily time-series of weighted-average implied volatilities. After combining all the datasets, there are 231 unique BHCs in the sample.

Data on the broad-level components of the CFSI comes from the Federal Reserve Bank of St. Louis's FRED database.[8] Daily VIX levels are from the Chicago Board Options Exchange (CBOE). Panel A of Table 1 reports the daily mean, median, standard deviation, and 25% and 75% implied volatility for all banks, and for the four CFSI components and VIX. The average bank has an implied volatility of 38.3%, which is similar to that of the average firm that has traded options.[9] The mean of the stress indicators range from 5.889 (IBS) to 9.906 (CS). The mean VIX level over the sample period is 21.46. The average log difference of the CFSI components ranges from -0.00025 to 0.00061. The greatest dispersion (measured as the difference between the 75th and 25th percentiles) lies with the equity and foreign exchange stress components at 0.0278 and 0.0252, respectively.

Our research design focuses on the log differences of the CFSI components and VIX, thus, Panel B of Table 1 reports the correlations only of the log-differences. The correlation with the largest magnitude is between the credit and interbank stress components at 0.4099. The next largest is between the credit and equity stress components at 0.2326. The magnitudes of the remaining correlations between the CFSI components and VIX are all lower than 0.075.

Monthly returns for the sample banks are calculated using CRSP data. The MKT, SMB, HML, and UMD risk factors come from Kenneth French's website and are used in the portfolio

[8] The CFSI also contains two broad-level components, real estate stress and securitization stress, which are omitted in this study due to errors found in their construction by the Cleveland Federal Reserve Bank.
[9] The average firm implied volatility is 40%, as shown in Diavatopoulos, Doran, and Peterson (2007).

regressions using the Fama and French (1993) and Carhart (1997) methodology to assess abnormal performance.

Table 2 presents the notional and fair value positions of the BHCs and the correlations among the positions. As seen in Panel A, most of the derivatives traded are associated with interest rates, followed by foreign exchange rates. Very few banks trade any commodity or equity derivatives. Additionally, the use of derivatives is highly skewed. For example, the median bank has less than $1 billion of notional interest rate derivatives. By comparison, the average bank has a notional value of interest rate derivatives of $1,360 billion. The highly skewed nature of the derivative positions lends credence to using the natural log of the positions in the research design. Panel B shows that there are high correlations in the logged positions between all the Traded accounts (all correlations are in excess of 0.6), but the correlations among the Non-traded accounts are much lower. This is true of both the notional and fair value of the derivatives positions.

5. Empirical Results

5.1 Effect of Bank Derivative Positions on CFSI Sensitivities

Panel A of Table 3 shows the summary statistics from the estimated sensitivities in equation (1). For the average firm, the betas for credit stress (CS) and equity stress (ES) are positive, but the betas for interbank stress (IBS), foreign exchange stress (FXS), and VIX are negative. The betas on the stress components have quite a bit of variation, as opposed to the VIX betas which are concentrated around the mean. The last six columns of Panel A show the percentage of the firms that have either statistically significant betas (at both the 5% and 10% levels) or insignificant betas. The firms with betas that are positive and significant are labeled as

“Exposed” as per the description in the Section 3. We analyze the firms using both the 5% and 10% level of significance, but for brevity we report the results using the 10% level of significance. Using the 5% level yields quantitatively and qualitatively similar results. Panel B of Table 3 shows the correlations among the betas. The strongest correlation is between the CS and IBS betas with a coefficient of -0.3311.[10]

The results from estimating the first stage probit model in equation (2) are shown in Panel A of Table 4. The probability of a BHC being a derivatives user is positively affected by the amount of earnings assets, the ratio of foreign currency denominated assets to dollar denominated assets, and the ratio of foreign currency denominated liabilities to dollar denominated liabilities. It is negatively affected by the ratio of tier one equity to risk weighted assets and the ratio of non-performing loans to total assets.

The results from the estimations of equations (3) and (4) are displayed in Panels B through E of Table 4. We estimate the regressions separately for each type of derivative for each type of sensitivity. We focus on the notional value of derivatives positions, but using the fair value of derivative positions yields very similar results. T (NT) denotes the traded (non-traded) account for interest rate, FX, equity, and commodity derivatives and sold (purchased) account for credit derivatives. Table B demonstrates, via the negative and statistically significant parameter estimates, that exposed BHCs generally use interest rate, foreign exchange, equity, and commodity derivatives in their Traded accounts to lower their sensitivity to credit stress in the financial system more so than BHCs that are not exposed. This is also true of foreign exchange and equity derivatives in the non-traded accounts and purchased credit derivatives, respectively. The evidence of using credit derivatives to reduce risk is contrary to the findings of Minton et al.

