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The Trading and Non-trading Derivatives Activities of U.S. Bank Holding Companies

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A B S T R A C T

We document the trading and non-trading derivatives activities reported by U.S. bank holding companies between 1995 and 2013. The overall bank derivatives activities, especially their reported trading activities, have increased substantially. The evidence indicates that the U.S. banks trade derivatives to supplement their poor cash flows and/or incomes generated in traditional banking businesses and that the derivatives reported for trading purposes are used somewhat for speculative activities. We also find that the bank derivatives reported for non-trading purposes are used to balance operational risk and to smooth cash flows.

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1. Introduction

In this paper, we investigate the derivatives activities of U.S. Bank Holding Companies (BHCs) from 1995 to 2013. According to the U.S. Office of the Comptroller of the Currency (OCC), the notional amounts of derivatives in the commercial bank portfolios grew from $16.86 trillion to $237 trillion during this period.[1] Furthermore, most of the derivatives activities, $221 trillion as of 2013 for example, were reported for trading purposes distinct from non-trading purposes. Despite the facts that the derivatives usage (by notional amount) reported for trading purposes by the commercial banks accounts for the lion's share in their total derivatives activities and that it increases dramatically, most recent academic studies focus on derivatives hedging properties. Represented by Brewer III, Deshmukh, and Opiela (2014), Brewer III, Minton, and Moser (2000), Minton, Stulz, and Williamson (2009), and Purnanandam (2007), these studies generally conclude that derivatives help banks hedge risk, thereby improving their lending capacity. The financial crisis of 2007–2010 as well as some following scandals aroused the attention to the risk inherent in derivatives activities of commercial banks. For example, on May 10, 2012, JP Morgan revealed a $2.3 billion-dollar loss due to its derivatives trading activities and this loss totaled $5.8 billion as of July 13.[2] In 2010, the Volcker Rule and Collins Amendment, which were enacted as part of the Dodd-Frank Act, put some new regulations and restrictions on derivatives activities for U.S. bank holding companies. Meanwhile, academics have turned to the risk effect of derivatives activities. Li and Yu (2010) conclude that derivatives transactions may increase the commercial banks' overall risk when derivatives positions are used to speculate, though derivatives activities could improve the bank profitability

However, our understanding of the commercial bank derivatives activities is far from clear, mainly because of the coarse reporting requirements of BHCs' derivatives transactions. BHCs follow the guidelines established by the Federal Reserve Board to determine the amount of derivatives reported for non-trading (hedging) and trading purposes. Generally, the derivatives positions reported for trading purposes include both speculating and dealing activities. Thus, it is difficult to determine the proportion of the trading activities that are due to speculating or dealing activities. Therefore, the purpose of this study is twofold; first we separately document and compare the notional amounts of derivatives reported for trading and non-trading purposes by BHCs in order to provide a more complete picture of their derivatives usage. Second, we document and compare several interesting correlations between bank characteristics and BHCs' reported trading and non-trading derivatives activities. The goal of the latter analysis is to provide policy makers, academics, and market participants with a better understanding of the motivations behind BHCs' derivatives usage.

While the OCC provides quarterly reports of aggregate BHC trading and non-trading activities, here we provide a more detailed analysis at the bank level. Consistent with the information provided by the OCC, we document that BHCs' usage of derivatives reported for trading purposes is largely concentrated in interest rate (IR) and foreign exchange (FX) products. The proportion of BHCs that report IR derivatives for trading purposes has increased by 52% during our sample period. This increase is also accompanied by a 140% increase in the average notional amount of IR derivatives reported for trading purposes scaled by total assets. This

[1] See "Quarterly Derivatives Fact Sheet" Q4 1995 and "Quarterly Report on Bank Trading and Derivatives Activities" Q4 2013 by U.S. Office of the Comptroller of the Currency (https://occ.gov/).
[2] May 11, 2012, The Wall Street Journal and July 13, 2012, CNNMoney.

suggests that not only are there more banks as a percentage of those reporting to the Federal Reserve participating in derivatives trading activities, but they are also allocating more resources to trading activities on average. Further, this growth has outpaced the 28% growth in the proportion of BHCs reporting IR derivatives for non-trading activities and the 10% growth in the average notional amount of IR derivatives reported for non-trading purposes scaled by total assets. By and large, the results suggest that the derivatives trading activities represent an increasingly important part of BHCs' overall business activities. In addition, we find strong positive correlations between the notional amounts of the different types of derivatives contracts reported for trading purposes but much lower correlations between those reported for non-trading purposes. This suggests that BHCs coordinate their trading activities across different derivatives markets. We also find lower correlations between the derivatives reported for trading and for non-trading purposes. This interesting finding may suggest that trading and non-trading activities are largely separate processes.

As mentioned before, the majority of the existing literature focuses on the hedging benefits of derivatives. The prior work examines either the derivatives reported as non-trading, which are most likely to be used for hedging purposes (e.g., Purnanandam, 2007), or the combined amounts of derivatives reported as trading and non-trading (e.g., Brewer III et al., 2000; Brewer III et al., 2014).[3] In this paper, we separately model the determinants of BHCs' usage of derivatives reported as trading and non-trading. Furthermore, we examine the determinants of several types of derivatives, namely, interest rate (IR), foreign exchange (FX), equity (EQ), and commodity (CM) derivatives as opposed to focusing solely on interest rate derivatives or credit derivatives (e.g., Minton et al., 2009). Our goal here is to better understand the overall role that derivatives play in the banking business.

We find evidence consistent with BHCs using trading activities to improve cash flows following periods of poor earnings performance. Also we find the evidence related to speculation and market timing. First, we hypothesize that banks known for taking risk in other business areas may be more likely to speculate on derivatives markets. Interestingly, we find that trading activities are generally positively correlated with past and current operational risk taking. Second, we hypothesize that banks may time the volatility of derivatives' underlying markets to make speculative profits. Consistent with this hypothesis, our results show that a large part of BHCs' trading activities are positively associated with underlying market volatility. In our knowledge, these findings are new to the literature about the commercial banks' speculative activities on derivatives markets.

Examining potential motivations for BHCs' non-trading activities, we find evidence that BHCs use non-trading activities to smooth cash flows. Specifically, the notional amounts of derivatives used for non-trading purposes are positively related to the average absolute changes in cash flows scaled by total assets over the previous four quarters. We also find evidence that BHCs use non-trading activities to hedge their operating risk; in most of our tests, non-trading notional amounts are positively correlated with the overall operational risk that BHCs are bearing.

Due to the limited nature of our dependent variable, we employ tobit regressions in all of our analysis to account for any bias resulting from our left censored sample. However, because the tobit model does not allow for bank fixed effects, our results may be susceptible to omitted

[3] Brewer III, Minton, and Moser (2000) separately examine the role of swaps and futures to tease out the role that banks play as dealers. However, they are unable to separately examine derivatives reported as trading and non-trading due to their sample period.

variable bias. We thus repeat all of our analysis using a fixed effects model to account for potentially confounding unobservable time invariant bank characteristics. The results of this additional analysis are qualitatively similar to those presented by the tobit model. Additionally, because the majority of BHCs' derivatives activities (by notional amount) are concentrated in the top four banks in the sample, we repeat all of our analyses eliminating these banks from the sample. The results from this analysis are virtually unchanged from our original analyses giving us confidence in the generality of the results.

The paper proceeds as follows. Section 2 reviews the relevant literature and outlines several hypotheses related to BHC's derivatives usage. Section 3 describes the data used in the study and presents summary statistics. Section 4 presents our main analysis. Section 5 discusses robustness tests. Finally, Section 6 concludes the paper.

2. Hypothesis Development

Derivatives are a double-edged sword that can be used for both speculating and hedging. Speculating with derivatives is thought to be highly risky and can generate quick profits or losses. The volatility of underlying assets is a key factor in determining expected speculative profit or loss. Hedging strategies, on the other hand, are used to minimize the variation of the value of a portfolio of underlying assets and derivatives. The volatility of underlying assets is also a key consideration in hedging as BHCs try to stabilize cash flows. Academics have documented the incentives for firms to hedge and speculate as more financial information about the use of derivatives has become available. In this section, we briefly review the relevant studies and develop hypotheses about the motivations that BHCs undertake for trading and non-trading derivatives activities.

Motivations for Trading Derivatives Activities

The speculative use of derivatives can change BHCs' risk profile. Prior banking literature generally discusses bank risk taking in conventional businesses, for example, the mismatch of assets and liabilities. Boyd and De Nicol (2005), in their revisit of the theory on bank risk taking and competition, suggest considering the loan side of the balance sheet together with deposits to determine the overall risk-taking behavior, a perspective expanding the prior literature that focuses on the deposit side. Gatev, Schuermann, and Strahan (2007) examine liquidity risk in banks and conclude that deposit-lending synergies mitigate liquidity risk. Despite several studies on bank risk-taking and risk management, the effects associated with bank derivatives trading are still an incipient area of research. In their trailblazing work, Gczy, Minton, and Schrand (2007) suggest that firms view speculation as a profitable activity, not merely a risk seeking activity because they have information and cost advantages. Inspired by this idea, we hypothesize that the pressure to improve poor earnings performance might be a factor that motivates BHCs to speculate on the derivatives markets. The managements of BHCs that experience a lower level of cash flow and/or net income are usually questioned by shareholders and analysts, and may be pressured to engage in off-balance-sheet trading activities to make quick money. Thus, we propose our first hypothesis.

Hypothesis 1 (Earnings performance pressure): BHCs use derivatives for trading purposes as a means to make quick money to improve their poor earnings performance.

