How Does Bank Trading Activity Affect Performance? An Investigation Before and After the Crisis

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Abstract

The current debate on the impact of proposed rules to ban or limit proprietary trading activities (e.g. Volcker Rule, Vickers and Liikanen reports) has motivated us to examine whether the exposure of U.S. bank holding companies (BHCs) to trading assets has an adverse impact on their risk, profitability and stock return. The literature provides conflicting evidence on how diversifying into different business lines may affect a BHC's performance. We examine three measures of a BHC's trading activity: the share of trading revenues in operating income, the share of trading assets in total assets, and the market share of trading assets across all BHCs. We find that a BHC's trading activities are positively correlated with its riskiness and negatively correlated with profitability and stock returns, especially during and after the 2007-2009 crisis. These results hold when we control for changes in traditional lending activities and off-balance-sheet activities. Additionally, we find that BHCs with a higher market share of trading assets make a greater contribution to systemic risk. These results suggest that limiting proprietary trading may improve BHC performance while reducing systemic risk, especially during economic downturns.

Keywords: Bank holding companies, proprietary trading, Volcker Rule, Z-score, idiosyncratic risk, profitability, diversification, financial crisis.

JEL Classifications: G2, G21

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1. Introduction

The 2007-2009 global financial crisis is viewed as the most severe since the Great Depression. Many large financial institutions were on the verge of collapse as a result of excessive exposures to subprime mortgages and other securitized assets. To stabilize the financial system the US Congress authorized the Treasury Department to bail out the financial system through the Troubled Asset Relief Program (TARP).[1] This bailout sparked a widespread public debate with respect to the regulation of banking activities and the moral hazard problem of 'too-big-to-fail' banks. The Center for Public Integrity, for example, stated that the "laissez-faire attitude toward regulation of investment banks is widely believed to have contributed to the depth of the current economic crisis."[2]

Concerned with the risks posed by trading activities, supervisors have proposed regulations that limit the scope of banking activities. In July 2009 the BIS's Basel Committee on Banking Supervision revised bank capital regulations to increase the risk weight assigned to the trading book and off-balance sheet securitizations (known as Basel 2.5).[3] In July 2010, the US passed the Dodd–Frank Wall Street Reform and Consumer Protection Act ("Dodd-Frank Act"), which included the "Volcker Rule" as Section 619. The Volcker Rule places strict limits on proprietary trading by US banks, as well as limiting exposure to hedge funds and private equity vehicles.[4] Despite adopting the final rule in February 2011, the Volker Rule is not yet

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1 The purpose of TARP is to purchase assets and equity from financial institutions to strengthen its financial sector.

2 The Center for Public Integrity, "SEC Allows Investment Banks To Go Unregulated", December 10, 2008.

3 For details on the new risk-weights for the trading book, see "Revisions to the Basel II market risk framework" (July 2009). For risk-weights on securitizations, see "Enhancements to the Basel II framework" (July 2009).

4 Proprietary trading is defined as "[E]ngaging as a principal for the trading account of a banking entity in any transaction to purchase or sell certain types of financial positions." By focusing on the trading account, the objective is to restrict positions taken to profit from short-term market movements.

operational.[5] Similarly, both the UK's Vickers Report and the EU's Liikanen Report propose to ring-fence retail banking and deposits from risky bank activities such as trading. [6] These proposals remain under discussion and have not been implemented.

The banking industry has fiercely resisted efforts to restrict their trading activities. US banks have reportedly spent millions of dollars to water down the Volcker Rule, which they view as an excessive restriction on a major source of profitability.[7] Moody's Investor Services issued a comment suggesting that the proposed Volcker Rule would "diminish the flexibility and profitability of banks' valuable market-making operations and place them at a competitive disadvantage to firms not constrained by the rule."[8] Other submissions critical of the rule have argued that it would have significant adverse consequences for corporations, investors, financial markets and the US economy (Oliver Wyman Inc., 2010; Duffie, 2012).

These steps to ban proprietary trading and the debate over regulation of bank activities have motivated us to examine whether current U.S. bank holding companies' (BHC) exposure to trading assets has an adverse impact on their risk, profitability and returns. Existing research investigates how certain bank activities affect performance, with a focus on noninterest income, funding sources and non-traditional activities such as venture capital (e.g. Stiroh, 2004; Baele et al., 2007; Demirgüç-Kunt and Huizinga, 2010; Fang et al., 2012). We are not aware of any studies that explicitly investigate how trading activity affects a bank's performance. This paper fills this gap.

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[5] The Wall Street Journal, "Volcker Rule Could Be Delayed—Again", February 27, 2013; The Wall Street Journal, "Volcker Rule to Curb Bank Trading Proves Hard to Write", September 10, 2013.

[6] The Vickers report refers to the "Report of the Independent Commission on Banking", published in September 2011 and chaired by Oxford Professor John Vickers. The Liikanen report refers to the "Report of the European Commission's High-level Expert Group on Bank Structural Reform" published in October 2012 by a group of experts led by Erkki Liikanen, Governor of the Bank of Finland.

[7] The New York Times, "Volcker Rule, Once Simple, Now Boggles", October 21, 2011.

[8] Moody's Investor Services, "Sector Comment: Complex Volcker Rule Is Credit Negative for US Market-Making Banks", October 10, 2011.

We provide empirical evidence on the impact of trading activity on a BHC's performance before and after Lehman's bankruptcy. We consider two time periods to capture the impact of both the financial crisis, which began in 2007, and the impact of the policy interventions and regulations that were subsequently introduced, such as the Volcker Rule, the Basel III capital and liquidity requirements, and the quantitative easing policies of leading central banks. Our objective is to infer whether and to what extent trading activities increase the riskiness of banks and their profitability. We also examine how best to measure a BHC's trading activity, as multiple approaches are possible and there is no clear consensus in the literature on this point. Finally, we consider how trading activity affects a BHC's contribution to systemic risk. Since much of the regulatory concern directed towards trading behavior focuses on too-big-to-fail banks, we re-run our tests for different groups of banks classified by size or by the intensity of trading activity, i.e. their too-big-to-fail characteristics.

The literature provides conflicting evidence on the benefits to a BHC from diversifying across business lines. On one hand, studies of the conglomerate discount argue that financial conglomerates tend to use capital inefficiently to cross-subsidize marginal or loss-making projects, draining resources from healthy businesses (Berger and Ofek, 1995; Laeven and Levine, 2009; Schmid and Walter, 2009). These findings are in line with recent attempts by regulators to limit the scope of a BHC's operations. On the other hand, studies in the diversification literature argue that relatively low correlations among key financial businesses explain a positive stability-effect of firm scope (Saunders and Walter, 1994, 2012; Baele et al.,

2007).[9] Accordingly, it is unclear whether expanding a BHC's business into trading could improve or diminish its performance.

We consider three measures of a bank's risk: *Z-score*, *expected default frequency* (EDF) estimated from a Merton-KMV model, and *idiosyncratic risk* from Fama-French regressions. While the first measure is based on accounting data, the other two measures incorporate market data. We examine two measures of bank profitability: *return on assets* (ROA) and *return on equity* (ROE). Finally, we measure buy-and-hold stock returns across banks with different exposure to trading. We employ univariate tests, difference-in-difference tests, and panel regressions with bank fixed effects.