[10] In the interest of brevity, we report all analyses using notional values. However, all analyses were repeated using fair values and the results are both qualitatively and quantitatively similar.

(2009) who find banks are playing a role as dealers of credit derivatives instead of hedgers. Additionally, the sold credit derivatives have no impact on the sensitivity to credit stress for the exposed banks and decreases the sensitivity for unexposed banks.

Panel C focuses on BHCs interbank stress betas, or the sensitivities of BHCs implied risk to interbank stresses. BHCs that do not have positive sensitivities to interbank stress appear to use FX, commodity, and credit derivatives held for trading purposes to increase their sensitivity to interbank stress risk. Conversely, BHCs with positive exposure to interbank stress use FX, equity, and commodity derivatives held for trading purposes to decrease their sensitivity to interbank stress. Further, similar to results associated with credit stress, BHCs with positive exposure to interbank stress use purchased credit derivatives to decrease their sensitivity to interbank stress. Again, this evidence is contrary to the conclusions of Minton et al.

Foreign exchange stress betas are the focus of Panel D. Yet again, BHCs with positive exposure to foreign exchange stress use derivatives held for trading to reduce their sensitivities; this time the reduction is done with interest rate, foreign exchange, equity, and commodity derivatives. Also, purchased credit derivatives reduce their sensitivities to foreign exchange stress.

Panel E shows that equity derivatives held for trading purposes decreases the sensitivity to equity stress, as does foreign exchange and commodity derivatives held for non-trading purposes. While sold credit derivatives increase the exposure to equity stress of BHCs with positive sensitivities, purchased credit derivatives decrease this exposure. Considering all the evidence together, interest rate, foreign exchange, equity, and commodity derivatives are generally used by BHCs with positive exposure to various financial stresses to reduce their sensitivities to these stresses. Interestingly, there is strong evidence that BHCs use purchased credit derivatives to reduce their positive sensitivities to all four types of financial stresses.

Although the VIX index is not a stand-alone component of the CFSI, we present the results from our analyses of VIX betas in Panel F. Here we see less evidence of risk reduction, with only foreign exchange derivatives held for trading purposes and commodity derivatives held for non-trading purposes reducing the sensitivities of exposed BHCs to the VIX. Also, unlike the evidence found for the CFSI components, credit derivatives play no role in risk reduction. However, there are no statically significant positive parameter estimates associated with any type of derivative usage, indicating that derivatives use is not increasing the sensitivity of banks to expected market volatility.

5.2 Stock Performance of Derivative Users versus Non-Derivative Users

Panel A of Table 5 presents the mean monthly returns of BHCs that use derivatives of any type and those that do not. A portfolio that goes long derivative-using BHCs and short BHCs that do not use derivatives earns -0.43% per month, although not statistically significant. However, this portfolio earns a Fama-French-Carhart (FFC) alpha of -0.60% per month that is statistically significant at the 10% level.

Panel B of Table 5 reports mean monthly returns of derivative users and non-users based on whether the BHCs are exposed or not to the four financial risk components of the CFSI. The mean returns (FFC alphas) of the portfolios long exposed derivative users and short exposed non-users range from -0.15% (0.04%) to -1.22% (-1.32%) per month, but all are not statistically significant across all four types of financial stresses. This indicates that the stock of exposed BHCs that use derivatives neither under- nor outperforms the stock of exposed BHCs that do not use derivatives. The analyses on the unexposed BHCs differ, however. While the mean returns of the long-short portfolios are statistically insignificant, the FFC alphas of the portfolios are statistically significant at the 10% level across all financial stresses and range from -0.58% to -0.70% per month. This suggests that exposed BHCs are better managing their derivative positions than unexposed BHCs, when compared to their non-derivative using counterparts. In other words, with respect to non-derivative using BHCs, investors perceive value in the derivative usage of exposed BHCs but regard derivative usage by unexposed BHCs as value-destroying.

5.3 Stock Performance of Exposed versus Unexposed Derivative Users

We narrow our portfolio analyses to only derivative users and compare the returns of exposed and unexposed BHCs. We first examine BHCs that use derivatives of any type, followed by specific types of derivative usage. The results are reported in Table 6. The majority of portfolios long exposed derivative users and short unexposed derivative users have positive mean returns and FFC alphas, but not statistically significant. The notable exceptions are equity and credit derivative users with respect to interbank stress. Of the equity derivative users, BHCs exposed interbank stresses outperform the unexposed BHCs by a risk-adjusted 1.74% per month (statistically significant at the 5% level). Of the credit derivative users, BHCs exposed interbank stresses outperform the unexposed BHCs by a risk-adjusted 2.36% per month (statistically significant at the 5% level). These differences in returns are economically large, and imply that the value creation by derivative use is concentrated in the management of interbank stress risk by those BHCs that are exposed to it.