BHCs' may endogenously form their risk taking culture over time. Ellul and Yerramilli

(2013) refer to this endogenously determined risk taking culture as a "business model channel" vis-a-vis the bank risk control mechanism. Further, Fahlenbrach, Prilmeier, and Stulz (2012) argue that this business model channel is persistent based on their finding that the U.S. banks' performance in the 1998 crisis forecasts their performance during the financial crisis of 2007-2008. A BHC with a risking culture may prefer to hire aggressive managers and/or to insert risk- taking incentives into executive compensation contracts. Additionally, managers may be inculcated by this risk favoring culture or stimulated by the terms encouraging risk taking in their contracts to be more aggressive. DeYoung, Peng, and Yan (2013) find a strong link between the risk-taking incentives in the CEO compensation contracts and the financially risky business policies of U.S. commercial banks. On the other hand, bank managers' personalities, including their risk preferences, may contribute to their banks' business culture. A bank led by an adventurous CEO would take more risk in its business. As a result, the business model or risk culture might be manifested in banks' risk-taking behavior and risk management. A bank with a historical risk-seeking propensity might own more risky assets but fewer secured assets, finance its assets with fewer deposits but more market borrowings, and, not surprisingly, engage in more speculative derivatives activities. Thus, we propose our second hypothesis.

Hypothesis 2 (Risk taking): BHCs with a risk-taking culture or nature are more likely to use derivatives for trading purposes.

Motivations for Non-trading Derivatives Activities

Risk management theory has examined the relationship between firm value and hedging activities. Froot, Scharfstein, and Stein (1993) argue that hedging can be a value increasing activity as it helps ensure that a corporation has sufficient internal funds available to take advantage of attractive investment opportunities. Smith and Stulz (1985) maintain that hedging narrows the distribution of firm value outcomes and, in turn, reduces the expected costs of financial distress, therefore increasing the value of a levered firm. Furthermore, because financial distress might make equity holders decline positive net present value projects if the gains accrue primarily to fixed claimholders (Myers, 1977), hedging reduces the probability of distress and the likelihood that equity holders would find it beneficial to pass up valuable projects. There also exist tax incentives to hedge the volatility of cash flows and income. One such benefit arises from the concavity of corporate taxes in a firm's expected profits (Smith and Stulz, 1985). Further, Stulz (1996) and Leland (1998) argue that a reduction in cash flow volatility through hedging can increase debt capacity and generate greater tax benefits. Thus we propose our third hypothesis.

Hypothesis 3 (Cash flow smoothing): BHCs with more volatile cash flows are more likely to use derivatives for non-trading purposes.

Derivatives may help BHCs hedge their operational risk exposure. For example, liquidity affects both the safety and profitability of firms and is arguably a more important characteristic for banking institutions than for industrial firms. Lower short-term liquidity is thought to increase bankruptcy costs (Nance, Smith, and Smithson, 1993), while higher liquidity may be kept at the expense of profitability. Brewer, Jackson, and Moser (2001) find that banks using derivatives to manage interest rate risk hold lower levels of capital, suggesting that derivatives usage allows banks to substitute risk management for capital. Additionally, Purnanandam (2007) finds that banks are more likely to use derivatives to manage financial distress. Overall, the

hedging theories (Ellul and Yerramilli, 2013; Froot, Scharfstein, and Stein 1993; Smith and Stulz, 1985) predict that banks have a self-control function — optimally balancing risks in different areas. Thus, we propose the following hypothesis.

Hypothesis 4 (Risk balancing): Banks faced with higher operational risk are more likely to use derivatives for non-trading purposes.

3. Data

Bank holding companies file their consolidated financial statements with the Federal Reserve using form FR Y-9C each quarter.[4] As is common in the literature, we apply the following screens to the bank-quarter observations in the FR Y-9C dataset: (a) U.S. bank holding companies with a non-missing values of total assets over the sample period; (b) the bank-quarters with total loans greater than zero (we exclude non-commercial banks such as investment banks); (c) the bank-quarters with total assets no more than the previous quarter by 50% (we exclude the bank-quarters where the bank undertook a major acquisition; (d) the sample period between the first quarter of 1995, the first time BHCs reported their holdings of derivative contracts, and the last quarter of 2013, the last quarter the FR Y-9C data was available when this study was updated. After eliminating bank-quarters with missing data, these criteria create the main sample that we use to document U.S banks' derivatives activities. The main sample comprises 85,804 bank-quarter observations involving 3,233 unique commercial banks.

Main Variables and Summary Statistics

Table 1 reports the summary statistics for the main variables used in the study. The summary statistics are computed using the last quarter of each year in the sample. For narrative convenience, we define the key variables before moving on. In our empirical analysis, we use variants of some variables. The complete list of variables and the details regarding their construction is reported in Appendix A.

We use the gross notional amount of derivative contracts scaled by a BHC's total assets to proxy for BHCs' derivatives activities. When combined with trading or non-trading, it refers to the scaled notional amount of derivative contracts reported for trading or non-trading purposes. For instance, *IR-trading* is used to refer to a BHC's total notional amount of interest rate products for trading purposes scaled by total assets.

A series of variables is introduced to describe BHCs' earnings performance. The two key variables that we use in our analysis are *CF*, measuring cash flow (the sum of total interest income, total non-interest income, and realized gains (`losses) on held-to-maturity securities and available-for-sale securities), and *ROA*, measuring net income. Both of these variables are scaled by total assets. Following Guay and Kothari (2003), we develop two variables to capture the fluctuations in *CF* and *ROA*. *WaveCF*, measuring the oscillation of a BHC's cash flow, is defined as the absolute changes of quarterly *CF* averaged over the previous four quarters. *WaveROA* measures the variation of a BHC's *ROA* in the same manner described for *WaveCF*.

[4] By the Bank Holding Company Act of 1956, a bank holding company is broadly defined as "any company which has control over any bank". All bank holding companies in the United States are required to register with the Board of Governors of the Federal Reserve System.

Table 1: Summary Statistics (Main Sample).

Variable	N	Mean	SD	Min	Q1	Q2	Q3	Max
Assets($Billions)	21,864	10.57	93.01	0.041	0.375	0.675	1.493	2,427
Size	21,864	6.877	1.400	3.716	5.928	6.514	7.309	14.70
Growth	21,864	0.168	20.17	-1,141	-0.093	0.080	0.244	1,259
Loans	21,864	0.650	0.133	0.010	0.578	0.665	0.740	1.182
CF	21,864	0.071	0.031	-0.036	0.058	0.068	0.079	0.916
ROA	21,864	0.009	0.013	-0.787	0.006	0.010	0.013	0.267
Int.income	21,864	0.058	0.016	0.001	0.048	0.057	0.069	0.555
non-Int.income	21,864	0.013	0.026	-0.099	0.006	0.009	0.013	0.895
WaveCF	21,864	0.027	0.011	0.006	0.022	0.026	0.030	0.408
WaveROA	21,864	0.004	0.004	0.000	0.003	0.004	0.005	0.101
Cap.ratio	21,864	0.092	0.038	-0.678	0.073	0.088	0.104	0.826
C&I.ratio	21,864	0.105	0.069	0.000	0.058	0.092	0.137	0.579
Depo.ratio	21,864	0.653	0.132	0.000	0.595	0.678	0.742	0.912
Liq.ratio	21,864	0.297	0.129	0.004	0.205	0.281	0.370	0.949
RCI	21,864	-0.004	1.141	-11.86	-0.624	0.062	0.686	6.473

Note: This table present the summary statistics for the key variables in the study. We report summary statistics for the last quarter of each year in the sample period between 1995 and 2013. Each of the variables are described in Appendix A.

We develop an index to describe a BHC's operational risk exposure. As discussed in Section 2.2, BHCs face several sources of operational risk. We thus combine several different measures from the balance sheet to form our measure of a BHC's overall operational risk. Traditionally, the ratio of total equity to total assets, *Cap.ratio*, is used to measure a BHC's risk taking in capital management. Commercial and industrial loans are usually thought to be the most risky loans since these loans are more exposed to market fluctuations. We use commercial and industrial loans over total loans, *C&I.ratio*, to measure the risk taking in loan portfolio management. As BHCs diversify their funding sources to include the overnight loan markets, such as the federal funds market, and to new financial instruments, such as negotiable CDs, deposits have become a relatively cheap and stable form of financing. Among the total deposits, core deposits, calculated as total deposits minus total time deposits of over $100,000 and total brokered retail deposits, are the most stable source of funds for lending because they are less vulnerable to changes in short-term interest rates. We use core deposits over total assets, *Depo.ratio,* to describe a BHC's risk taking in fund management. BHCs have to keep a reasonable level of liquid assets in case of unexpected withdrawals and expenditures; therefore, the ratio of liquid assets to total assets, *Liq.ratio*, reflects a BHC's risk-taking in liquidity management.

We then construct a Risk Condition Index (*RCI*) by taking the first principal component of the four risk taking variables to measure the overall operational risk exposure in each bank-quarter. For purposes of the principle component analysis we convert each of the risk variables so that higher values of the variables indicates higher risk taking (e.g. one minus *Cap.ratio*). By construction, the greater the value of the index, the higher level of operational risk a BHC is exposed to. The four risk taking variables may not necessarily correlate with each other in

the same direction because these variables also reflect the bank policies beyond risk taking, such as leverage choice and clientele preference, and/or because banks balance their risks in different areas. The main advantage of the principle component approach is that we can measure the across-the-board risk profile of a bank with a single, variance-maximized variable by reducing the dimensionality of the dataset. Additionally, the extent to which these variables are connected to non-risk taking components is minimized by putting them together into an index based on Principal Components Analysis (Bharath, Pasquariello, and Wu, 2009). *RCI* is computed using the main sample including four quarters prior to the quarter when a BHC began reporting its derivatives positions so that we save more information. After getting *RCI*, we compute the average of *RCI* over the previous four quarters, *avg.RCI*, to proxy for a BHC's risk-taking propensity.

Size is the logarithm of total assets (in millions) adjusted by annual CPI deflator to 2013 dollars. Larger BHCs are more likely to get involved in the derivatives activities possibly because of economies of scale (Brewer et al., 2001; Graham and Rogers, 2002; Nance et al., 1993). The growth rate of the net income over the previous four quarters, denoted *Growth*, controls for BHCs' growth potential. A commercial bank with more loans may have fewer speculative activities but more hedging activities (Brewer et al., 2001) so we include the ratio of total loans to total assets, denoted *Loans*, in the regressions as a control variable.