We measure a BHC's trading activities using regulatory data reported quarterly to the US Federal Reserve on Form FR Y-9C "Consolidated Financial Statements for Bank Holding Companies". To capture a BHC's diversification across business lines, we decompose its activities into the shares from traditional lending, trading, and off-balance-sheet activities. We measure the intensity of each activity using three approaches: one based on the income share from these activities, one based on the asset share, and one based on each bank's market share across all BHCs. Existing studies focus on the share of noninterest income as a measure for non-traditional banking activities (Stiroh, 2004, 2012; De Jonghe, 2010; Brunnermeier et al., 2012; DeYoung and Torna, 2012). Using income statement variables to measure trading activity, however, suffers from several drawbacks. First, it is well documented that a BHC's sources of income are sensitive to market conditions and may rise and fall with the business cycle. Second, the share of noninterest income may not accurately reflect the extent of a BHC's activities in a

[9] Saunders and Walter (1994, 2012) investigate the impact on earnings stability of combining commercial banks, broker-dealers, insurers and asset management firms. Baele et al. (2007) find that functionally diversified banks have a comparative advantage in terms of their risk-return trade-off.

given business. Trading revenues, in particular, could be zero or negative even though a bank is actively engaged in this business. Third, different income statement items may not be comparable as some are reported gross while others are reported net of expenses. For this reason, we examine different measures to see which may be most suitable for capturing the importance of trading activity for a given bank.

In our univariate tests, we group BHCs into four categories: a control group of banks with no significant trading activity and terciles of BHCs based on increasing levels of trading activity. Across all groups, we find that the riskiness of the average BHC increased during the post-2007 period relative to the pre-crisis period, with consistently lower profitability. BHCs with the greatest exposure to trading, however, suffered a greater increase in riskiness and a greater decline in profitability than BHCs with no trading assets. Our multivariate tests confirm these results, particularly when measuring trading using the asset share and the market share measures, highlighting the importance of looking at a BHC's assets, not its income. We find that riskiness is positively correlated with trading activity while profitability and stock returns are negatively correlated with trading activity, especially during and after the crisis period. These results are robust when: (i) restricting the sample to BHCs with more than $2 million in trading assets, (ii) controlling for fees, and (iii) controlling for off-balance-sheet derivative exposures. Splitting the post-2007 sample into two periods highlights that the adverse effects are greatest during the crisis years from 2007-2009. In summary, our findings show that higher exposure to trading activity does increase the riskiness of a BHC, particularly during economic downturns. These findings are in line with the motivation for Volcker-type rules.

Next we investigate how more stable funding and higher capitalization affects the sensitivity of BHC performance to trading activities. We find that BHCs engaged in trading that

have a high level of funding from deposits exhibit statistically lower risk and higher profitability. This result is consistent with the conventional wisdom that deposit-taking banks fared better during and after the crisis. We also show that better capitalized BHCs that engage in trading are more profitable and less risky. These results imply that the negative impact of trading on performance may be mitigated by increasing deposits or by holding more equity. Under these conditions, BHCs appear to use financial resources more efficiently.

Finally, we investigate the contribution of trading activities to systemic risk. Former Fed Chairman Paul Volcker argued that banks engaged in proprietary trading create unacceptable levels of systemic risk. Many theoretical papers (e.g. Wagner, 2010; Song and Thakor, 2007) argue that diversification or transactional banking activities can increase systemic risk. We therefore expect to find that BHCs with higher trading activities make a greater contribution to systemic risk. We use a systemic risk measure developed by Acharya et al. (2012, 2013) known as marginal expected shortfall (MES), which is the one-day expected loss on a BHC's total stock return based on a 2% daily decline in the overall stock market. The authors kindly provided us with the MES variable for 274 BHCs. We show that a higher market share of trading assets increases a BHC's MES and increases systemic risk, especially during the financial crisis. Other approaches to measuring trading activity (i.e. income share, asset share) are not statistically related to the MES measure. The statistical significance of market share over other measures is consistent with the methodology used by regulators to identify systemically important financial institutions (SIFIs) (BCBS, 2011).

The rest of the paper is organized as follows. Section 2 reviews the related literature. Section 3 discusses our data and presents our methodology. Section 4 presents our empirical results. Section 5 concludes.

2. Related literature

Our paper is related to the existing literature investigating how the share of noninterest income in operating income contributes to either systemic risk or bank failure during a financial crisis. Brunnermeier et al. (2012) investigate this relationship by decomposing noninterest income into two components: trading income, and the sum of investment banking and venture capital income. The authors find that banks with a higher noninterest income share make a greater contribution to systemic risk than traditional banks that exhibit a greater share of interest income in operating income. De Jonghe (2010) investigates why some banks perform better during the financial crisis by analyzing the banks' contribution to systemic risk. He decomposes operating income into four categories: net interest income, net commission and fee income, net trading income, and net other operating income. He concludes that diversifying financial activities does not improve banking system stability. DeYoung and Torna (2012) test whether noninterest income was a determining factor in the failures of U.S. commercial banks during the financial crisis. They separate noninterest income into three categories: fee income from *traditional* banking activities such as deposit accounts and lines of credit; *fee-for-service* income from nontraditional activities like brokerage and insurance, and *stakeholder* income from nontraditional activities that require banks to make principal investments on their own behalf. They find that nontraditional activities significantly and substantially increased the probability of failure among banks that were distressed.

While most of these papers focus on the impact of noninterest income on either systemic risk or financial distress at the banking sector level before or during the crisis, our paper tests the impact of trading activity on the risk-return trade-off at the BHC level both before the crisis and during and after the financial crisis. Our empirical design covers important regulatory changes

and provides evidence on the economic soundness of these new regulations. Our tests highlight the importance of using balance sheet items, as opposed to income statement items, to measure trading activity. Additionally, our tests show that the market share of trading assets is more relevant for explaining a BHC's contribution to systemic risk than the trading income share.

Our paper is related to the theoretical model by Boot and Ratnovski (2013). Their model highlights two sources of inefficiencies when banks combine traditional relationship banking with trading activities. They show that a bank may allocate too much capital to trading, damaging banking relationships and reducing charter value, and may use trading for risk shifting. They conclude that combining relationship banking with trading may offer some benefits at a low scale of trading, but the risks outweigh the benefits when trading becomes a greater share of activity. Our paper provides empirical support for the theoretical predictions from their model.

3. Data and methodology

3.1. Data sources

We begin by downloading all BHC data filed on Form FR Y-9C from the first quarter of 2000 (1Q 2000) to the second quarter of 2012 (2Q 2012) via WRDS. All U.S. BHCs with total consolidated assets of $500 million or more are required to file this data by regulation. We download quarterly balance sheet and income statement data for 3,081 BHCs. We merge this data with CRSP and keep the publicly-listed BHCs. The merged sample has 15,288 quarterly observations for 417 BHCs, with the median bank in the sample for 40 quarters (10 years).

A BHC's consolidated income statement filed on Schedule HI identifies trading revenues (item 5.c) as one of 15 activities that contribute to noninterest income. The consolidated balance sheet filed on Schedule HC reports a BHC's trading assets at fair value (item 5) based on mark-

to-market accounting.[10] According to the instructions for Schedule HI, trading assets are related to the following activities: (a) underwriting or dealing in securities; interest rate, foreign exchange rate, commodity, equity, and credit derivative contracts; other financial instruments; and other assets for resale; (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 in order to profit from short-term price movements; or (c) acquiring or taking positions in such items as an accommodation to customers or for other trading purposes. Accordingly, trading revenues and trading assets provide useful estimates of a BHC's trading activity, including proprietary trading.

We consider three approaches to capture bank trading activity. All our measures are based on lagged quarterly averages. The first approach follows the current literature and is based on income share (Stiroh, 2004, 2012; De Jonghe, 2010; Brunnermeier et al., 2012; DeYoung and Torna, 2012). We decompose a BHC's operating income into the shares from interest income (i.e. traditional banking) and from noninterest income. We further identify the share of noninterest income from trading revenues vs. securitization income, where securitization is a proxy for off-balance-sheet activities. Many studies point to the growth of originate-to-distribute and securitization activity as causes of the recent crisis (Brunnermeier, 2009; Diamond and Rajan, 2009; Gorton, 2009). Specifically, we measure gross interest income to operating income (*IntInc/OpInc)*, trading revenue to operating income (*TrRev/OpInc),* and securitization revenue to operating income *(Secz/OpInc).* Hereafter we refer to this decomposition of operating income as the "income approach".