6. Conclusions

Using implied volatility from options traded on banks, we are able to classify banks that are using derivatives to speculate versus hedge by linking their derivative use to the sensitivity of the banks' implied volatilities to the broad components of the Cleveland Fed's Financial Stress Index. We find implied volatilities especially useful, since they represent the financial markets' best estimates about the future risks of a given bank. The dispersion in banks' volatility betas can be associated with both the amount of derivative use and how the banks are using them. As such, banks can be identified as hedgers or speculators by how the estimated volatility betas react to the use of traded and non-traded derivatives. Specifically, if a derivative position increases (decreases) the elasticity to the sensitivities to financial stresses, then the position is speculative (a hedge). Our results suggest that banks that are positively exposed to various financial stress risks are using multiple derivatives to reduce their sensitivity to these stresses. Hence, these banks appear to use derivatives, particularly credit derivatives, to hedge against credit, interbank, foreign exchange, and equity stress factors.

We are also able to link derivative use by BHCs to stock performance. Using portfolio analyses, our findings show that, in general, BHCs that use derivatives underperform those that do not. However, further analyses demonstrate that derivative-using BHCs which are exposed to financial stresses perform similarly to non-using BHCs. It is the derivative-using BHCs that are unexposed to financial stresses that underperform their non-using counterparts. Additionally, when comparing exposed and unexposed derivative users, we find there is value creation by the exposed BHCs when they use equity and credit derivatives to reduce their risk sensitivity to interbank stresses.

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Table 1: Daily Variable Summary Statistics

Panel A of this table provides the summary statistics for the daily bank holding company (BHC) implied volatilities, the Cleveland Financial Stress Index components, and the VIX index, as well as the log differences between each of the variables. The variables are summarized from January 1996 through March 2014. Each table reports the number of observations (N), the mean (Mean), standard deviation (STD), 25% percentile (25%), median (Median), and 75% percentile (75%). Panel B displays the pairwise correlations between the log-differenced variables.

Panel A: Summary of Implied Volatilities and Financial Stress Indicators

	N	Mean	STD	25%	Median	75%
Mean Daily Implied Volatility (IV)	425,875	0.383	0.227	0.244	0.322	0.443
Credit Stress (CS)	4,426	9.906	1.939	8.59	9.55	11.03
Equity Stress (ES)	4,426	9.225	6.804	3.16	8.28	13.88
Foreign Exchange Stress (FXS)	4,426	6.350	3.871	2.72	6.09	9.61
Interbank Stress (IBS)	4,426	5.889	2.063	4.46	5.53	7.01
VIX	4,426	21.460	8.394	15.71	20.03	24.84

	N	Mean	STD	25%	Median	75%
$Ln(IV_t/IV_{t-1})$	425,875	-0.0004	0.146	-0.032	-0.001	0.029
$Ln(CS_t/CS_{t-1})$	4,426	-0.00014	0.0115	-0.0044	0	0.0051
$Ln(ES_t/ES_{t-1})$	4,426	0.00061	0.0383	-0.0132	0	0.0146
$Ln(FXS_t/FXS_{t-1})$	4,426	0.00005	0.0928	-0.0130	0	0.0122
$Ln(IBS_t/IBS_{t-1})$	4,426	-0.00025	0.0157	-0.0053	0.0018	0.0067
$Ln(VIX_t/VIX_{t-1})$	4,426	0.00059	0.0624	-0.0311	0.0038	0.0373

Panel B: Correlations

	$Ln(IV_t/IV_{t-1})$	$Ln(CS_t/CS_{t-1})$	$Ln(ES_t/ES_{t-1})$	$Ln(FXS_t/FXS_{t-1})$	$Ln(IBS_t/IBS_{t-1})$	$Ln(VIX_t/VIX_{t-1})$
$Ln(IV_t/IV_{t-1})$	1.0000					
$Ln(CS_t/CS_{t-1})$	0.0106	1.0000				
$Ln(ES_t/ES_{t-1})$	0.0206	0.2326	1.0000			
$Ln(FXS_t/FXS_{t-1})$	-0.0070	-0.0214	-0.0262	1.0000		
$Ln(IBS_t/IBS_{t-1})$	-0.0030	0.4099	-0.0075	-0.0018	1.0000	
$Ln(VIX_t/VIX_{t-1})$	-0.1357	-0.0076	-0.0725	0.0196	0.0379	1.0000

Table 2: Quarterly Variable Summary Statistics

Panel A of this table presents the notional and fair values of BHCs' derivatives positions in billions of dollars, as well as the total assets. The derivatives positions are reported to the Federal Reserve on the form FR Y-9C. The table reports the number of observations (N), the mean (Mean), standard deviation (STD), 25% percentile (25%), median (Median), and 75% percentile (75%). Panel B presents the correlations of the natural log of the notional and fair value derivative positions.