In Table 1, we present the summary statistics of the key variables in the main sample. These summary statistics provide us with a general picture about the distributions of the key control variables used in the regression samples. Table 1 shows that the size of BHCs, in terms of the CPI-adjusted book value of total assets, has a highly skewed distribution— more than three quarters of the entire sample have total assets below the sample mean, while the distribution of *Size*, the logarithm of total assets, is much less skewed, with its mean approximately equal to its median. Some variables, such as *Growth* and *Cap.ratio*, have obvious outliers. The samples used in the regressions will be winsorized at the 1^{st} and 99^{th} percentiles to mitigate the effects from outliers and data errors.

Derivatives Used for Trading and Non-trading Activities

BHCs report their derivatives holdings in four categories: interest rate derivative contracts, foreign exchange derivative contracts, equity derivative contracts, and commodity derivative contracts. For each category, BHCs report the gross notional amounts classified by the type of contract—futures contracts, forward contracts, option contracts, and swaps—as well as the total gross amount of derivative contracts separated as for trading purposes and for purposes other than trading. The Federal Reserve System defines the derivatives trading and non-trading activities as follows: derivatives used for trading activities include (a) regularly dealing in interest rate contracts, foreign exchange contracts, equity derivative contracts, and other off-balance-sheet commodity contracts, (b) acquiring or taking positions in such items principally for the purpose of selling in the near term or otherwise with the intent to resell (or repurchase) in order to profit from short-term price movements, or (c) acquiring or taking positions in such items as an accommodation to customers. Derivative instruments used to hedge trading activities are also included as trading activities.

Derivatives activities reported for non-trading purposes include (a) off-balance-sheet contracts used to hedge debt and equity securities classified as available-for-sale, (b) foreign exchange contracts that are designated as, and are effective as, economic hedges of a net investment in a foreign office, (c) intercompany foreign exchange contracts of a long-term

investment nature when the parties to the contract are consolidated, combined or accounted for by the equity method, and (d) off-balance-sheet contracts used to hedge other assets or liabilities not held for trading purposes that are accounted for at market value.[5]

According to the definitions described above, the notional amount of derivative contracts for non-trading purposes can be thought of as representing the bank's hedging activities while the notional amount of derivative contracts for trading purposes may be regarded as a measure of or a proxy for the bank's speculative activities. However, derivatives reported for trading purposes could also include dealing positons.

Thus, one purpose of this study is to document the extent to which BHCs use trading activities for speculative purposes.

Table 2 reports the derivatives usage of BHCs in the main sample. We report an overall description of the IR, FX, EQ, and CM derivatives activities at the year-ends of the sample period in panels A, B, C, and D of Table 2, respectively. In each panel, we first report the number of BHCs in the main sample. We next report, separately for trading purposes and for non-trading purposes, the proportion of derivatives users, the average notional amounts of the derivative contracts at the bank level, and the average notional amounts as a proportion of a BHC's assets across all BHCs. Here, we summarize only the main interesting features.

First, the IR derivative contracts dominate the derivatives activities at BHCs. The number of BHCs using IR derivatives are greater than the numbers of the BHCs using FX derivatives, and much greater than the numbers of BHCs using EQ and CM derivatives. Both the average notional amounts and the notional amounts as a proportion of total assets of IR derivative contracts also appear to be larger than other types of contracts. For example, at the end of 2013 the average notional amounts of IR derivatives (trading and non-trading combined) totaled about $320 billion compared to just $43 billion in FX derivatives, $8.8 billion in EQ derivatives, and $4.5 billion in CM derivatives, respectively. This evidence is consistent with the fact reported by OCC that derivative contracts remain concentrated in IR products, which usually comprise 80% of total derivative notional amounts.

Second, the Federal Reserve no longer required BHCs with assets less than $500 million to file form FR Y-9C since 2006.[6] Taking this change into account, one can see a mostly uninterrupted increase in the average notional amounts of derivatives used for both trading and non-trading purposes. Focusing on IR derivatives, the proportion of banks using them for trading purposes falls from 0.098 in 1995 to 0.049 in 2005. This fall is most likely due to an influx of nonusers as the number of BHCs also climbs from 798 to 2,097 over the same period. The proportion of BHCs using IR derivatives for trading purposes increases from 0.088 to 0.134 over the 2006 to 2013 period. This increase could be due the decrease in the number of BHCs over the period or the nearly three-fold increase in the average amount of IR derivatives used for trading purposes. Similar patterns hold for the remaining contract types. Moving on to examine non-trading activities, we observe that the proportion of BHCs using IR derivatives contracts prior to 2006 was between 0.152 and 0.240, forming a "u" shaped pattern across years. Following 2006 the proportion of non-trading IR derivatives users increased from 0.419 to 0.569. IR contracts make up the majority of non-trading activities. Additionally, the notional amounts of IR derivatives used for non-trading purposes are much smaller than those used for

[5] See the website of the Federal Reserve Board: http://www.federalreserve.gov/apps/mdrm/data-dictionary

[6] In unreported tests, we repeat all of our analysis using only the sample of banks with assets of at least $500 million. Our results are practically unchanged. We report summary statistics for the entire sample to give the reader a fuller picture of the derivatives activities among U.S. BHCs.

Table 2: Description of U.S. BHC's Derivatives Activities from 1995 to 2013 (Main Sample).

		Panel A: IR Derivative Contracts						Panel B: FX Derivative Contracts					
		Trading Purposes			Non-trading Purposes			Trading Purposes			Non-trading Purposes		
Year	N	Proportion of BHCs	Notional Amount ($billions)	Proportion of Assets	Proportion of BHCs	Notional Amount ($billions)	Proportion of Assets	Proportion of BHCs	Notional Amount ($billions)	Proportion of Assets	Proportion of BHCs	Notional Amount ($billions)	Proportion of Assets
1995	797	0.098	12.64	0.087	0.222	1.582	0.038	0.098	6.393	0.054	0.058	0.124	0.001
1996	813	0.074	10.24	0.059	0.202	1.542	0.030	0.074	5.395	0.037	0.063	0.143	0.001
1997	909	0.065	18.90	0.082	0.198	1.609	0.028	0.064	8.064	0.042	0.061	0.255	0.002
1998	975	0.055	21.76	0.083	0.170	1.182	0.021	0.045	6.419	0.031	0.042	0.195	0.001
1999	1,196	0.040	17.27	0.059	0.152	1.024	0.019	0.030	3.904	0.015	0.042	0.084	0.001
2000	1,352	0.038	12.69	0.029	0.154	0.886	0.016	0.031	3.594	0.009	0.044	0.127	0.001
2001	1,404	0.042	25.59	0.057	0.152	1.670	0.018	0.033	5.549	0.013	0.036	0.071	0.001
2002	1,564	0.046	46.10	0.083	0.169	1.843	0.017	0.035	7.062	0.014	0.032	0.097	0.001
2003	1,789	0.046	52.47	0.088	0.203	2.121	0.021	0.034	7.201	0.015	0.032	0.076	0.001
2004	1,955	0.045	61.50	0.077	0.210	2.221	0.017	0.033	7.857	0.014	0.024	0.134	0.001
2005	2,097	0.049	52.27	0.065	0.240	1.939	0.018	0.027	5.748	0.011	0.025	0.116	0.001
2006	942	0.088	115.6	0.106	0.419	3.609	0.030	0.051	12.48	0.020	0.045	0.247	0.002
2007	892	0.098	144.5	0.102	0.444	2.878	0.022	0.046	18.27	0.021	0.040	0.320	0.001
2008	881	0.107	150.3	0.092	0.464	1.421	0.021	0.040	15.79	0.012	0.044	0.226	0.001
2009	894	0.121	180.6	0.108	0.496	1.513	0.031	0.044	16.49	0.014	0.040	0.379	0.001
2010	919	0.126	260.2	0.202	0.504	2.737	0.040	0.058	26.85	0.029	0.050	0.388	0.001
2011	865	0.114	275.7	0.226	0.513	5.713	0.041	0.052	33.25	0.034	0.050	0.821	0.001
2012	859	0.123	259.8	0.205	0.527	4.497	0.039	0.055	35.41	0.034	0.048	0.781	0.001
2013	761	0.134	316.4	0.254	0.569	5.076	0.033	0.060	42.16	0.041	0.045	0.807	0.001

		Panel C: EQ Derivative Contracts						Panel D: CM Derivative Contracts					
		Trading Purposes			Non-trading Purposes			Trading Purposes			Non-trading Purposes		
Year	N	Proportion of BHCs	Notional Amount ($billions)	Proportion of Assets	Proportion of BHCs	Notional Amount ($billions)	Proportion of Assets	Proportion of BHCs	Notional Amount ($billions)	Proportion of Assets	Proportion of BHCs	Notional Amount ($billions)	Proportion of Assets
1995	797	0.015	0.304	0.003	0.011	0.002	0.000	0.019	0.178	0.002	0.006	0.007	0.000
1996	813	0.012	0.226	0.001	0.007	0.002	0.000	0.016	0.177	0.001	0.009	0.001	0.000
1997	909	0.014	0.374	0.002	0.009	0.004	0.000	0.019	0.189	0.001	0.006	0.001	0.000
1998	975	0.018	0.509	0.002	0.012	0.004	0.000	0.011	0.168	0.001	0.005	0.001	0.000
1999	1,196	0.013	0.461	0.002	0.012	0.001	0.000	0.006	0.129	0.001	0.001	0.000	0.000
2000	1,352	0.013	0.386	0.001	0.016	0.006	0.000	0.008	0.080	0.000	0.001	0.000	0.000
2001	1,404	0.020	0.553	0.001	0.016	0.003	0.000	0.013	0.126	0.001	0.002	0.000	0.000
2002	1,564	0.021	0.762	0.002	0.020	0.001	0.000	0.014	0.239	0.001	0.001	0.000	0.000
2003	1,789	0.018	0.733	0.002	0.030	0.005	0.000	0.011	0.216	0.001	0.001	0.000	0.000
2004	1,955	0.013	0.957	0.001	0.035	0.003	0.000	0.012	0.237	0.001	0.001	0.003	0.000
2005	2,097	0.014	1.055	0.001	0.035	0.003	0.000	0.014	0.404	0.001	0.002	0.003	0.000
2006	942	0.024	3.408	0.003	0.047	0.023	0.004	0.023	0.989	0.001	0.006	0.005	0.000
2007	892	0.024	4.359	0.003	0.052	0.013	0.000	0.022	1.325	0.002	0.009	0.006	0.000
2008	881	0.019	3.660	0.002	0.047	0.032	0.000	0.020	1.181	0.001	0.010	0.007	0.000
2009	894	0.021	3.170	0.002	0.046	0.066	0.000	0.020	1.714	0.001	0.009	0.007	0.000
2010	919	0.029	5.700	0.005	0.051	0.078	0.000	0.026	4.026	0.004	0.010	0.015	0.000
2011	865	0.024	6.846	0.006	0.046	0.063	0.000	0.025	4.758	0.005	0.009	0.035	0.000
2012	859	0.023	6.369	0.005	0.044	0.019	0.000	0.024	4.539	0.004	0.013	0.020	0.000
2013	761	0.028	8.758	0.008	0.038	0.021	0.000	0.028	4.545	0.004	0.012	0.014	0.000