[10] Schedule HC-Q provides details on the inputs used for calculating the value of any assets and liabilities reported at fair value, including trading assets. Level 1 inputs are quoted prices in active markets for identical assets or liabilities that the BHC has the ability to assess at the measurement date. Level 2 inputs are inputs other than quoted prices included within Level 1 that are observable for the asset or liability either directly or indirectly (e.g. yield curves, interest rates). Level 3 inputs are unobservable inputs for the asset or liability, and reflect the BHC's own assumptions about the pricing for illiquid assets where there is no traded market price.

A second approach to categorize a BHC's activities is to decompose its assets into the share for traditional banking (based on loans), the share for trading (based on trading assets), and the share for securitization (based on the quantity of assets securitized off-balance-sheet over a given period). We refer to this method as the "asset approach". The asset approach is consistent with the regulatory practice of assessing capital requirements (or a leverage ratio) using balance sheet variables. In comparison to the income approach, the quantity of assets may be more indicative of a bank's trading activities because the FR Y-9C data report the actual dollar exposure of trading assets *at fair value* (i.e. marked-to-market). To avoid concerns about window dressing, we use the quarterly average quantity, which is correlated 0.9965 with the end of quarter amount. Specifically, we calculate quarterly average loans-to-total assets (*Loans/TA)*, trading assets-to-total assets (*TrAssets/TA)* and securitized assets-to-total assets *(Secz/TA).*

Our study is the first to investigate BHC trading activities using the asset approach. Existing studies of bank diversification may not have used trading assets because this variable is not disclosed in commercial databases such as Bankscope or Compustat. The Federal Reserve only began requiring US BHCs to report trading assets separately after the passage of the 1999 Gramm–Leach–Bliley Act, which revoked the 1933 Glass-Steagall Act and allowed deposit-taking banks to engage in investment banking activities.

Third, we measure a BHC's business activity using its market share of assets across all BHCs in our sample, which we term the "market share" approach. Market share is one of the characteristics used by regulators to identify SIFIs, which are being targeted by both higher capital requirements and business restrictions (BCBS, 2011).[11] We calculate a BHC's market

[11] The G-20 defines SIFIs as " financial institutions whose distress or disorderly failure, because of their size, complexity and systemic interconnectedness, would cause significant disruption to the wider financial system and economic activity".

share in each quarter for three categories (loans, trading assets, and securitized assets). The market share of loans (*Mkt share of Loans*) is the ratio of a BHC's loans to the aggregate sum of loans across BHCs in a given quarter. Similarly the market share of trading assets (*Mkt share of Tr A*ssets) is the ratio of a BHC's trading assets to the aggregate sum of trading assets in a given quarter. The principal amount of assets sold and securitized in each quarter is reported on Schedule HC-S. The market share of securitized assets (*Mkt share of Secz*) is a BHC's securitized assets to the sum of all assets securitized in a given quarter across all BHCs.

Figure I shows quarterly weighted averages of the income share variables across BHCs in Panel A and the asset share variables in Panel B. The averages are weighted using total assets. The two measures capture different patterns, with Panel A highlighting the volatility of income share variables and the problem of negative values. The weighted average interest income declines from 2000 to 2004, rises to a peak in 2007, falls during 2008 and 2009, and trends sideways at around 70% of operating income from 2010 onwards. The income shares from trading and securitization are relatively constant in the run-up to the crisis but then fall over 2007 and 2008. The trading income share is particularly volatile and becomes negative in two quarters (4Q 2007 and 4Q 2008) before recovering to an average of around 10% of operating income from 2009 onwards. Securitization income declines over time then stabilizes around 1% to 3% of operating income from 2010 onwards.

[Insert Figure I here]

Panel B shows the quarterly averages for the asset share ratios. The weighted average loan share shows a similar decline prior to 2007 from above 55% to around 51% by year-end 2006. It then declines over the crisis period and stabilizes at around 45% of total assets post-2009. The trading asset share rises from 7.5% in 1Q 2000 to a peak of 13.7% in 1Q 2008, then

declines to around 10% by mid-2009 and stabilizes at this level. The securitization share shows peaks of 19.5% in 4Q 2001, 17.5% in 4Q 2006 and 22.0% in 4Q 2008, but then falls steadily to 10.9% in 2Q 2012.

In terms of measuring the importance of different activities, the asset share is less volatile and more representative of activity than the income share. The trading income share appears more sensitive to general market conditions relative to the trading assets share. In particular the share of trading income is highly volatile during the crisis, dropping sharply on two occasions and then recovering. By contrast, the share of trading assets in total assets takes longer to drop after the start of the crisis and falls more gradually. Accordingly, in our tests, we expect to observe different results from using the income approach versus the asset approach.

We measure a BHC's performance using five variables. We create three risk measures. *Z-score* is the sum of *Equity/TA* and *ROA* divided by standard deviation of *ROA*, estimated over rolling windows of 8 quarters. A higher *Z-score* implies a bank can withstand greater losses and is less risky. *EDF* is estimated based on a modified version of KMV-Merton Model (Bharath and Shumway 2008). A higher *EDF* indicates a higher probability of default. *Idiosyncratic Risk* is the standard deviation of daily return residuals from Fama-French regressions plus momentum, run over a three-month rolling window (Campbell et al., 2001). We create two profitability measures. *ROA* is the ratio of quarterly income before taxes and extraordinary items-to-total assets. *ROE* is the ratio of quarterly income before taxes and extraordinary items-to-total equity. We annualize quarterly *ROA* and *ROE* by multiplying the quarterly values by 4.

Our analysis includes a number of controls that might affect BHC performance. *LN(TA)* is the natural logarithm of total assets in millions of US dollars. *Equity/TA* is the ratio of total equity-to-total assets. *High Equity* is a dummy variable set to 1 if a BHC belongs to the top

tercile of average *Equity/TA* ratio before the crisis, and 0 otherwise. *Deposits/TA* is the ratio of deposits-to-total assets. *High Deposit* is a dummy variable set to 1 if a BHC belongs to the top tercile of average *Deposits/TA* ratio before the crisis, and 0 otherwise. *Non-deposit funding/ST Funding* is the sum of short-term funding sources less deposits-to-total short-term funding, measured as deposits, repo, commercial paper, Federal Funds and other borrowed money with less than 1 year to maturity. Demirgüç-Kunt and Huizinga (2010) use this variable to capture bank risk arising from over-reliance on short-term wholesale funding. Finally *TARP* is a dummy variable set to 1 once a BHC has received TARP funding.

Table I provides summary statistics for our sample in Panel A and correlations between variables in Panel B. Absolute correlations greater than 0.700 are highlighted in bold. Appendix I provides full definitions of all variables used in this paper.

[Insert Table I here]

3.2. Methodology

Our goal is to investigate the impact of trading activity on BHC performance. Given the dramatic changes to the financial industry in response to the 2007-2009 crisis, we also wish to distinguish how trading affects performance during booms and busts. Many economists agree that the first crisis symptoms started in the Q1 2007 when the ABX index linked to the cost of insuring subprime mortgages began plummeting (Brunnermeier, 2009; Diamond and Rajan, 2009; Gorton, 2009). In May 2007 UBS shut down its internal hedge fund and in June 2007 Bear Stearns rescued two of its hedge funds. Many financial institutions then began reporting large write-downs and losses, culminating with the failure of Lehman Brothers, the nationalization of Fannie Mae and Freddie Mac, and the rescue of AIG in September 2008.