Panel A: Derivative Positions

	N	Mean	STD	25%	Median	75%
Total Assets	5375	98	286	7.04	16.1	56.7
Derivatives - Notional Values						
Interest Rate	5375	1360	7510	0.055	0.861	13.4
Foreign Exchange	5375	159	822	0	0.007	1.15
Equity	5375	32.9	194	0	0	0
Commodity	5375	18.3	119	0	0	0
Traded Interest Rate	5375	1330	7460	0	0.002	5.64
Traded FX	5375	157	811	0	0	0.558
Traded Equity	5375	32.8	194	0	0	0
Traded Commodity	5375	18.2	119	0	0	0
Non-Traded Interest Rate	5375	23.4	115	0.002	0.376	3.56
Non-Traded FX	5375	2.39	16.1	0	0	0.031
Non-Traded Equity	5375	0.156	2.21	0	0	0
Non-Traded Commodity	5375	0.074	0.834	0	0	0
Total Traded	5375	1540	8520	0	0.57	8.89
Total Non-Traded	5375	26	127	0.021	0.467	4.10
Total Derivatives	5375	1570	8590	0.104	1.06	18.4
Derivatives - Fair Values						
Interest Rate	5373	45.3	280	0.001	0.022	0.270
Foreign Exchange	5374	6.13	32.7	0	0.0001	0.037
Equity	5374	2.55	14.7	0	0	0
Commodity	5374	1.78	12.1	0	0	0
Traded Interest Rate	5374	44.5	276	0	0	0.104
Traded FX	5375	6.02	32.3	0	0	0.018
Traded Equity	5375	0.003	14.7	0	0	0
Traded Commodity	5375	0.002	12.1	0	0	0
Non-Traded Interest Rate	5375	0.799	6.35	0	0.006	0.090
Non-Traded FX	5375	0.109	0.762	0	0	0.001
Non-Traded Equity	5375	0.014	0.157	0	0	0
Non-Traded Commodity	5375	0.007	0.127	0	0	0
Total Traded	5374	54.8	328	0	0.001	0.180
Total Non-Traded	5374	0.926	7.04	0.002	0.009	0.109
Total Derivatives	5373	55.8	332	0.002	0.031	0.437

Panel B: Correlations of Derivative Positions

Log (Notional Value of Derivatives)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)Traded Interest Rate	1							
(2)Non-Traded Interest Rate	0.384	1						
(3)Traded FX	0.778	0.338	1					
(4)Non-Traded FX	0.362	0.360	0.406	1				
(5)Traded Equity	0.603	0.337	0.643	0.481	1			
(6)Non-Traded Equity	0.127	0.236	0.199	0.244	0.192	1		
(7)Traded Commodity	0.571	0.328	0.615	0.423	0.749	0.147	1	
(8)Non-Traded Commodity	0.081	0.193	0.079	0.273	0.173	0.250	0.171	1

Log (Fair Value of Derivatives)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)Traded Interest Rate	1							
(2)Non-Traded Interest Rate	0.470	1						
(3)Traded FX	0.791	0.406	1					
(4)Non-Traded FX	0.426	0.436	0.484	1				
(5)Traded Equity	0.660	0.397	0.683	0.524	1			
(6)Non-Traded Equity	0.139	0.260	0.214	0.264	0.199	1		
(7)Traded Commodity	0.621	0.387	0.641	0.464	0.765	0.153	1	
(8)Non-Traded Commodity	0.141	0.191	0.123	0.280	0.199	0.159	0.201	1

Table 3: Financial Stress Sensitivities

Panel A of this table reports the average volatility betas from the fixed-effect regression in equation (1):

$$\ln\left(\frac{IV_{i,t}}{IV_{i,t-1}}\right) = \alpha_i + \beta_{CS,i}\ln\left(\frac{CS_t}{CS_{t-1}}\right) + \beta_{ES,i}\ln\left(\frac{ES_t}{ES_{t-1}}\right) + \beta_{FXS,i}\ln\left(\frac{FXS_t}{FXS_{t-1}}\right) + \beta_{IBS,i}\ln\left(\frac{IBS_t}{IBS_{t-1}}\right) + \beta_{VIX,i}\ln\left(\frac{VIX_t}{VIX_{t-1}}\right) + \varepsilon_{i,t}$$

It also reports the percentage of the betas that are statistically significance and insignificant. The relative numbers of firms with positive, negative, and insignificant betas are also reported. Panel B of this table reports the correlations between the sensitivities.