Note: This table reports the derivatives activities of all BHCs in the main sample for the last quarter of each year in the sample. Panels A, B, C, and D report derivatives activities in IR, FX, EQ, CM markets, respectively. Each panel reports the proportion of BHCs using the type of contract, the average notional amounts, and the average notional amounts as a proportion of total assets. Derivatives for trading and non-trading activities are reported separately.

trading purposes. In 2013, the average BHC had $316.4 billion in notional amount of IR derivatives for trading purposes, representing 0.254 of its total assets, while the average BHC had just $5.1 billion in average notional amount of IR contracts for non-trading purposes, representing just 0.033 of its total assets.

Finally, Table 3 reports the pairwise correlation coefficients between each type of derivatives contract (notional amounts scaled by total assets). As reported in the introduction, there is a strong positive pairwise correlation (ranging from 59% to 88%) between the different types of derivatives contracts used for trading purposes. This suggests that BHCs coordinate their trading activities across multiple markets. However, this kind of correlation between contract types does not exist among contracts used for non-trading purposes; the highest correlation, 11%, is between *IR-nontrading* and *FX-nontrading*. The correlations between the trading and non-trading activities of each derivatives contracts, which range from zero to 28%, suggests that trading and non-trading derivatives usage represent two separate activities undertaken by BHCs.

Table 3: Correlation Matrix (Main Sample).

	A	B	C	D	E	F	G	H
A *IR-trading*	1.00							
B *IR-non-trading*	0.11***	1.00						
C *FX-trading*	0.69***	0.13***	1.00					
D *FX-non-trading*	0.18***	0.11***	0.28***	1.00				
E *EQ-trading*	0.88***	0.08***	0.59***	0.15***	1.00			
F *EQ-non-trading*	0.00	0.01**	0.00	0.00	-0.00	1.00		
G *CM-trading*	0.78***	0.08***	0.59***	0.14***	0.76***	0.00	1.00	
H *CM-non-trading*	0.05***	0.04***	0.15***	0.06***	0.03***	0.02***	0.13***	1.00

Note: This table presents the pair-wise correlation matrix across notional amounts scaled by total assets for each contract type. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

Derivatives Users and Nonusers

The prior subsection examines the overall derivatives usage of U.S. bank holding companies. As discussed above, the majority of BHCs do not use derivatives for trading purposes. However, nearly half of BHCs use derivatives for non-trading purposes. Thus, to present a more complete picture of the magnitude of derivatives activities among BHCs that choose to participate in derivatives markets, we repeat the analysis in Table 2 using only the sample of derivative users.

Table 4 recreates Table 2 using only the sample of BHCs with nonzero derivative usage at the end of each fiscal year. As shown, the overall patterns are consistent with Table 2. The notional amounts of derivatives used for trading purposes increased dramatically over the sample period. IR contracts are the most used type of contract. Between 1995 and 2013, the notional amounts of IR contracts for trading purposes increase 18.3 times. Derivatives usage for trading purposes seems to be concentrated in about 100 BHCs. Moving to derivatives used for non-trading purposes, we see much lower levels of growth in the average notional amount

of IR derivatives. However, the average notional amount of FX contracts used by BHCs has doubled since 2011 compared to relatively stagnant growth in the other types of derivative contracts. It is consistent with Table 2 that more BHCs engage in non-trading derivatives activities compared to trading activities. As shown, the number of BHCs using IR derivatives contracts for non-trading purposes increases rather steadily from 177 in 1995 to 449 in 2013, whereas the number of BHCs using IR contracts for trading purposes increases from 78 to 107 over the same period, with a low of around 50 firms in the late 1990s and early 2000s. The results presented in Table 4 suggest that a large fraction of BHCs engage in some types of derivatives activities. While relatively few BHCs engage in trading activities, the average notional amounts used in trading activities far exceed those for non-trading purposes, even after controlling for BHC size.

Table 5 reports univariate differences among BHCs that reported using derivatives for trading purposes, BHCs that only reported using derivatives for non-trading purposes, and BHCs that never report any derivatives activity as of the last quarter in each year of the sample. As shown in Table 5, on average, BHC derivatives users are much larger than nonusers and BHCs that use derivatives for trading purposes are about 20 times larger than those that only use derivatives for non-trading purposes. BHCs that use derivatives for trading purposes typically have lower loans to total assets, lower interest income, and a lower proportion of deposits to total assets compared to those that only use derivatives for non-trading purposes. BHCs that use derivatives for trading purposes typically have a higher non-interest income, a higher proportion of commercial and industrial loans to total loans, and higher operational risk compared to their non-trading counterparts. Overall, the Table 5 may suggest that BHCs use trading activities as substitute for interest income and traditional lending businesses.

To further examine the differences between BHCs with trading, non-trading, and no derivatives usage, we compliment the univariate results by pooled multinomial regressions using the entire panel of BHCs in our main sample. In these models, instead of classifying BHCs as trading and non-trading using only the year end reports as in Table 5, we classify BHCs as trading if they report trading activities at the end of the quarter, non-trading if they only report non-trading activities at the end of the quarter, and no usage if they report no derivatives activity at the end of the quarter. The results, presented in Table 6, are broadly consistent with those reported in Table 5. BHCs that undertake trading activities tend to be larger, rely less on interest income, have smoother quarter over quarter cash flows, and have greater operational risk (*RCI*). Compared to nonusers, both BHCs engaged in trading and non-trading activities are larger, may have lower loans to total assets, lower interest income, greater non-interest income, smoother *ROA*, and greater overall operating risk.

Table 4: Description of U.S. BHC's Derivatives Activities from 1995 to 2013 (Derivatives Users).

Year	Panel A: IR Derivative Contracts						Panel B: FX Derivative Contracts					
	Trading Purposes			Non-trading Purposes			Trading Purposes			Non-trading Purposes		
	N	Notional Amount ($billions)	Proportion of Assets	N	Notional Amount ($billions)	Proportion of Assets	N	Notional Amount ($billions)	Proportion of Assets	N	Notional Amount ($billions)	Proportion of Assets
1995	78	129.2	0.889	177	7.124	0.17	78	65.32	0.55	46	2.155	0.016
1996	60	138.8	0.806	164	7.644	0.149	60	73.1	0.499	51	2.277	0.016
1997	59	291.1	1.257	180	8.127	0.142	58	126.4	0.657	55	4.213	0.025
1998	54	392.9	1.507	166	6.94	0.125	44	142.2	0.69	41	4.639	0.023
1999	48	430.2	1.467	182	6.727	0.127	36	129.7	0.503	50	2.019	0.016
2000	51	336.3	0.776	208	5.757	0.103	42	115.7	0.286	59	2.905	0.019
2001	59	608.9	1.348	214	10.95	0.118	46	169.4	0.402	50	1.993	0.018
2002	72	1,001	1.801	265	10.87	0.101	54	204.5	0.412	50	3.036	0.019
2003	83	1,131	1.907	363	10.45	0.102	60	214.7	0.44	57	2.383	0.024
2004	87	1,382	1.73	411	10.56	0.08	64	240	0.415	47	5.589	0.034
2005	103	1,064	1.333	504	8.066	0.073	57	211.5	0.422	53	4.575	0.027
2006	83	1,312	1.207	395	8.607	0.072	48	244.8	0.388	42	5.55	0.037
2007	87	1,482	1.042	396	6.482	0.049	41	397.4	0.457	36	7.927	0.027
2008	94	1,409	0.862	409	3.062	0.044	35	397.5	0.305	39	5.106	0.014
2009	108	1,495	0.898	443	3.054	0.063	39	378.1	0.313	36	9.41	0.018
2010	116	2,062	1.602	463	5.433	0.08	53	465.5	0.495	46	7.749	0.021
2011	99	2,409	1.978	444	11.13	0.08	45	639.1	0.647	43	16.51	0.028
2012	106	2,105	1.664	453	8.528	0.074	47	647.2	0.615	41	16.37	0.025
2013	102	2,361	1.893	433	8.92	0.058	46	697.5	0.679	34	18.06	0.029