The US government responded with numerous actions to provide extraordinary support to banks and their distressed assets. In September 2008 the Federal Reserve announced the TARP and in late November 2008 it began the first of several programs of large-scale asset purchases, known as Quantitative Easing (QE). Under QE the Fed has purchased Treasuries and illiquid assets such as mortgage-backed securities (MBS), many of which are held in BHC trading portfolios. As of year-end 2012, the Federal Reserve's holdings of MBS and Treasury securities had increased to $2.9 trillion from around $800 billion in mid-2008. These extraordinary US government programs continue to support the prices of trading assets held by BHCs. The trading environment has changed in many ways post-Lehman. Supervisors have introduced many regulations that address BHCs' excessive exposure to trading assets (e.g. Volcker Rule, Basel III requirements). These rules are expected to influence the valuation and composition of BHCs' trading assets for some time.

Accordingly, we split our sample into two periods. We refer to the period from 1Q 2000 to 4Q 2006 as "before" the crisis, and the period from 1Q 2007 to 2Q 2012 as "during and after" the crisis.[12] We code a *Crisis* dummy set to 1 from 1Q 2007 onwards, and 0 otherwise.[13] In our robustness tests, we show results using three periods – before, during and after the global financial crisis.

We first conduct univariate tests of BHC risk and profitability, followed by difference-in-difference analysis, and finally multivariate tests. In our univariate tests, described in greater detail below, we group BHCs into four categories based on their quarterly average trading assets. BHCs with no significant trading assets (less than $2 million) are categorized as Group 0, which

[12] We ran structural break tests on the time series of BHC assets and income and identified breaks in 2007 at different quarters for different data series.
[13] Our results are robust to starting the crisis in either 1Q 2007 or 1Q 2008.

is the reference (or control) group.[14] The remaining BHCs are sorted into terciles with Group 1 containing observations with the smallest quantity of trading assets and Group 3 containing the highest quantity in each quarter. There are very few cases of BHCs switching groups based on this categorization.

Second we look at the difference-in-differences (DIDs) across groups and time using a multivariate regression. The treated and control groups are identified by a dummy variable *D*, set to 1 for the treated group and 0 for the control group. The pre- and post-treatment periods are identified by a second dummy variable (T=0, 1). The regression takes the following form:

$$y_{it} = \alpha + \beta_1 D + \beta_2 T + \beta_3 (D \times T) + \nu_i + \varepsilon_{it} \quad (1)$$

The coefficient β_1 identifies average differences across groups for the full period. The coefficient β_2 identifies level changes over periods within each group. The coefficient β_3 on the interaction term (*D x T)* tests whether the DIDs across groups and periods are statistically different from zero. We wish to test how the performance of BHCs engaged in different levels of trading activity change relative to BHCs with no trading activity in response to the crisis. Many BHC characteristics changed over the crisis and these changes are expected to contribute to changes in BHC risk and profitability. We therefore add a series of controls to equation (1) and estimate the following regression for our sample:

$$y_{it} = \alpha + \beta_1 Group + \beta_2 Crisis + \beta_3 Group \times Crisis + Controls'\beta' + \nu_i + \varepsilon_{it} \quad (2)$$

where *Group* is a dummy identifying the terciles of trading assets (Groups 1, 2 and 3), *Crisis* is a dummy set to 1 for the period 1Q 2007-2Q 2012, and *Controls* is a vector of bank-specific variables to capture changing BHC characteristics. The controls are lagged values of:

[14] The $2 million threshold is used when collecting data on Schedule HC-D "Trading Assets and Liabilities". BHCs must fill out this schedule if average trading assets exceed $2 million in any of the four preceding quarters.

Ln(Total Assets), Equity/TA, Non-deposit funding/Short-term funding, Loans/TA, Securitized Assets/TA, and a TARP dummy set to 1 once a BHC has received US government support. We also include squared terms of Ln(Total Assets) and Equity/TA to capture any non-linearities. A positive value on the estimated coefficient β_3 indicates that a given group saw a greater increase in risk or profitability than the base Group 0 for the post-2007 period.

Third, we run panel regressions with firm-fixed effects separately for each sub-period on our measures of BHC risk and profitability. We run three specifications for each measure: the income approach, the asset approach and the market share approach. Our base regression is:

$$\textit{Bank Risk (or Profitability)}_t = \beta_0 + \beta_1 \times \textit{Trading Share}_{t-1} + \beta_2 \times \textit{Traditional Share}_{t-1} + \beta_3 \times \textit{Securitization Share}_{t-1} + \beta \times \text{Controls}_{t-1} + v_i + \varepsilon_{it} \quad (3)$$

Recall that the five measures of BHC risk and profitability are: *Z-score, EDF, Idiosyncratic risk, ROA*, and *ROE.* The income approach uses *TrRev/OpInc*, *IntInc/OpInc*, and *Secz/OpInc.* The asset approach uses *TrAssets/TA, Loans/TA,* and *Secz/TA.* The market share approach uses *Mkt Share of Tr Assets*, *Mkt Share of Loans*, and *Mkt Share of Secz*. The controls are the same as equation (2). Standard errors are clustered at the BHC level.

4. Empirical results

4.1. Univariate analysis of BHC risk and profitability

Table II reports univariate tests of the relationship between BHC performance and trading activity. We report the average value for the four groups, where Group 0 has no trading assets and Group 3 has the highest quantity. Panel A shows the average values prior to the crisis, while Panel B reports statistics during and after the crisis. In each panel, we test for differences in the means between Group 0 (no trading assets) and the other groups using a parametric t-test.

[Insert Table II here]

During the pre-crisis period, Panel A shows that holdings of trading assets are concentrated in the largest BHCs, with average quarterly holdings increasing exponentially from $10 million in Group 1 to $39.817 billion in Group 3. The total assets of BHCs in each group similarly grow exponentially (not shown). The average ratio of trading assets-to-total assets increases from 0.2% for Group 1 to 7.2% for Group 3. The BHCs with no trading assets have a Z-score of 59.3 vs. 41.2 for the BHCs with the most trading assets – a decline of 30 percent. This drop between groups is statistically different from zero at the 1% level. Prior to the crisis, the average EDF across groups is not statistically different, while the idiosyncratic risk is significantly lower for Group 3 vs. Group 0. Group 3 BHCs with more trading assets exhibit statistically higher profitability than Group 0, measured by ROA (0.4% higher) or ROE (5.1% higher). Overall, prior to the crisis, diversification into trading activities benefited BHCs by increasing profitability but its impact on risk is not clear with some measures suggesting higher risk (i.e. Z-scores) while others suggest lower (i.e. idiosyncratic risk). We will see later how controlling for changes in BHC characteristics will explain some of these mixed findings.

Panel B shows the average values during and after the crisis (i.e. post-2007). BHCs in each group *increased* their average quarterly holdings of trading assets, with the mean differences vs. the pre-crisis period statistically different from zero (t-tests not shown). The ratio of *TrAssets/TA* rose for BHCs in Groups 1 and 2, but fell for Group 3 (from 7.2% of assets to 5.1%). Across all groups, BHCs exhibit higher risk and lower profitability relative to the pre-crisis period. The average Z-score for Group 0, for example, drops in half from 59.3 to 30.2. Similarly, the average ROE for Group 0 declines from 18.5% to 0.5%. The same magnitude of declines are seen for Groups 1, 2 and 3. The difference-in-means test in Panel B confirm that Group 3 BHCs continue to exhibit lower Z-scores, lower EDFs, lower idiosyncratic risk, and

higher profitability than Group 0 BHCs. A similar pattern is seen when comparing Groups 1 or 2 against Group 0.

4.2. Difference-in-difference analysis of risk and profitability

The univariate tests in Table II establish two facts. First, on average BHCs with the greatest exposure to trading assets have a statistically lower Z-score and idiosyncratic risk and higher ROA and ROE than BHCs with less exposure to trading assets, both in the years prior to the crisis and the years during and after the crisis. Second, all BHCs experienced an increase in riskiness and a decrease in profitability as a result of the crisis. While this univariate set-up allows us to test that average differences across groups within a given period are statistically different from each other, it does not allow us to test whether the differences across groups grew larger or smaller across periods. In other words, we cannot say whether BHCs with more trading activity saw their risk increase by more (or less) than other BHCs as a result of the crisis.