Panel A: Summary Statistics

							At 5% Significance			At 10% Significance		
	N	Mean	STD	25%	Median	75%	% Neg	% Pos	% Insig	% Neg	% Pos	% Insig
CS	5375	0.144	2.037	-0.478	0.096	0.697	1.69	2.40	95.91	3.52	4.69	91.80
IBS	5375	-0.186	2.228	-0.649	-0.106	0.394	3.81	2.18	94.01	6.98	3.94	89.08
FXS	5375	-0.042	1.377	-0.161	-0.009	0.137	2.14	1.84	96.02	4.30	3.76	91.94
ES	5375	0.013	1.161	-0.194	0.013	0.196	1.21	1.79	97.00	3.05	3.96	92.99
VIX	5375	-0.265	0.387	-0.452	-0.225	-0.059	40.32	0.78	58.90	46.12	1.67	52.20

Panel B: Correlations

	CS	IBS	FXS	ES	VIX
CS	1				
IBS	-0.3311	1			
FXS	-0.0387	0.1062	1		
ES	-0.1319	-0.0620	0.0428	1	
VIX	0.0971	-0.0974	-0.0101	0.0342	1

Table 4: CFSI Sensitivities and Bank Derivative Positions

Panel A of this table reports the parameter estimates from the Heckman first stage Probit model in equation (2):

$$P(D\_USER_{i,q} = 1) = \Phi(\alpha + \gamma_1 EA_{i,q} + \gamma_2 GAP12_{i,q} + \gamma_3 EQWAR_{i,q} + \gamma_4 NPLR_{i,q} + \gamma_5 FXDAR_{i,q} + \gamma_6 FXDLR_{i,q} + \varepsilon_{i,q})$$

D_USER is set to one for banks who use any type of derivative reported in the FR Y9C report, and is equal to zero otherwise. *EA* is the earning assets of the bank i in quarter q. *GAP12* is the 12-month repricing. *EQWAR* is the ratio of tier one equity to risk weighted assets. *NPLR* is the ratio of non-performing loans to total assets. *FXDAR* is the ratio of foreign currency denominated assets to dollar denominated. *FXDLR* is the ratio of foreign currency denominated liabilities to dollar denominated liabilities. Z-statistics are shown in parentheses. Panels B through F report the parameter estimates from the regression specified in equations 3 and 4:

$$\tilde{\beta}_{k,i,q} = \alpha + \delta_{DT,j} \ln(D\_Traded_{j,i,q} + 1) + \delta_{DNT,j} \ln(D\_NonTraded_{j,i,q} + 1) + \delta_{DTP,j} \ln(D\_Traded_{i,q} + 1) * Exposed + \delta_{DNTP,j} \ln(D\_NonTraded_{j,i,q} + 1) * Exposed + \ln(ASSETS_{i,q}) + IMR_{i,q} + \varepsilon_{i,q}$$

and (for credit derivatives),

$$\tilde{\beta}_{k,i,q} = \alpha + \delta_{DT,j} \ln(D\_Sold_{j,i,q} + 1) + \delta_{DNT,j} \ln(D\_Purchased_{j,i,q} + 1) + \delta_{DTP,j} \ln(D\_Sold_{i,q} + 1) * Exposed + \delta_{DNTP,j} \ln(D\_Purchased_{j,i,q} + 1) * Exposed + \ln(ASSETS_{i,q}) + IMR_{i,q} + \varepsilon_{i,q}$$

For each quarter, q, there are five estimated vectors of volatility betas, , for each bank i where k the CFSI factor *CS, ES, FXS, IBS,* or *VIX*. There are four j types of derivatives traded include interest rate, foreign exchange, equity, and commodity. *D_Traded* (*Sold*, in the case of credit derivatives), or *D_T*, represents either the notional or fair value of derivatives used for trading while *D_NonTraded* (*Purchased*, in the case of credit derivatives), or *D_NT*, represents either the notional or fair value of derivatives used for non-trading. *Exposed* is a dummy variable that takes on a value of 1 when the respective estimated volatility betas for the CFSI factors are positive and statistically significant, and otherwise zero. *ASSETS* are the value of the bank's assets. *IMR* is the inverse Mills ratio computed from the first stage. Robust t-statistics are presented in parentheses. Standard errors are clustered by firm. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: First Stage Probit Regression