Year	Panel C: EQ Derivative Contracts						Panel D: CM Derivative Contracts					
	Trading Purposes			Non-trading Purposes			Trading Purposes			Non-trading Purposes		
	N	Notional Amount ($billions)	Proportion of Assets	N	Notional Amount ($billions)	Proportion of Assets	N	Notional Amount ($billions)	Proportion of Assets	N	Notional Amount ($billions)	Proportion of Assets
1995	12	20.18	0.177	9	0.136	0.001	15	9.47	0.082	5	1.155	0.013
1996	10	18.4	0.107	6	0.227	0.004	13	11.05	0.074	7	0.144	0.003
1997	13	26.15	0.118	8	0.444	0.006	17	10.09	0.06	5	0.224	0.004
1998	18	27.55	0.114	12	0.361	0.01	11	14.9	0.085	5	0.175	0.003
1999	16	34.45	0.128	14	0.092	0.009	7	21.99	0.091	1	0.018	0.000
2000	17	30.73	0.066	21	0.361	0.014	11	9.82	0.022	1	0.02	0.000
2001	28	27.73	0.068	22	0.163	0.009	18	9.84	0.044	3	0.005	0.000
2002	33	36.1	0.072	32	0.065	0.009	22	16.99	0.059	2	0.195	0.001
2003	33	39.71	0.09	53	0.172	0.01	20	19.29	0.075	2	0.313	0.001
2004	26	71.98	0.102	68	0.073	0.008	24	19.32	0.077	2	3.16	0.009
2005	29	76.28	0.094	73	0.09	0.009	30	28.22	0.075	5	1.152	0.003
2006	23	139.6	0.125	44	0.486	0.075	22	42.36	0.063	6	0.771	0.003
2007	21	185.1	0.127	46	0.26	0.006	20	59.11	0.067	8	0.676	0.003
2008	17	189.7	0.127	41	0.692	0.009	18	57.81	0.054	9	0.639	0.01
2009	19	149.2	0.105	41	1.434	0.01	18	85.11	0.071	8	0.772	0.005
2010	27	194	0.176	47	1.529	0.008	24	154.1	0.154	9	1.563	0.003
2011	21	282	0.249	40	1.356	0.008	22	187.1	0.182	8	3.837	0.005
2012	20	273.5	0.234	38	0.44	0.007	21	185.7	0.165	11	1.578	0.006
2013	21	317.4	0.274	29	0.55	0.008	21	164.7	0.143	9	1.209	0.002

Note: This table reports the derivatives activities of all BHCs that report non-zero derivatives activity for the last quarter of each year in the sample. Panels A, B, C, and D report derivatives activities in IR, FX, EQ, CM markets respectively. Each panel reports the proportion of BHCs using the type of contract, the average notional amounts, and the average notional amounts as a proportion of total assets. Derivatives for trading and non-trading activities are reported separately.

Table 5: Univariate Comparison among BHC Derivative Users.

Variable	Trading Purposes			Non-trading Purposes			*t-statistic*	No Derivative Usage		
	N	Mean	SD	N	Mean	SD		N	Mean	SD
Assets ($Billions)	1,726	111.3	310.2	5,213	4.996	27.88	4.221***	14,925	0.867	1.437
Growth	1,726	-0.194	10.29	5,213	0.156	35.59	-0.637	14,925	0.215	11.89
Loans	1,726	0.614	0.159	5,213	0.663	0.130	-4.106***	14,925	0.649	0.130
CF	1,726	0.071	0.024	5,213	0.070	0.038	0.664	14,925	0.071	0.029
ROA	1,726	0.008	0.010	5,213	0.007	0.014	1.187	14,925	0.009	0.013
Int.income	1,726	0.051	0.015	5,213	0.053	0.016	-2.966***	14,925	0.061	0.015
nonInt.income	1,726	0.019	0.019	5,213	0.016	0.036	2.178**	14,925	0.011	0.022
WaveCF	1,726	0.027	0.009	5,213	0.026	0.014	0.701	14,925	0.027	0.010
WaveROA	1,726	0.004	0.003	5,213	0.004	0.004	-1.348	14,925	0.004	0.004
Cap. ratio	1,726	0.091	0.030	5,213	0.088	0.043	1.185	14,925	0.093	0.037
C&I ratio	1,726	0.139	0.086	5,213	0.107	0.069	4.800***	14,925	0.101	0.065
Depo. ratio	1,726	0.529	0.202	5,213	0.616	0.133	-6.096***	14,925	0.681	0.108
Liq. ratio	1,726	0.286	0.136	5,213	0.277	0.122	0.901	14,925	0.305	0.129
RCI	1,726	0.265	1.224	5,213	0.131	1.109	1.633*	14,925	-0.083	1.133

Note: This table presents summary statistics as of the last quarter of each year in the sample for thee subsamples (1) BHCs that reported derivatives used for trading activities at any time during the sample period, (2) BHCs that only reported derivatives used for non-trading purposes anytime during the sample period, and (3) BHCs that never report derivatives activities at any time during the sample period. We also provide t-statistics for differences between trading and non-trading subsample means. Standard errors are clustered at the BHC level and statistical significance at the 1%, 5% and 10% level is indicated by ***, **, and *, respectively.

Table 6: Multinomial Logistic Regressions.

	Trading vs No usage	Non-trading vs No usage	Trading vs Non-trading
Size	1.826***	1.042***	0.783***
	(22.284)	(16.635)	(12.025)
$Size^2$	-1.927**	0.251	-2.178***
	(-2.459)	(0.536)	(-3.180)
Growth	0.012	-0.000	0.012
	(0.680)	(-0.022)	(0.744)
Loans	-1.680*	-0.612	-1.068
	(-1.673)	(-1.254)	(-1.129)
Int. income	-49.169***	-15.838*	-33.330***
	(-4.198)	(-1.954)	(-3.001)
non-II	50.118***	42.551***	7.567
	(5.547)	(7.729)	(0.894)
WaveCF	-12.052	9.956	-22.008*
	(-0.943)	(1.020)	(-1.945)
WaveROA	-65.194***	-24.902***	-40.292**
	(-3.462)	(-2.787)	(-2.271)
RCI	0.558***	0.294***	0.264***
	(5.347)	(5.793)	(2.707)
Observations		85,804	
Pseudo R^2		0.346	

Note: This table reports the results of multinomial logistic regressions comparing BHCs that engage in trading, non-trading, and no derivatives activities. The regression are run on the full panel of bank-quarters in the main sample. Standard errors are clustered at the BHC level; z-statistics are reported in parenthesis with statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

4. Determinants of Derivatives Activities

After examining the differences between derivatives users and nonusers, we explore the determinants of BHCs' usage of each type of derivatives contract. The tobit model is used in our analysis since dependent variables in the regressions, the notional amounts scaled by total assets (e.g. *IR-trading*, *IR-nontrading*, and so on for each type of derivatives contract), are highly censored. To gauge how BHCs' derivatives activities responds to the business conditions faced by BHCs, our tobit models estimate BHCs' derivative activities conditional on the average conditions over the previous four quarters. Thus, we construct several variables with prefix "*avg.*" that represent the average of a particular variable over the previous four quarters. Finally, to assess the importance of market conditions in determining BHCs' derivatives activities, we include a proxy for the quarterly standard deviation of the underlying assets estimated from the daily returns on the appropriate market indices. Specifically, we use the yield on AAA bonds, the Other Important Trading Partners Dollar Index provided by the Federal Reserve (Partner), the S&P 500, and the S&P GSCI Commodity indices to proxy for assets underlying IR, FX, EQ, and CM contracts, respectively. We will examine the determinants of both trading and non-trading derivatives usage in turn.

Determinants of derivatives usage for trading purposes

The earnings performance pressure hypothesis states that banks trade derivatives as a means to make quick money to improve their poor earnings performance. We thus examine the relationship between the notional amounts of derivatives used for trading purposes and the averages of earnings variables over the previous four quarters—*avg.CF*, and *avg.ROA*. We expect a negative relationship if the hypothesis holds.

The risk-taking hypothesis asserts that the bank speculative derivatives activities can be attributed to the bank's risk culture. This hypothesis can be tested in two perspectives. First, we examine the effects of the variables that proxy for a bank's risk profile. We use the average of *RCI* over the previous four quarters to capture the bank's propensity for risk taking because we believe that the culture and nature of an organization can be accumulated and manifested somewhat in the organization's historical behaviors. Thus, we expect that a bank with a higher *avg. RCI* would exhibit more speculative activities on the derivatives markets in current quarters if the risk-taking hypothesis holds. Second, we examine the risk-taking hypothesis by looking at how banks respond to fluctuations in the underlying asset's market. Risk seekers would take advantage of market volatility, which is measured by the standard deviation, *STD*, of the indices that represent the prices of the underlying assets. Thus under the risk taking hypothesis, we expect a positive relationship between *STD* and the trading notional amount of derivatives.

Using the pooled cross-sectional time series data selected from the FR-Y9C database, we test the speculation hypotheses using the following regression specifications where *trading* is for each type of derivatives contract.

$$trading = Size + Size^2 + Growth + Loans + avg.CF + avg.RCI + STD\ (QD) \quad (1)$$

$$trading = Size + Size^2 + Growth + Loans + avg.ROA + avg.RCI + STD\ (QD) \quad (2)$$

$$trading = Size + Size^2 + Growth + Loans + avg.CF + avg.ROA + avg.RCI + STD\ (QD) \quad (3)$$

Since *avg. CF* and *avg. ROA* have a high correlation between them, we check their effects

separately in specifications (1) and (2), and then put them together in specification (3) to see whether their correlation affects the overall results. Because *STD* is a time variant variable that might correlate with some unobservable time trend, we also run regressions that replace STD with quarter dummies (*QD*) to make sure that our main results are not affected by a possible bias resulting from endogeneity. In each specification, we control for *Size*, *Growth*, and *Loans*. We also include $Size^2$ to control for the possible nonlinear relationship between BHCs' size and their derivatives activities. Following Ellul and Yerramilli (2013), we orthogonalize *Size* and $Size^2$ before including them in the regressions. Finally, considering that each category of IR, FX, EQ, and CM derivatives contracts has its own unique characteristics and markets of underlying assets, we apply our analysis to each category of contracts separately.

We present the results in Table 7 in which Panel A, B, C, and D correspond to our four categories of derivatives, IR, FX, EQ, and CM, respectively. The results from this analysis provide evidence supporting the earnings performance pressure hypothesis at varying degrees. In Panel A, C, and D with IR, EQ, and CM notional amounts of derivatives used for trading purposes, *avg.CF* and *avg.ROA* are, both or individually, negatively associated with notional amounts for trading purposes at different levels of significance. Only in Panel B are the coefficients on *avg.CF* and *avg.ROA* insignificant but negative. Generally, the results are consistent with the earnings performance pressure hypothesis that banks use derivatives trading activities to make quick money following down turns in their main businesses.