To answer this question, we look at the DIDs across groups and periods using a multivariate regression that controls for changes in BHC characteristics. Table III shows the regressions estimated using equation (2) for different groups of BHCs, with Group 0 as the base case in all specifications. The panel regressions are estimated with random effects due to the time invariant group dummies. In each regression, each observation represents the group average for each variable in a given quarter. The controls from equation (2) plus a constant are included but not shown. The first three columns show regressions on Z-score. Column 1 compares Group 1 (with low trading assets) against Group 0 (with no trading assets). The negative but insignificant coefficient for the *Group 1* dummy indicates the average Group 0 Z-score is lower but not statistically different from the Group 0 Z-score prior to the crisis. The *Crisis* dummy confirms that Z-scores are lower on average post-2007 for all Groups. The interaction term *Group 1 x*

Crisis is not statistically significant, indicating that the Z-scores of Group 1 BHCs declined by the same amount as Group 0 during and after the crisis. Column 2 shows the same relationship holds for Group 2 BHCs. Column 3, however, shows that the average Z-score for Group 3 fell by more than Group 0 during the crisis, with the difference statistically different at the 1% level. In other words, BHCs that held the most trading assets became riskier from 2007 onwards relative to banks with no trading activity, controlling for BHC-specific characteristics.

[Insert Table III here]

We briefly discuss the DIDs results for Group 3 BHCs for the remaining variables. Column 6 shows the average EDF of Group 3 BHCs rose by 17.5% more than Group 0 during and after the crisis, and this DID is statistically significant at the 10% level. Column 9 shows the idiosyncratic risk of both Group 0 and 3 BHCs rose during and after the crisis, but their rate of change and levels were the same. Columns 12 shows the average ROA of Group 3 fell by around 1.0% more than Group 0, while column 15 shows the average ROE of Group 3 fell by 11.4% more than Group 0 during and after the crisis. Overall, these tests show BHCs with the most trading assets suffered a greater increase in riskiness – measured by Z-score and EDF – and a greater decline in profitability – measured by ROA and ROE – than BHCs with no trading assets.

4.3. Multivariate analysis of risk and profitability

While the univariate results in Table II are not consistent with the conglomerate discount theory, the DID results in Table III are consistent and suggest that engaging in more trading activity reduces BHC performance during and after the crisis. To investigate this issue further, we focus on the contribution of trading activities to BHC performance by differentiating between traditional banking activities (loans) and nontraditional activities (trading and securitization).

We run multivariate regressions based on equation (3) with firm and time fixed effects. The error term is clustered at the firm level to control for outliers. Table IV reports results for Z-score, EDF and ROE. Due to space limitations, we do not report the results for idiosyncratic risk and ROA, which are consistent and available upon request. Panel A shows the results for the income approach, Panel B for the asset approach, and Panel C for the market share approach. For each dependent variable, we run separate regressions for the period before the crisis vs. during and after the crisis to allow for different loadings on the control variables. At the bottom of each table we report a test for the difference in estimated coefficients on the trading activity variable before vs. during and after the crisis, with the p-value shown in brackets.

[Insert Table IV here]

4.3.1 Income approach

In Panel A of Table IV, the key income share variables are trading income share (*TrRev/OpInc)*, interest income share (*IntInc/OpInc*) and securitized income share (*Secz/OpInc).* In general, the trading income share and securitized income share cannot explain the variation in either bank profitability or riskiness. The coefficients are generally insignificant both before and during and after the crisis. The results from traditional banking activities are also counterintuitive. A higher share of *IntInc/OpInc* is associated with a higher EDF and lower ROE during both periods. In other words, banks engaged in traditional lending are riskier with lower profitability.

The measure of trading activity using the share of income from trading lacks explanatory power. This result may be due to its sensitivity to market conditions, with high variability and both positive and negative values observed across the sample periods. Accordingly, we conclude

that trading income may not accurately reflect the extent of a bank's trading activities. In our subsequent tests, our analysis therefore focuses on the asset approach.

4.3.2 Asset approach

Panel B of Table IV reports the regressions using our preferred measure of business activity, namely the asset approach. Our key variables are trading asset share (*TrAssets/TA*), loan share (*Loans/*TA) and securitized asset share (S*ecz/TA).* The trading asset share is not significant before the crisis, but is positively associated with BHC risk and negatively associated with BHC profitability during and after the crisis. Specifically, the coefficient is negative for Z-score, positive for EDF and negative for ROE. These results are economically significant. From 2007 onwards, a one-standard deviation increase in the ratio of *TrAssets/TA* is associated with a decrease in the average BHC's Z-score of 2.66 and a 2.24% decrease in ROE. The tests at the bottom of the table confirm that the difference in the estimated coefficients on *TrAssets/TA* before vs. during and after the crisis is significant. Higher exposure to trading assets is associated with higher risk and lower profitability during and after the financial crisis.

The loan share and securitized asset share do not explain the variation in bank risk or return, except for the regression on EDF during and after the crisis. The positive and significant coefficient implies that the EDF increases for BHCs that securitized more assets, which is consistent with the losses on subprime assets suffered by many US BHCs. The other control variables indicate that larger banks have lower Z-scores and lower ROE during and after the crisis. Better capitalized banks are more profitable and less risky over the entire sample period. These size and capitalization effects are non-linear, as seen in the statistically significant coefficients on the squared terms. Finally, the positive coefficients on the TARP dummies for

EDF and ROE may indicate that more distressed banks accepted TARP funding and this support may have improved their profitability. We leave this question for future research.

In summary, the results from Panel B of Table IV show that a greater share of trading assets increases bank risk while reducing profitability during and after the crisis. These results are consistent with the conglomerate discount literature and suggest the benefits from diversifying into trading activities are limited, especially during economic downturns.

4.3.3 Market share approach

Panel C of Table IV reports the regressions using the market share approach. Our key variables are the market share of trading assets (*Mkt share of Tr Assets*), the market share of loans (*Mkt Share of Loans*) and the market share of securitized assets (*Mkt share of Secz*). Table II shows that the correlation between *Mkt Share of Loans* and *Mkt share of Tr Assets* is 0.780 and between *Mkt Share of Loans* and *Mkt share of Secz* is 0.711. The correlation between *Mkt share of Tr Assets* and *Mkt share of Secz* is lower at 0.529. While all three market share measures are correlated with Total Assets, the correlations with Ln(Total Assets) are below 0.600. To avoid multicollinearity, we exclude the *Mkt Share of Loans* in our regressions.

The market share variables are only important for two specifications. In the regressions on Z-score before the crisis, the *Mkt share of Tr Assets* has a positive and significant coefficient while the *Mkt share of Secz* has a negative and significant coefficient. Trading activity reduces BHC risk but securitization increases it. Both variables flip signs and become insignificant during and after the crisis, likely due to high variation and large standard errors across the sample. The regressions on idiosyncratic risk are similarly unstable, flipping signs and changing statistical significance. Unlike with Z-score, however, a greater market share of trading assets reduces EDF while a higher market share of securitization increases it. Neither variable is able to

explain the variation in ROE. Overall, these regressions suggest that market shares do not consistently explain the cross-sectional variation in BHC risk and profitability.

4.4. Effect of deposits and equity capitalization on sensitivity of BHC performance to trading

One of the most important economic issues raised by the Volcker Rule relates to the excessive levels of risk in the banking system. Volcker argued that for US BHCs to engage in high-risk speculative trading created moral hazard and unacceptable levels of systemic risk. Accordingly, a greater share of funding from deposits may reduce bank risk, particularly during periods when wholesale funding markets are impaired. Another proposal under Basel III is to increase equity levels and reduce BHC leverage. Table V explores both relationships.