	D_User=1
Log(Earning Assets)	0.664***
	(28.77)
Log(12 Month Maturity Gap)	0.116
	(0.64)
Log(Tier One Equity/Risk Weighted Assets)	-2.814***
	(-5.47)
Log(Non-Performing Loan/Total Loan)	-4.906***
	(-4.79)
Log(Foreign Currency Denominated Assets/Dollar Denominated Assets)	2.737***
	(3.35)
Log(Foreign Currency Denominated Liabilities/Dollar Denominated Liabilities)	0.952*
	(1.76)
Constant	-10.060***
	(-30.35)
Observations	99364
Robust z statistics in parentheses	

*** p<0.01, ** p<0.05, * p<0.1

Panel B: Second Stage Regressions (Notional Values) – Credit Stress Betas

	Interest Rate Derivatives	FX Derivatives	Equity Derivatives	Commodity Derivatives	Credit Derivatives
Ln(D_Traded/Sold)	0.003	-0.005	0.002	-0.003	-0.026*
	(0.34)	(-0.51)	(0.56)	(-0.43)	(-1.89)
Ln(D_Non-Traded/Purchased)	-0.009	0.010*	-0.006	-0.003	0.009
	(-1.02)	(1.69)	(-0.70)	(-0.36)	(0.62)
Ln(D_T/S)*Exposed	-0.084***	-0.049*	-0.075**	-0.075**	0.018
	(-2.59)	(-1.83)	(-2.46)	(-2.31)	(0.35)
Ln(D_NT/P)*Exposed	-0.027	-0.098***	-0.074**	-0.040	-0.133**
	(-0.62)	(-2.99)	(-2.03)	(-1.01)	(-2.46)
Exposed	4.235***	4.039***	3.578***	3.464***	4.192***
	(6.69)	(7.78)	(8.11)	(8.36)	(7.89)
Ln(Assets)	-0.144	-0.172	-0.160	-0.165	-0.279
	(-1.05)	(-1.25)	(-1.15)	(-1.20)	(-1.19)
IMR	-0.146	-0.155	-0.148	-0.124	0.048
	(-1.23)	(-1.32)	(-1.20)	(-1.02)	(0.15)
Constant	2.123	2.552	2.339	2.410	4.502
	(0.99)	(1.18)	(1.07)	(1.11)	(1.18)
OBS	5375	5375	5375	5375	3800
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes

Panel C: Second Stage Regressions (Notional Values) – Interbank Stress Betas

	Interest Rate Derivatives	FX Derivatives	Equity Derivatives	Commodity Derivatives	Credit Derivatives
Ln(D_Traded/Sold)	-0.000	0.026***	0.012	0.014*	0.031**
	(-0.00)	(2.59)	(1.18)	(1.88)	(2.15)
Ln(D_Non-Traded/Purchased)	0.004	0.016**	0.005	0.020**	-0.010
	(0.54)	(1.99)	(0.70)	(2.02)	(-0.72)
Ln(D_T/S)*Exposed	-0.033	-0.107***	-0.087***	-0.087***	0.054
	(-1.11)	(-3.23)	(-2.87)	(-2.75)	(1.24)
Ln(D_NT/P)*Exposed	-0.099*	-0.050	-0.079*	-0.039	-0.176***
	(-1.91)	(-1.54)	(-1.96)	(-0.70)	(-3.02)
Exposed	4.129***	3.783***	3.154***	3.060***	3.764***
	(5.01)	(5.98)	(6.30)	(6.29)	(5.07)
Ln(Assets)	-0.131	-0.213**	-0.153*	-0.159*	-0.069
	(-1.43)	(-2.26)	(-1.71)	(-1.86)	(-0.41)
IMR	-0.121	-0.203	-0.157	-0.174	-0.037
	(-0.90)	(-1.48)	(-1.19)	(-1.56)	(-0.11)
Constant	1.862	3.144**	2.292	2.411*	0.825
	(1.29)	(2.10)	(1.62)	(1.80)	(0.30)
OBS	5375	5375	5375	5375	3800
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes

Panel D: Second Stage Regressions (Notional Values) – Foreign Exchange Stress Betas

	Interest Rate Derivatives	FX Derivatives	Equity Derivatives	Commodity Derivatives	Credit Derivatives
Ln(D_Traded/Sold)	-0.001	0.004	-0.001	0.005	-0.006
	(-0.15)	(0.61)	(-0.17)	(1.36)	(-0.47)
Ln(D_Non-Traded/Purchased)	0.002	0.002	-0.002	0.005***	0.026*
	(0.32)	(0.59)	(-0.65)	(4.39)	(1.65)
Ln(D_T/S)*Exposed	-0.077***	-0.070***	-0.056***	-0.057***	0.092
	(-2.74)	(-2.94)	(-3.04)	(-2.70)	(1.23)
Ln(D_NT/P)*Exposed	0.049	0.028	0.055*	0.022	-0.121**
	(1.33)	(1.18)	(1.80)	(0.50)	(-2.36)
Exposed	1.373***	1.628***	1.384***	1.412***	2.017***
	(3.47)	(4.54)	(4.56)	(4.56)	(4.28)
Ln(Assets)	0.127	0.122	0.130	0.119	-0.044
	(1.51)	(1.41)	(1.54)	(1.43)	(-0.26)
IMR	0.138	0.117	0.143	0.112	-0.104
	(1.10)	(0.90)	(1.08)	(0.91)	(-0.54)
Constant	-2.113	-2.035	-2.154	-1.953	0.379
	(-1.60)	(-1.49)	(-1.61)	(-1.49)	(0.14)
OBS	5375	5375	5375	5375	3800
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes

Panel E: Second Stage Regressions (Notional Values) – Equity Stress Betas

	Interest Rate Derivatives	FX Derivatives	Equity Derivatives	Commodity Derivatives	Credit Derivatives
Ln(D_Traded/Sold)	0.007	0.001	0.003*	0.002	-0.003
	(1.12)	(0.13)	(1.76)	(0.51)	(-0.20)
Ln(D_Non-Traded/Purchased)	-0.004	-0.003	0.005	-0.001	0.007
	(-0.60)	(-0.71)	(0.87)	(-0.15)	(0.47)
Ln(D_T/S)*Exposed	-0.008	-0.016	-0.025*	-0.015	0.053*
	(-0.67)	(-1.48)	(-1.78)	(-1.06)	(1.91)
Ln(D_NT/P)*Exposed	-0.006	-0.040***	-0.013	-0.036**	-0.072***
	(-0.53)	(-3.00)	(-0.81)	(-2.27)	(-3.06)
Exposed	1.150***	1.303***	1.071***	1.052***	1.185***
	(7.16)	(6.69)	(6.97)	(7.02)	(6.03)
Ln(Assets)	-0.083**	-0.069*	-0.089**	-0.078*	-0.062
	(-2.00)	(-1.92)	(-2.06)	(-1.95)	(-0.72)
IMR	-0.163**	-0.146**	-0.172**	-0.160**	-0.302
	(-2.21)	(-2.10)	(-2.27)	(-2.09)	(-1.19)
Constant	1.246*	1.030*	1.376**	1.197*	1.051
	(1.86)	(1.79)	(1.96)	(1.84)	(0.70)
OBS	5375	5375	5375	5375	3800
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes

Panel F: Second Stage Regressions (Notional Values) – VIX Betas

	Interest Rate Derivatives	FX Derivatives	Equity Derivatives	Commodity Derivatives	Credit Derivatives
Ln(D_Traded/Sold)	0.000	-0.001	-0.004*	-0.001	-0.002
	(0.06)	(-0.30)	(-1.84)	(-0.63)	(-0.34)
Ln(D_Non-Traded/Purchased)	0.002	-0.001	-0.002	0.003	-0.001
	(1.46)	(-0.44)	(-0.73)	(1.00)	(-0.31)
Ln(D_T/S)*Exposed	-0.012	-0.028***	0.001	0.008	-0.017
	(-1.17)	(-2.94)	(0.10)	(1.21)	(-0.75)
Ln(D_NT/P)*Exposed	0.016	-0.004	0.014	-0.032***	0.020
	(1.32)	(-0.24)	(0.45)	(-3.04)	(0.75)
Exposed	0.707***	0.881***	0.789***	0.799***	1.025***
	(4.80)	(8.01)	(8.50)	(8.05)	(8.12)
Ln(Assets)	-0.086***	-0.074***	-0.070***	-0.082***	-0.027
	(-3.57)	(-2.95)	(-2.96)	(-3.56)	(-0.73)
IMR	-0.112***	-0.112***	-0.095**	-0.115***	0.108
	(-2.70)	(-2.64)	(-2.08)	(-2.70)	(1.46)
Constant	1.398***	1.233***	1.150***	1.351***	0.175
	(3.59)	(3.05)	(2.93)	(3.58)	(0.29)
OBS	5375	5375	5375	5375	3800
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes

Table 5: Stock Performance of Bank Holding Companies

Panel A reports the mean monthly returns of BHCs that use derivatives of any type and those that do not. It also reports the differences in these returns as well as the risk-adjusted alphas using the Fama-French-Carhart model (FFC). Panel B reports mean monthly returns (and mean return and risk adjusted alpha differences) of derivative users and non-users based on whether or not the BHCs are exposed or not to the four financial risk components of the CFSI. T-statistics are reported in parentheses. * indicates statistical significance at the 10% level.