With respect to the risk taking hypothesis, the coefficients on *avg.RCI* in most of the cases in Panel A, B, C and D have positive signs at different levels of significance as predicted by the risk taking hypothesis. The same can be said about the signs and significance of the coefficients on our measures of the variability of the underlying assets, only except for *GSCI-STD*. This may suggest that BHCs trade derivatives to speculate on market volatility. Overall, these results are consistent with the risk-taking hypothesis.

Determinants of derivatives usage for non-trading purposes

The cash flow smoothing hypothesis maintains that BHCs use derivatives to smooth their cash flows. Thus, a BHC having experienced higher fluctuations in cash flows may use more derivatives for hedging purposes. Consistent with this hypotheses, we expect that notional amounts of derivatives used for non-trading purposes will be positively associated with *WaveCF* and/or *WaveROA*. The risk-balancing hypothesis suggests that when bank managers sense that they are currently experiencing a serious overall risk exposure, they will use more derivatives to hedge the risk. We would thus expect that *RCI*, which is used to proxy for the bank current risk profile, is positively associated with the notional amounts of derivatives used for non-trading purposes. There are two competing predictions about the response of notional amounts of derivatives used for non-trading purposes to market volatility. First, because a bank's hedging contracts are scheduled based on its operational needs or on the exposures of the planned positions in its balance sheet to future uncertainties, hedging derivatives activities may be unrelated to current market volatility. Thus, we expect that the coefficients on *STD* would not be statistically different from zero. Second, the competing prediction is that banks would hedge more using derivatives instruments when the markets are more volatile, so the coefficients of *STD* are expected to be positive. We use the following specifications to test these hypotheses.

Table 7: Determinants of BHCs' Derivatives Activities Used for Trading Purpose.

Panel A: IR Derivatives Contracts (Dependent Variable: *IR-trading*)						
Size	2.118***	2.187***	2.111***	2.163***	2.122***	2.190***
	(5.301)	(5.234)	(5.313)	(5.234)	(5.303)	(5.236)
Size^2	-3.662***	-3.439***	-3.557***	-3.308***	-3.646***	-3.440***
	(-3.052)	(-3.021)	(-2.995)	(-2.951)	(-3.041)	(-3.019)
Growth	0.060	0.033	0.069	0.065	0.065	0.046
	(1.320)	(0.813)	(1.558)	(1.572)	(1.481)	(1.181)
Loans	-8.172***	-6.773***	-8.425***	-7.086***	-8.112***	-6.678***
	(-3.115)	(-3.002)	(-3.127)	(-3.048)	(-3.104)	(-2.982)
avg.CF	-33.589*	-59.834***			-30.622*	-54.591***
	(-1.877)	(-3.129)			(-1.669)	(-2.894)
avg.ROA			-39.423	-76.865***	-21.309	-40.657*
			(-1.590)	(-2.964)	(-0.844)	(-1.754)
avg.RCI	0.789***	0.644***	0.789***	0.588***	0.776***	0.620***
	(3.010)	(2.878)	(2.963)	(2.671)	(2.953)	(2.779)
AAA-STD		0.171***		0.201***		0.158***
		(4.019)		(3.953)		(3.863)
Pseudo R^2	0.286	0.281	0.285	0.279	0.286	0.282
N	85,804	85,804	85,804	85,804	85,804	85,804
N(Uncensored)	6,130	6,130	6,130	6,130	6,130	6,130
N(Censored)	79,674	79,674	79,674	79,674	79,674	79,674

Panel B: FX Derivatives Contracts (Dependent Variable: *FX-trading*)						
Size	0.730***	0.728***	0.730***	0.727***	0.731***	0.729***
	(8.546)	(8.435)	(8.635)	(8.557)	(8.610)	(8.497)
Size^2	0.112	0.124	0.120	0.125	0.114	0.126
	(0.370)	(0.410)	(0.397)	(0.423)	(0.383)	(0.423)
Growth	-0.005	-0.005	-0.004	-0.004	-0.005	-0.004
	(-0.337)	(-0.340)	(-0.282)	(-0.291)	(-0.313)	(-0.310)
Loans	-4.590***	-4.661***	-4.598***	-4.658***	-4.585***	-4.658***
	(-7.432)	(-7.487)	(-7.505)	(-7.523)	(-7.463)	(-7.515)
avg.CF	-1.713	-1.400			-1.488	-1.186
	(-0.336)	(-0.353)			(-0.273)	(-0.274)
avg.ROA			-3.277	-3.034	-1.597	-1.403
			(-0.317)	(-0.356)	(-0.146)	(-0.155)
avg.RCI	0.349***	0.371***	0.350***	0.369***	0.348***	0.371***
	(4.809)	(5.285)	(4.762)	(5.221)	(4.740)	(5.256)
Partner-STD		0.025**		0.024**		0.024**
		(2.424)		(2.276)		(2.268)
Pseudo R^2	0.594	0.589	0.594	0.589	0.594	0.589
N	85,804	85,804	85,804	85,804	85,804	85,804
N(Uncensored)	3,883	3,883	3,883	3,883	3,883	3,883
N(Censored)	81,921	81,921	81,921	81,921	81,921	81,921

Panel C: EQ Derivatives Contracts (Dependent Variable: *EQ-trading*)						
Size	0.133***	0.136***	0.134***	0.135***	0.134***	0.135***
	(4.492)	(4.640)	(4.543)	(4.658)	(4.523)	(4.639)
$Size^2$	-0.234**	-0.242**	-0.231**	-0.244**	-0.231**	-0.243**
	(-2.180)	(-2.358)	(-2.148)	(-2.334)	(-2.137)	(-2.335)
Growth	0.000	-0.001	0.002	0.002	0.002	0.002
	(0.016)	(-0.251)	(0.556)	(0.587)	(0.577)	(0.572)
Loans	-0.945***	-0.790***	-0.907***	-0.772***	-0.913***	-0.767***
	(-3.904)	(-3.580)	(-3.630)	(-3.523)	(-3.800)	(-3.537)
avg.CF	-0.542	-1.910			0.326	-0.837
	(-0.310)	(-1.174)			(0.177)	(-0.490)
avg.ROA			-6.019**	-7.830***	-6.345**	-6.746***
			(-2.228)	(-3.112)	(-2.337)	(-2.857)
avg.RCI	0.053*	0.024	0.049*	0.021	0.050*	0.022
	(1.919)	(1.007)	(1.706)	(0.913)	(1.771)	(0.927)
S&P-STD		0.003***		0.002**		0.002**
		(3.278)		(2.118)		(2.145)
Pseudo R^2	0.740	0.731	0.742	0.733	0.742	0.734
N	85,804	85,804	85,804	85,804	85,804	85,804
N(Uncensored)	1,609	1,609	1,609	1,609	1,609	1,609
N(Censored)	84,195	84,195	84,195	84,195	84,195	84,195
Panel D: CM Derivatives Contracts (Dependent Variable: *CM-trading*)						
Size	0.096***	0.094***	0.100***	0.096***	0.096***	0.094***
	(3.730)	(4.005)	(3.785)	(4.143)	(3.767)	(4.028)
$Size^2$	-0.109	-0.124	-0.089	-0.113	-0.110	-0.124
	(-1.201)	(-1.522)	(-0.976)	(-1.399)	(-1.225)	(-1.525)
Growth	0.003	0.002	0.004	0.002	0.003	0.002
	(1.294)	(0.668)	(1.353)	(0.793)	(1.276)	(0.761)
Loans	-0.788***	-0.674***	-0.833***	-0.667***	-0.791***	-0.673***
	(-4.975)	(-5.022)	(-4.963)	(-4.727)	(-4.887)	(-4.922)
avg.CF	-3.665**	-4.864***			-3.775**	-4.799***
	(-2.009)	(-3.251)			(-2.041)	(-3.147)
avg.ROA			-2.534	-5.751***	0.726	-0.412
			(-1.279)	(-3.217)	(0.313)	(-0.214)
avg.RCI	0.073***	0.055***	0.078***	0.046***	0.074***	0.055***
	(4.281)	(4.188)	(4.247)	(3.517)	(4.245)	(4.131)
GSCI-STD		0.002		0.002		0.002
		(1.502)		(1.138)		(1.397)
Pseudo R^2	0.862	0.848	0.853	0.824	0.862	0.848
N	85,804	85,804	85,804	85,804	85,804	85,804
N(Uncensored)	1,413	1,413	1,413	1,413	1,413	1,413
N(Censored)	84,391	84,391	84,391	84,391	84,391	84,391

Note: This table reports the results of tobit regressions using the full panel of bank-quarter observations in the main sample. The dependent variable is the notional amount of derivatives scaled by total assets. We separately examine the notional amounts of IR, FX, EQ, and CM derivatives in panels A, B, C, and D respectively. Standard errors are clustered at the BHC level; z-statistics are reported in parenthesis with statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

$$nontrading = Size + Size^2 + Growth + Loans + WaveCF + RCI + STD\ (QD) \quad (4)$$

$$nontrading = Size + Size^2 + Growth + Loans + WaveROA + RCI + STD\ (QD) \quad (5)$$

$$nontrading = Size + Size^2 + Growth + Loans + WaveCF + WaveROA + RCI + STD\ (QD) \quad (6)$$

We apply the specifications (4), (5), and (6) to IR, FX, EQ, and CM dependent variables separately. The results are presented in Table 8 with four panels assigned for different types of derivatives contracts. The majority of the coefficients on *WaveCF* are positive with varying levels of significance. This evidence supports the cash flow smoothing hypothesis; banks appear to hedge when cash flows are more volatile.