Panel A of Table V examines the relationship between deposits, trading activity and bank performance. We construct a dummy variable *High Deposit* identifying banks in the top tercile of average *Deposits/TA* ratio over the pre-crisis period. We use the same specification based on the asset approach from Panel B of Table IV. We focus on the post-crisis period and include the interaction term *High Deposit x TrAssets/TA*. This interaction term captures the marginal effect of deposits on the sensitivity of BHC performance to trading activity.

[Insert Table V here]

Panel A of Table V shows the results of these regressions. In all cases, the direction and statistical significance of the coefficient on *TrAssets/TA* is the same as the earlier specification, although the magnitude is greater (either more positive or negative). Higher exposure to trading activity increases bank risk and reduces bank profitability during and after the crisis. The coefficient on the *High Deposit* dummy is statistically significant in three out of five specifications, implying that banks funded with more deposits have lower Z-Score and lower

profitability measured by either ROA or ROE. The interaction of *High Deposit x TrAssets/TA* is statistically significant in four regressions. BHCs with a high level of deposits and a high share of trading assets exhibit statistically lower EDF, lower idiosyncratic risk, higher ROA, and higher ROE than BHCs with similar trading activity. In other words, funding with more deposits offsets some of the adverse effects from trading activities.

Another argument is that the greater risks from trading may be addressed by requiring BHCs to hold more equity. Higher capitalization and lower leverage is one of the most important measures being pursued by bank supervisors through Basel III. Given this importance, we examine how equity capitalization affects the sensitivity of BHC performance to trading activity. We expect that well capitalized banks engaged in trading will perform better during economic downturns, as the higher capital absorbs trading losses. Similar to before, we construct a dummy variable *High Equity* set to 1 for banks in the top tercile of average *Equity/TA* prior to the crisis.

Panel B of Table V reports regressions on BHC risk and profitability including the interaction of the *High Equity x TrAssets/TA*. Again we only consider the period during and after the crisis. The coefficient on the *High Equity* dummy is only statistically significant in two regressions; it is associated with higher idiosyncratic risk and lower ROE. The relationship between *TrAssets/TA* and the performance measures is unchanged, but the magnitude is bigger (more positive or negative). The interaction *High Equity x TrAssets/TA* is not statistically significant for regressions on Z-score or EDF. The interaction has a negative coefficient for idiosyncratic risk, implying BHCs with more trading activity but lower leverage are less risky measured by this variable. For both ROA and ROE, the interaction terms indicate that better capitalized banks engaged in more trading are more profitable at the margin than their peers.

These results contradict the claims of many bank CEOs that higher capital levels must be associated with lower profitability.

4.5. Robustness tests

We provide a variety of robustness tests to examine whether our results hold when adding more restrictions on our sample. Our results so far show that, among the three approaches to classify bank activities, the asset approach can best explain how trading activities impact BHC performance. Additionally, the results are mostly significant for the period during and after the crisis. Accordingly, our robustness tests focus only on the results using the asset approach during the post-2007 period.

4.5.1. BHCs with trading assets of $2 million and greater

Table VI re-runs the balance sheet regressions from Panel B of Table IV using only BHCs that have at least $2 million in trading assets. This cut-off restricts the sample to 122 BHCs, with at most 67 BHCs in any given quarter.[15] The regression results and statistical significance are very similar, with the same sign, magnitude and statistical significance for the *TrAssets/TA* variable.

[Insert Table VI here]

4.5.2. Controlling for fees and commissions

Our analysis of diversification has compared the role of traditional banking, trading assets and securitization on a BHC's risk-adjusted return. When looking at a BHC's operating income, however, an important source of noninterest income that increases during the crisis is fees and commissions. Fees and commissions are generated from fiduciary activities, from

[15] The number of BHCs fluctuates due to mergers and acquisitions as well as new BHCs joining the sample over time. DeYoung et al. (2009) review the literature on bank mergers.

service charges on deposit accounts, from investment banking (brokerage, advisory, underwriting and commissions) and from insurance (annuity sales, underwriting income). As a share of noninterest income, fee income (excluding securitization fees and servicing fees) averaged 12.5% of operating income from 2000 to 2006, but then rose to 33.8% in 4Q 2007 before declining to 20.1% in 4Q 2009. Over 2010 to 2012, fee income averaged 21.5% of operating income. We re-run the income approach regressions from Panel A of Table IV and include the ratio of fees to operating income (*Fees/OpInc*). The results (not reported) are unchanged. The coefficient on *Fees/OpInc* is statistically significant in the period during and after the crisis for all variables, indicating that BHCs with a higher share of fee income are riskier (lower Z-score, higher EDF) and less profitable (lower ROE). We are not able to identify which assets are related to fee-income sources, so are not able to add this variable to the asset share regressions.

4.5.3. Controlling for off-balance-sheet derivatives

Many regulators are concerned about the risks posed by derivatives. Derivatives may be used for either speculation or hedging. While the trading assets category on Form FR Y-9C includes the value of derivatives with a positive fair value, many derivative positions used for trading are held off-balance-sheet. BHCs are required to report the notional and gross fair values of off-balance-sheet derivatives on Schedule HC-L. This schedule identifies five categories of derivatives: credit, interest rate, foreign exchange, equity, and commodity and other derivatives. Credit derivatives are broken down into protection bought vs. sold. The remaining four categories provide details on contracts with a positive fair value and contracts with a negative fair value, allowing us to calculate the net fair value. Finally, Schedule HC-L also identifies the

breakdown between derivatives held for trading purposes vs. contracts held for other purposes. We exploit this distinction in our analysis.

The notional value of off-balance-sheet derivative positions are extremely large, dominated by interest rate derivatives. The weighted average ratio of notional amounts-to-total assets rises steadily from 730% in 1Q 2000 to a peak of 1900% of total assets in 2Q 2011. The ratio then declines linearly to 1650% by the end of the period. Almost all of these positions are derivatives held for trading purposes. The weighted average net fair values tell a different story, representing on average only 0.6% of total assets, with a range from a minimum of -0.3% to a maximum of +1.6%. The net fair values are negative only for the 4 quarters from 4Q 2006 to 3Q 2007, and then become positive, rising to a peak of 1.6% in 4Q 2008. The weighted average net fair value-to-total assets is then 0.9% from 2009 to the end of our sample. The range in the ratio using only derivatives held for trading purposes is even narrower, suggesting BHCs manage these positions carefully.

We check the robustness of our results to controlling for these off-balance sheet derivative positions. We re-run the asset share regressions in Panel B of Table IV and control for either the ratio of off-balance sheet derivatives related to trading at notional value–to-total assets or the ratio of off-balance sheet derivatives related to trading at net fair value-to-total assets. The results (not reported) are unchanged, whether the sign, magnitude or statistical significance.

4.5.4. Splitting the sample into three periods: before, during and after the crisis

Thus far we have examined two periods, before the crisis (Q1 2000 to Q4 2006) vs. during and after the crisis (Q1 2007 to Q2 2012). The choice of two periods was motivated by the extraordinary government support for asset prices following Lehman's bankruptcy, particularly the Fed's asset purchases, and the new regulations targeting trading activities. Table

VII examines the results when the sample is split into three periods: before the crisis (Q1 2000 to Q4 2006), during the crisis (Q1 2007 to Q4 2009), and after the crisis (Q1 2010 to Q2 2012).

[Insert Table VII]

Splitting the post-crisis sample into two periods divides the number of observations for each BHC by half for each window, lowering the power of the test. Any statistical significance for controls such as *Ln(Total Assets)*, its squared value and the share of nondeposit funding disappears. *Equity/TA* loses statistical significance for regressions on Z-score, remains significant for EDF, and is only significant for ROE during the crisis when it is positive with greater magnitude.