Panel A: Derivative Users versus Non-users

	Mean Monthly Return (%)
Derivative Users (U)	0.78
Derivative Non-Users (NU)	1.21
U-NU	-0.43
	(-1.25)
FFC Alpha (U-NU)	-0.60*
	(-1.71)

Panel B: Derivative Users versus Non-users Conditional on Stress Exposure

	Credit Stress		Interbank Stress		FX Stress		Equity Stress	
	Exposed	Unexposed	Exposed	Unexposed	Exposed	Unexposed	Exposed	Unexposed
Derivative Users (U)	0.86	0.76	0.58	0.96	0.66	0.78	1.13	0.78
Derivative Non-Users (NU)	1.65	1.21	1.74	1.41	1.43	1.19	1.29	1.27
U-NU	-0.87	-0.45	-1.22	-0.53	-0.99	-0.42	-0.15	-0.49
	(-0.84)	(-1.29)	(-1.42)	(-1.48)	(-0.37)	(-1.21)	(-0.13)	(-1.38)
FFC Alpha (U-NU)	-1.20	-0.62*	-1.32	-0.70*	-1.05	-0.58*	0.04	-0.65*
	(-1.22)	(-1.75)	(-1.49)	(1.93)	(-0.33)	(-1.65)	(0.03)	(-1.84)

Table 6: Stock Performance of Derivative Using Bank Holding Companies: Stress Factor Exposed versus Unexposed

This table reports the mean monthly returns of BHCs derivatives users that are exposed to CFSI components and those that are not. The table breaks up the sample into categories based what types of derivatives the BHCs use. It also reports the differences in these returns as well as the risk-adjusted alpha differences using the Fama-French-Carhart (FFC) model. T-statistics are reported in parentheses. ** indicates statistical significance at the 5% level.

	CFSI Stress Factors			
Derivative Users (Any)	Credit	Interbank	FX	Equity
Exposed	1.08	0.58	0.79	0.86
Unexposed	0.96	0.55	0.42	0.96
Exposed - Unexposed	0.13	0.03	0.37	-0.08
	(0.29)	(0.06)	(0.96)	(-0.19)
FFC Alpha (Ex-Unex)	0.53	-0.06	0.26	-0.06
	(1.08)	(-0.11)	(0.60)	(-0.12)

	CFSI Stress Factors			
Equity Derivative Users	Credit	Interbank	FX	Equity
Exposed	1.79	2.95	-0.53	0.35
Unexposed	0.68	1.54	-0.85	-0.80
Exposed - Unexposed	1.11	1.42**	0.32	1.15
	(1.00)	(2.03)	(0.48)	(1.25)
FFC Alpha (Ex-Unex)	1.69	1.74**	0.19	1.05
	(1.34)	(2.40)	(0.25)	(1.10)

	CFSI Stress Factors			
Interest Rate Derivative Users	Credit	Interbank	FX	Equity
Exposed	1.14	0.72	0.77	0.86
Unexposed	0.96	0.74	0.41	1.03
Exposed - Unexposed	0.18	0.18	0.35	-0.14
	(0.41)	(0.36)	(0.90)	(-0.34)
FFC Alpha (Ex-Unex)	0.64	0.26	0.24	-0.07
	(1.31)	(0.42)	(0.55)	(-0.15)

	CFSI Stress Factors			
Commodity Derivative Users	Credit	Interbank	FX	Equity
Exposed	3.68	2.39	-0.64	0.51
Unexposed	1.26	1.86	-1.34	0.14
Exposed - Unexposed	2.42	0.52	0.71	0.37
	(1.54)	(0.63)	(0.91)	(0.36)
FFC Alpha (Ex-Unex)	3.20	1.02	0.70	0.59
	(1.61)	(1.21)	(0.79)	(0.55)

	CFSI Stress Factors			
FX Derivative Users	Credit	Interbank	FX	Equity
Exposed	1.82	0.48	0.33	0.68
Unexposed	1.02	0.50	0.31	0.88
Exposed - Unexposed	0.80	-0.03	0.02	-0.19
	(1.56)	(-0.05)	(0.04)	(-0.40)
FFC Alpha (Ex-Unex)	1.01	-0.22	0.12	-0.17
	(1.62)	(-0.32)	(0.21)	(-0.32)

	CFSI Stress Factors			
Credit Derivative Users	Credit	Interbank	FX	Equity
Exposed	2.85	2.79	-2.23	-1.31
Unexposed	0.70	0.79	-2.24	-0.35
Exposed - Unexposed	2.15	2.00**	-0.01	-0.96
	(1.27)	(2.14)	(-0.01)	(-0.68)
FFC Alpha (Ex-Unex)	3.16	2.36**	-0.19	-0.78
	(1.52)	(2.22)	(-0.16)	(-0.52)