The risk-balancing hypothesis suggests that BHCs' usage of derivatives for non-trading purposes will be positively associated with *RCI*. This is the case in Panel A, B, and D. Moving to *STD*, we see that *IR-nontrading* is positively correlated with market volatility, suggesting that BHCs use derivatives to hedge interest rate risk. However, in other panels in Table 8, the notional amounts of derivative usage for non-trading purposes do not appear to be correlated with market conditions. Thus, how BHCs' hedging behavior responds to the market volatility is inclusive. Overall, the results here suggest that BHCs are more likely to use non-trading derivatives to hedge operational risk.

Revisiting the earnings performance pressure hypothesis

Table 7 provides evidence that BHCs trade IR derivatives in order to improve their cash flows. In this section, we further examine which part of cash flow drives their trading activities. We classify BHCs' cash flows into two parts: interest income and non-interest income, and then compute two variables, *avg.Int.income*, and *avg.nonInt.income*, representing the BHCs' average interest and non-interest income over the four prior quarters. We substitute these two variables for *avg.CF* in equation (1) to examine which part is associated with BHCs' IR derivatives trading activities. The results are presented in Table 9. As shown, BHCs tend to increase the notional amounts of derivatives activities used for trading purposes following periods of poor interest income. These results suggest that BHCs may use trading activities to boost earnings performance, when traditional lines of business are less profitable.

Revisiting the earnings smoothing hypothesis

Table 8 reports a positive relationship between the fluctuations in cash flows and non-trading derivatives usage. To complement this analysis, we also examine the relationship between fluctuations in cash flows in or out of the country and FX derivatives usage for non-trading purposes. This is a more direct test of the cash flow smoothing hypothesis as total cash flows contain amounts that are unrelated to foreign exchange risk. Accordingly, we create two new variables that measure the average absolute change in cash flow in, *WaveXCF-in*, and cash flow out, *WaveXCF-out*, of the country over the past four quarters and substitute these values into equation (4) for *WaveCF*. The results are reported in Table 10. As shown, each of the coefficients on *WaveXCF-in* and *WaveXCFout* are positive and significant at 5% levels or better. Again, this evidence is consistent with the earnings-smoothing hypothesis.

Table 8: Determinants of BHCs' Derivatives Activities Used for Non-trading Purposes.

Panel A: IR Derivatives Contracts (Dependent Variable: *IR-nontrading*)

Size	0.115***	0.121***	0.119***	0.122***	0.115***	0.121***
	(5.112)	(4.984)	(5.092)	(5.009)	(5.111)	(4.983)
$Size^2$	0.110	0.133	0.096	0.128	0.113	0.134
	(1.401)	(1.561)	(1.264)	(1.505)	(1.428)	(1.568)
Growth	0.002	0.002	0.002	0.002	0.002	0.002
	(1.545)	(1.427)	(1.394)	(1.233)	(1.297)	(1.361)
Loans	-0.232*	-0.120	-0.163	-0.104	-0.234*	-0.120
	(-1.679)	(-1.167)	(-1.300)	(-1.019)	(-1.691)	(-1.168)
WaveCF	8.529***	2.643***			9.565***	2.876***
	(3.770)	(2.819)			(3.796)	(2.941)
WaveROA			0.059	-0.011	-4.303***	-1.310
			(0.067)	(-0.012)	(-2.791)	(-1.388)
RCI	0.052***	0.040***	0.046***	0.039***	0.051***	0.040***
	(3.574)	(3.659)	(3.441)	(3.608)	(3.566)	(3.651)
AAA-STD		0.014***		0.012***		0.014***
		(3.250)		(3.032)		(3.259)
Pseudo R^2	0.374	0.335	0.356	0.333	0.376	0.336
N	85,804	85,804	85,804	85,804	85,804	85,804
N(Uncensored)	24,646	24,646	24,646	24,646	24,646	24,646
N(Censored)	61,158	61,158	61,158	61,158	61,158	61,158

Panel B: FX Derivatives Contracts (Dependent Variable: *FX-nontrading*)

Size	0.039***	0.039***	0.040***	0.040***	0.040***	0.040***
	(3.963)	(3.937)	(3.951)	(3.918)	(3.963)	(3.936)
$Size^2$	0.049*	0.049*	0.048*	0.049*	0.051*	0.050*
	(1.893)	(1.876)	(1.855)	(1.858)	(1.921)	(1.900)
Growth	-0.000	0.000	-0.000	0.000	-0.000	-0.000
	(-0.104)	(0.021)	(-0.110)	(0.275)	(-0.170)	(-0.103)
Loans	-0.152***	-0.148***	-0.141***	-0.143***	-0.152***	-0.146***
	(-3.174)	(-3.208)	(-3.080)	(-3.164)	(-3.185)	(-3.218)
WaveCF	0.890*	0.903**			1.173**	1.105**
	(1.881)	(2.173)			(2.081)	(2.299)
WaveROA			-0.291	-0.292	-1.208	-1.169
			(-0.507)	(-0.521)	(-1.553)	(-1.589)
RCI	0.010***	0.009***	0.008**	0.009***	0.009***	0.009***
	(2.804)	(2.846)	(2.406)	(2.788)	(2.719)	(2.674)
Partner-STD		0.000		0.000		0.000
		(0.610)		(0.563)		(0.679)
Pseudo R^2	1.085	1.081	1.079	1.073	1.087	1.084
N	85,804	85,804	85,804	85,804	85,804	85,804
N(Uncensored)	3,525	3,525	3,525	3,525	3,525	3,525
N(Censored)	82,279	82,279	82,279	82,279	82,279	82,279

Panel C: EQ Derivatives Contracts (Dependent Variable: *EQ-nontrading*)						
Size	0.033*	0.036*	0.033*	0.036*	0.033*	0.036*
	(1.923)	(1.928)	(1.929)	(1.923)	(1.923)	(1.926)
$Size^2$	-0.037	-0.037	-0.036	-0.027	-0.037	-0.038*
	(-1.611)	(-1.602)	(-1.573)	(-1.179)	(-1.612)	(-1.670)
Growth	-0.001	-0.002	-0.001	-0.003	-0.001	-0.002
	(-0.409)	(-1.240)	(-0.408)	(-1.402)	(-0.409)	(-1.209)
Loans	-0.151	-0.038	-0.154	-0.045	-0.151	-0.040
	(-1.303)	(-0.510)	(-1.304)	(-0.587)	(-1.302)	(-0.530)
WaveCF	-0.431	-2.932*			-0.401	-3.118*
	(-0.547)	(-1.814)			(-0.499)	(-1.882)
WaveROA			-0.307	-0.519	-0.103	1.017
			(-0.362)	(-0.466)	(-0.124)	(1.022)
RCI	0.003	-0.009	0.003	-0.010	0.003	-0.009
	(0.445)	(-0.950)	(0.467)	(-1.015)	(0.440)	(-0.915)
S&P-STD		0.000		-0.000		0.000
		(0.159)		(-1.084)		(0.271)
Pseudo R^2	0.271	0.231	0.271	0.218	0.271	0.231
N	85,804	85,804	85,804	85,804	85,804	85,804
N(Uncensored)	2,560	2,560	2,560	2,560	2,560	2,560
N(Censored)	83,244	83,244	83,244	83,244	83,244	83,244
Panel D: CM Derivatives Contracts (Dependent Variable: *CM-nontrading*)						
Size	0.004***	0.004***	0.004***	0.004***	0.004***	0.004***
	(3.806)	(4.188)	(3.881)	(4.228)	(3.836)	(4.221)
$Size^2$	0.001	0.001	0.001	0.001	0.001	0.002
	(0.130)	(0.246)	(0.134)	(0.319)	(0.335)	(0.394)
Growth	0.000	-0.000	0.000	-0.000	0.000	-0.000
	(0.121)	(-1.240)	(0.089)	(-1.337)	(0.063)	(-1.388)
Loans	-0.024***	-0.020**	-0.022**	-0.019**	-0.023***	-0.019**
	(-2.734)	(-2.300)	(-2.561)	(-2.179)	(-2.751)	(-2.192)
WaveCF	0.152	-0.010			0.271**	0.077
	(1.437)	(-0.099)			(2.183)	(0.658)
WaveROA			-0.416	-0.659	-0.700*	-0.765*
			(-1.454)	(-1.641)	(-1.794)	(-1.687)
RCI	0.002***	0.001*	0.002**	0.001*	0.002***	0.001
	(2.965)	(1.791)	(2.464)	(1.663)	(2.785)	(1.542)
GSCI-STD		0.000		0.000		0.000
		(0.250)		(0.179)		(0.182)
Pseudo R^2	1.099	0.955	1.100	0.977	1.129	0.980
N	85,804	85,804	85,804	85,804	85,804	85,804
N(Uncensored)	455	455	455	455	455	455
N(Censored)	85,349	85,349	85,349	85,349	85,349	85,349

Note: This table reports the results of tobit regressions using the full panel of bank-quarter observations in the main sample. The dependent variable is the notional amount of derivatives scaled by total assets. We separately examine the notional amounts of IR, FX, EQ, and CM derivatives in panels A, B, C, and D respectively. Standard errors are clustered at the BHC level; z-statistics are reported in parenthesis with statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

Table 9: IR Derivatives and Cash Flow revisited.