Despite the lower power, *TrAssets/TA* remains negative and statistically significant during the crisis period in regressions on Z-score and EDF, but not for the period after the crisis. In the regressions on ROE, trading activity is not statistically significant during the crisis but is negative and significant after the crisis. Finally, neither *Loans/TA* nor *Secz/TA* is statistically significant in regressions on Z-score and EDF post-2007, but *Loans/TA* is positive and significant for ROE both during and after the crisis. Table VII confirms the importance of trading activity for explaining BHC risk and profitability, but suggests the importance for BHC risk is primarily driven by the crisis quarters from 1Q 2007 to 4Q 2009.

4.6. Contribution of trading activities to BHC buy-and-hold stock returns

Having examined the relationship between trading activity and BHC risk and return, we now consider how trading activity affects bank stock returns. We address this question by examining the variation in quarterly buy-and-hold returns (BHRs) and buy-and-hold abnormal returns (BHARs). The BHAR for firm i in quarter q is defined as

$$BHAR_{i,q} = \prod_{t=1}^{T}(1 + r_{i,t}) - \prod_{t=1}^{T}(1 + r_{m,t}) \quad (4)$$

where $r_{i,t}$ is firm *i*'s daily stock returns in quarter *t*, and $r_{m,t}$ is the daily returns on CRSP value-weighted market index. Table VIII shows the regressions on BHRs and BHARs. The explanatory variables are similar to Panel B of Table IV except we use the contemporaneous values of *TrAssets/TA*, *Loans/TA* and *Secz/TA*. As discussed extensively in the asset pricing literature, any test of the determinant of stock returns is a joint test of market efficiency and the model used to generate asset returns. If market participants are irrational or unable to correctly distinguish the impact of different business lines on a BHC's earnings, then the estimated coefficients on the independent variables may be insignificant. If markets are efficient and investors understand the impact of trading activities on earnings, we expect to find a positive relationship between trading activity and stock returns prior to the crisis, and a negative or insignificant relationship during and after the crisis.

[Insert Table VIII here]

Table VIII shows that the results using stock returns – whether measured using BHRs and BHARs – are similar in magnitude and statistical significance. Both specifications explain from 21% to 33% of the variation in the data. Larger BHCs are associated with lower stock returns, with some evidence of non-linearity prior to the crisis. Leverage and non-deposit funding are not statistically significant. BHCs that receive TARP funding exhibit higher stock returns than other BHCs. Both *TrAssets/TA* and *Loans/TA* are positive but not statistically significant prior to the crisis, then negative and significant during and after the crisis. The magnitude of the coefficient on trading activity suggests a one standard deviation increase in *TrAssets/TA* is associated with a decline in annualized stock returns of around 5%. Exposure to securitization activity has no

significant impact on stock returns. This result confirms that greater trading activity reduces BHC performance during and after the crisis.

4.7. Contribution of trading activities to systemic risk

A final important issue that we address is how BHC trading activities contribute to systemic risk. Systemic risk can be defined as the risk that a crisis in the financial system will have adverse consequences for the real economy. Acharya et al. (2012, 2013) argue that systemic risk arises due to the loss of financial intermediation for the overall economy when the financial sector becomes undercapitalized as a whole. A systemic crisis therefore only occurs if there is a capital shortfall of the aggregate financial sector due to the failure of a large financial firm and the liquidation of its assets, leading to funding problems for other financial firms. Theoretical papers by Song and Thakor (2007) and Wagner (2010) argue that diversification or transactional banking activities can increase systemic risk. Most commentators expect that higher exposure to trading activities will increase a BHC's contribution to systemic risk.

In our study we use the measure of systemic risk developed by Acharya et al. (2012, 2013) called Marginal Expected Shortfall (MES). These papers show that the minimum equity requirement for a BHC can be calculated using this formula:

$$E_{i0} \geq K_i \frac{A_{i0}}{(1-(1-K_i)\times MES_i)} \tag{5}$$

where E_{i0} and A_{i0} are the current equity and assets of firm *i*, respectively, K_i is a hard leverage constraint, and MES_i is the one-day expected loss on a BHC's total stock return based on a 2% daily decline in the overall stock market.

To test how a BHC's trading activity contributes to systemic risk, we run the base regression from equation (3) with MES as our dependent variable. Acharya et al. kindly provided

the MES variable for 274 BHCs. We use the quarterly average of the daily values in our analysis. Table II shows the mean (median) value of MES is 1.9% (1.8%) for our sample. We run panel regressions for the full sample period from 1Q 2000 to 2Q 2012, with errors clustered at the bank level. We include time fixed effects in all specifications and show results with and without firm fixed effects. To be consistent with the definition of MES, we use a narrower crisis window identified by a dummy set to 1 for the eight quarters from 1Q 2007 to 4Q 2009 (*D_20072009*). We interact this dummy variable with our lagged variable measuring the intensity of BHC trading activities.

While we tried all three approaches – the income approach, the asset approach, and the market share approach – we find that only the market share approach generated statistically significant coefficients. This finding is not surprising, given that our dependent variable is a measure of a BHC's contribution to systemic risk, not a firm-level measure of risk or profitability.

Table IX presents the regression results for four specifications. Column 1 introduces the *Mkt Share of Tr Assets*, Column 2 includes the *D_20072009* dummy and the interaction with the *Mkt Share of Tr Assets*, Columns 3 introduces the *Mkt Share of Secz*, and Column 4 adds firm fixed effects. By entering the variables sequentially, we ensure that our results are not due to some spurious correlation between the various independent variables. A positive coefficient on any of the independent variables implies that it contributes positively to systemic risk.

[Insert Table IX here]

Consistent with our previous findings, Table IX shows a positive and significant relationship between the market share of trading assets and systemic risk in all specifications. The coefficient is economically significant; a one standard deviation increase in market share of

trading assets is associated with a 10% increase in MES. As expected, systemic risk increases during the crisis period. The *D_20072009* dummy is positive and significant in all specifications, implying that MES is higher by 70 basis points on average over 2007 to 2009. Additionally, the contribution of trading market share to systemic risks increases over these eight quarters. The interaction term is positive and significant in all specifications at 1% level. The only control variables that are statistically significant are the size controls in columns 1 to 3, and the TARP dummy in column 4. Consistent with regulatory concerns, larger banks make a greater contribution to systemic risk in a nonlinear way. The TARP dummy in column 4 implies that BHCs receiving US government assistance were systemically important.

Our results support the empirical findings by Brunnermeier et al. (2012).[16] BHCs with higher exposure to trading activities can be detrimental to the financial system, especially during economic downturns.

5. Conclusion

The current debate on proposed regulations restricting or ring-fencing the trading activities of banks (US Volcker Rule, UK Vickers and EU Liikanen reports) has motivated us to examine whether US bank holding companies' exposure to trading activities has an adverse impact on their risk and profitability. The current literature suggests that diversification into non-traditional activities may provide benefits to a BHC, although financial conglomerates may also allocate resources inefficiently across business lines. While other researchers have provided indirect evidence on this question by studying how noninterest income contributes to a BHC's

[16] Brunnermeier et al. (2012) capture trading activities by decomposing noninterest income into trading income, and investment banking and venture capital income. They scale both values by gross interest income. Their definition of trading income includes trading revenue, net securitization income, gains (losses) on loan sales and gains (losses) on real estate sales. Given our focus on trading activities, we only consider trading revenues and trading assets, and we scale our income variables by operating income. Finally we use MES, whereas Brunnermeier et al. (2012) use systemic expected shortfall (SES). For these reasons, our results are not directly comparable to their results.

performance and systemic risk, noninterest income is an imprecise measure as it includes many non-trading activities that generate fees and commissions.

Our study exploits regulatory data to examine directly how trading income and trading assets affect the risk, profitability and returns of US BHCs. We show that income-based measures may be unreliable for measuring the intensity of trading activity, as they fluctuate over the business cycle and may be zero or negative during certain periods. Asset-based measures are more stable and indicative of bank trading activity. We find that BHCs with a higher share of trading assets-to-total assets exhibit higher risk and lower profitability, particularly over the period from 2007 to mid-2012. We also show that the BHCs with the greatest market share of trading assets make the greatest contribution to systemic risk. These results suggest that limiting proprietary trading may improve BHC performance while reducing systemic risk.