	Dependent Variable: *IR-trading*					
Size	2.029***	2.097***	2.102***	2.160***	2.034***	2.109***
	(5.412)	(5.300)	(5.308)	(5.220)	(5.396)	(5.283)
$Size^2$	-3.733***	-3.366***	-3.580***	-3.313***	-3.744***	-3.391***
	(-3.029)	(-2.937)	(-3.005)	(-2.957)	(-3.035)	(-2.955)
Growth	0.050	0.014	0.059	0.043	0.050	0.015
	(1.163)	(0.358)	(1.304)	(1.009)	(1.168)	(0.387)
Loans	-6.220***	-5.412***	-8.636***	-7.459***	-6.257***	-5.514***
	(-2.850)	(-2.662)	(-3.132)	(-3.098)	(-2.837)	(-2.673)
avg.Int.income	-110.676**	-108.306***			-111.241**	-108.406***
	(-2.284)	(-3.736)			(-2.285)	(-3.738)
avg.nonInt.income			-2.637	-9.691	-4.885	-10.661
			(-0.131)	(-0.477)	(-0.243)	(-0.531)
avg.RCI	0.741***	0.661***	0.819***	0.635***	0.740***	0.660***
	(2.957)	(2.898)	(3.056)	(2.847)	(2.969)	(2.906)
AAA-STD		0.137***		0.236***		0.135***
		(3.778)		(4.121)		(3.756)
Pseudo R^2	0.286	0.283	0.285	0.277	0.286	0.283
N	85,804	85,804	85,804	85,804	85,804	85,804
N(Uncensored)	6,130	6,130	6,130	6,130	6,130	6,130
N(Censored)	79,674	79,674	79,674	79,674	79,674	79,674

Note: This table reports the results of tobit regressions using the full panel of bank-quarter observations. The dependent variable is the notional amount of interest rate derivatives used for trading purposes scaled by total assets. Standard errors are clustered at the BHC level; z-statistics are reported in parenthesis with statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

Table 10: FX Derivatives and Foreign Cash Flow.

	Dependent Variable: *FX-nontrading*					
Size	0.037***	0.037***	0.038***	0.038***	0.037***	0.037***
	(3.584)	(3.562)	(3.702)	(3.690)	(3.549)	(3.536)
$Size^2$	0.054**	0.055**	0.058**	0.057**	0.058**	0.058**
	(2.016)	(2.006)	(2.124)	(2.074)	(2.100)	(2.067)
Growth	0.000	0.000	-0.000	0.000	0.000	0.000
	(0.146)	(0.441)	(-0.191)	(0.167)	(0.013)	(0.318)
Loans	-0.110**	-0.111**	-0.095**	-0.096**	-0.092**	-0.091**
	(-2.474)	(-2.516)	(-2.236)	(-2.323)	(-2.137)	(-2.201)
WaveXCF-in	17.689***	17.867***			13.181***	13.166***
	(4.651)	(4.615)			(3.660)	(3.650)
WaveXCF-out			19.017***	18.763***	10.461**	10.525**
			(3.836)	(3.772)	(2.128)	(2.145)
Avg. RCI	0.007*	0.007**	0.004	0.004	0.004	0.004
	(1.854)	(2.156)	(1.170)	(1.234)	(1.283)	(1.395)
Partner-STD		0.001		0.001		0.001
		(1.160)		(1.193)		(1.260)
Pseudo R^2	1.127	1.122	1.116	1.113	1.135	1.132
N	85,804	85,804	85,804	85,804	85,804	85,804
N(Uncensored)	3,525	3,525	3,525	3,525	3,525	3,525
N(Censored)	82,279	82,279	82,279	82,279	82,279	82,279

Note: This table reports the results of tobit regressions using the full panel of bank-quarter observations. The dependent variable is the notional amount of foreign exchange derivatives used for non-trading purposes scaled by total assets. Standard errors are clustered at the BHC level; z-statistics are reported in parenthesis with statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

5. Robustness Tests

The OCC quarterly reports point out that usually the top four banks with the most derivatives positions hold above 90% of all derivative contracts (by notional amount). We are concerned that the activities of these top banks may drive the results of our analysis. To make sure that our results are universal rather than the consequences of the behaviors of the top banks, we remove in each quarter from the main sample the top four banks measured in terms of the sum of their notional amounts of four categories of derivative contracts and then repeat our analysis. We find that the removal of the top four banks does not materially change any of our conclusions. Additionally, we repeat our analysis including the maturity gap developed in Purnanandam (2007) to measure banks short term operational risk. Maturity gap is shown to be correlated with BHC's non-trading derivatives activities and we find similar correlations in some our regression models.

Throughout the paper, we have employed tobit regressions to limit the potential bias associated with our limited dependent variable, because the notional amount of derivatives activities is heavily left censored. However, the unaccounted for unobservable BHC characteristics may also be biasing our results. We thus repeat our analysis using bank fixed effect regressions. Bank fixed effects will account for all unobservable time invariant bank characteristics that may be affecting our results. Overall, the interpretation of this additional analysis related to the earnings performance pressure hypothesis, the cash-flow smoothing hypothesis and the risk-balancing hypothesis is similar to that reported in the paper.[7]

6. Conclusion

Using the notional amounts of derivative contracts for trading and non-trading purposes, reported in Federal Reserve Y-9C filings, we document the trading and non-trading derivatives activities of U.S. bank holding companies. During our sample period from 1995 to2013, the overall bank derivatives activities, especially their reported trading activities, have increased substantially. As more banks have gotten involved in the derivatives markets and more resources have been spent on banks' derivatives activities, derivatives contracts have played an increasingly important role in banking operation and management. We present evidence that U.S. Bank Holding Companies trade a large amount of derivatives following periods of poor earnings performance, following periods of high operational risk exposure, and during periods of high market volatility in the underlying assets. This evidence indicates that U.S. banks use derivatives instruments to supplement their poor cash flows and/or incomes generated in traditional banking businesses and that the derivatives reported for trading purposes are somewhat of speculative activities. We also present evidence that banks with higher cash flow volatility and higher overall operational risk use more derivatives for non-trading purposes. This evidence is consistent with our understandings about the application of derivatives for hedging; by using derivatives, banks smooth their cash flows and balance their overall risk so as to maximize the firms' value.

These results help us better understand the motivations of U.S. bank holding companies conducting derivatives activities. This understanding not only places a solid foundation for further study of the effects of derivatives activities on the BHCs performance, risk management, as well as other behaviors, but also has insightful implication for policy makers and market

[7] The results of robust tests are available upon request.

participants. For example, given the results that derivatives trading activities appears to supplement the income of large bank holding companies in times of poor earnings, which is a strategy for BHCs to diversify the income sources, the Volcker Rule and Collins Amendment under the Dodd-Frank Act, which puts restrictions on proprietary trading or enforces higher capital requirements for derivatives trading activities, might hamper BHCs' income diversification strategy, creating an unexpected policy impact.

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Appendix A: Variable Definitions.

Variables	Definition
Derivatives Activities	
IR-trading	Notional amounts of interest rate derivative contracts for trading purposes /total assets =BHCKA126 / BHCK2170
FX-trading	Notional amounts of foreign exchange derivative contracts for trading purposes / total assets =BHCKA127 / BHCK2170
EQ-trading	Notional amounts of equity derivative contracts for trading purposes / total assets = BHCK8723 / BHCK2170
CM-trading	Notional amounts of commodity derivative contracts for trading purposes /total assets = BHCK8724 / BHCK2170
IR-nontrading	Notional amounts of interest rate derivative contracts for non-trading purposes / total assets = (BHCK8725+BHCK8729) / BHCK2170 prior to 2001 and BHCK8725 / BHCK2170 from 2001 onward
FX-nontrading	Notional amounts of foreign exchange derivative contracts for non-trading purposes / total assets = (BHCK8726+BHCK8730) / BHCK2170 prior to 2001 and BHCK8726 / BHCK2170 from 2001 onward
EQ-nontrading	Notional amounts of equity derivative contracts for non-trading purposes / total assets = (BHCK8727+BHCK8731) / BHCK2170 prior to 2001 and BHCK8727 / BHCK2170 from 2001 onward
CM-nontrading	Notional amounts of commodity derivative contracts for non-trading purposes / total assets = (BHCK8728+BHCK8732) / BHCK2170 prior to 2001 and BHCK8728 / BHCK2170 from 2001 onward
Earnings Performance	
Int.income	Interest income /total assets = BHCK4107 / BHCK2170
nonInt.income	Non-interest income/total assets = (BHCK4079+BHCK3521+BHCK3196) / BHCK2170
CF	Cash flow/total assets = (BHCK4107+BHCK4079+BHCK3521+BHCK3196) / BHCK2170
ROA	Net income/total assets = BHCK4340 / BHCK2170
Fluctuations in Cash Flow	
waveCF	Average of the absolute changes in CF across previous four quarters
waveROA	Average of the absolute changes in ROA across previous four quarters
waveXCF-in	Average of the absolute changes in foreign interest incomes / total assets (BHCK4059 / BHCK2170) across the previous four quarters
waveXCF-out	Average of the absolute changes in foreign interest outflows / total assets (BHCK4172 / BHCK2170) across the previous four quarters
Risk Conditions	
Cap.ratio	Total equity / total assets = BHCK3210 / BHCK2170
C&I.ratio	Commercial and industrial loans / total loans = (BHCK1763 + BHCK1764) / BHCK2122
Depo.ratio	Core deposits / total assets; core deposits = (total deposits − total time deposits of over $100,000 - total brokered retail deposits) = (BHCB2210 + BHCB3187 +

	BHCB2389 + BHCB6648 + BHOD3189 + BHOD3187 + BHOD2389 + BHOD6648 − BHDMA243 − BHDMA164) / BHCK2170
Liq.ratio	Total liquid assets / the total assets = (BHCK0081 + BHCK0395 + BHCK0397 + BHCK1754 + BHCK1773 + BHDMB987 + BHCKB989 + BHCK1350) / BHCK2170
RCI	The first principal component of the correlation matrix of (1- *Cap.*ratio), C*&I.ratio*, (1-*Depo.ratio*), and (1- *Liq.ratio*) so that higher values of *RCI* indicate higher risk
avg.RCI	The average of *RCI* across the previous four quarters

Other Controls

Assets	Book value of total assets = BHCK2170 adjusted by annual CPI of 2013
Size	Logarithm of *Assets*
Growth	Growth rate of net income (BHCK4340) across the previous four quarters
Loans	Total loans / total assets = BHCK2212 / BHCK2170

Market Volatility

STD	The quarterly standard deviation of the financial indices representing prices of the underlying assets after the indices are converted to daily yields (percent changes)
AAA-STD	*STD* for the interest rate of AAA bonds
Partner-STD	*STD* for the Nominal Other Important Trading Partners Dollar Index
S&P-STD	*STD* for S&P 500 index
GSCI-STD	*STD* for S&P-GSCI spot prices index