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Table I: Summary Statistics

Table I provides summary statistics for 418 publicly-listed US bank holding companies (BHCs) based on quarterly data reported on Form FR Y-9C from the 1Q 2000 to 2Q 2012. Z-score is the sum of Equity/Total Assets plus Return on Assets (ROA), divided by the standard deviation of ROA over the previous 8 quarters. Expected default frequency (EDF) refers to the estimated probability of default using the KMV-Merton model. Idiosyncratic Risk is calculated as the standard deviation of return residuals from daily Fama-French plus momentum regressions over a quarter, times the square root of number of observations in a quarter. ROA is the ratio of quarterly pre-tax income before extraordinary items-to-total assets, annualized by multiplying by 4. Return on Equity (ROE) is the ratio of quarterly pre-tax income before extraordinary items-to-total equity, annualized by multiplying by 4. Trading Revenue/Operating Income is the sum of trading revenue plus interest income from trading assets to operating income, which is the sum of net interest income plus noninterest income. Interest income /Operating Income is gross income from interest earning assets divided by operating income. Securitization income /Operating Income is the sum of servicing fees and securitization income to operating income. Total Assets (TA) is based on the consolidated entity in millions of US dollars. Trading Assets/TA is the ratio of quarterly average trading assets-to-total assets. Loans/TA is loans net of allowances-to-total assets. Securitized assets/TA is the sum of off-balance sheet assets that have been securitized over the past quarter-to-total assets, based on Schedule HC-S. The market share of trading assets is the ratio of a bank's trading assets to the sum of all BHC's trading assets in a given quarter. Similarly, market share of loans and of securitized assets are a bank's share of the total amount for a given quarter. Equity/TA is the ratio of total equity-to-total assets. Non-deposit funding/short-term funding is the sum of short-term funding sources less deposits-to-total short-term funding, measured as deposits, repo, commercial paper, Federal Funds and other borrowed money with less than 1 year to maturity. TARP is a dummy set to 1 once a BHC receives funding under the Troubled Asset Relief Program (TARP). Panel B reports the pairwise correlations between these variables. Cell values greater than 0.700 or less than -0.700 are shown in bold.

Panel A: Key variables

Variables	Obs	Mean	St. Dev.	Minimum	Median	Maximum
Z-score	13,091	43.97	40.18	-0.13	32.84	192.80
Expected default frequency (EDF)	13,779	9.5%	22.3%	0.0%	0.0%	100.0%
Idiosyncratic risk	14,240	16.7%	14.0%	0.7%	12.5%	254.4%
Return on assets (ROA)	15,282	1.0%	1.7%	-8.3%	1.4%	3.5%
Return on equity (ROE)	15,282	9.8%	26.2%	-165.1%	15.0%	39.5%
Marginal expected shortfall (MES)	10,698	1.9%	1.4%	-10.2%	1.8%	11.9%
Trading revenue/Operating income	15,282	0.6%	2.4%	-0.8%	0.0%	17.3%
Interest income/ Operating income	15,282	123.0%	37.6%	41.3%	118.6%	262.2%
Securitization income/ Operating income	14,301	0.6%	1.9%	-3.1%	0.0%	12.5%
Total assets (TA)	15,282	27,256	163,827	181	1,787	2,370,594
Trading assets/TA	14,325	0.5%	2.3%	0.0%	0.0%	32.9%
Loans/TA	15,282	61.7%	19.8%	0.0%	66.3%	94.0%
Securitized assets/TA	15,282	1.8%	17.0%	0.0%	0.0%	787.1%
Market share of trading assets	15,282	0.3%	3.1%	0.0%	0.0%	47.0%
Market share of loans	15,282	0.3%	1.6%	0.0%	0.0%	21.9%
Market share of securitized assets	15,282	0.3%	2.6%	0.0%	0.0%	47.7%
Equity/TA	15,282	9.1%	2.5%	0.0%	8.8%	25.1%
Non-deposit funding/Short-term funding	14,865	8.4%	8.2%	0.0%	6.4%	90.1%
TARP dummy	15,282	0.14	0.35	0.00	0.00	1.00

Panel B: Correlation between variables

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	Z-score	1.00																		
2	EDF	-0.37	1.00																	
3	Idiosyncratic risk	-0.36	**0.72**	1.00																
4	ROA	0.41	-0.62	-0.56	1.00															
5	ROE	0.34	-0.61	-0.57	**0.93**	1.00														
6	Marginal expected shortfall	-0.09	0.18	0.04	-0.13	-0.13	1.00													
7	Trading rev./OpInc.	-0.07	0.02	-0.06	0.04	0.04	0.21	1.00												
8	Interest Income/OpInc.	-0.04	0.23	0.25	-0.26	-0.23	-0.32	-0.24	1.00											
9	Securitization Income/OpInc.	-0.04	0.01	-0.05	0.05	0.04	0.12	0.32	-0.14	1.00										
10	Total assets (TA)	-0.05	0.04	-0.06	0.01	0.01	0.21	0.54	-0.16	0.34	1.00									
11	Trading assets/TA	-0.07	0.04	-0.05	0.01	0.02	0.16	**0.77**	-0.17	0.36	**0.73**	1.00								
12	Loans/TA	-0.04	0.07	0.05	-0.13	-0.13	0.05	-0.20	-0.03	-0.06	-0.13	-0.30	1.00							
13	Securitized assets/TA	-0.02	0.01	-0.02	0.03	0.03	0.11	0.27	-0.09	0.33	0.12	0.26	-0.02	1.00						
14	Mkt. sh. trading assets	-0.05	0.03	-0.05	0.00	0.01	0.14	0.56	-0.11	0.32	**0.87**	**0.82**	-0.14	0.07	1.00					
15	Mkt. sh. loans	-0.04	0.01	-0.08	0.04	0.04	0.21	0.52	-0.18	0.39	**0.91**	0.69	-0.12	0.15	**0.78**	1.00				
16	Mkt. sh. securitized assets	-0.03	0.03	-0.05	0.02	0.02	0.14	0.36	-0.12	0.35	**0.71**	0.52	-0.06	0.46	0.53	**0.71**	1.00			
17	Equity/TA	0.12	-0.18	-0.20	0.11	0.07	0.23	-0.04	-0.24	0.05	-0.01	-0.04	0.05	0.01	-0.06	-0.01	-0.02	1.00		
18	Nondeposit fund/ST funding	-0.03	0.08	-0.07	0.03	0.05	0.21	0.29	-0.03	0.22	0.28	0.34	-0.12	0.32	0.26	0.28	0.30	-0.08	1.00	
19	TARP dummy	-0.27	0.29	0.23	-0.25	-0.20	0.24	0.05	-0.17	-0.01	0.09	0.03	0.07	0.00	0.05	0.06	0.06	0.14	-0.04	1.00

Table II Univariate Analysis of Bank Risk and Profitability

Table II reports univariate tests of bank holding company (BHC) risk and return during two sub-periods, pre-crisis (1Q 2000-4Q 2006) and during and after the crisis (1Q 2007-2Q 2012). In each sub-period, group 0 contains BHCs without significant trading assets (less than $2 million in a quarter). We sort the remaining BHCs into terciles (groups 1 to 3) by the average level of trading assets in each quarter, where Group 3 is the highest. We calculate the average *Z-score, EDF, Idiosyncratic Risk, ROA, and ROE* in each group. T-tests of the difference in the mean of each group minus the mean of group 0 (no trading assets) are shown. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

	Obs	*Trading Assets ($m)*	*Tr Assets / Assets (%)*	*Z-score*	*EDF (%)*	*Idiosyn. Risk (%)*	*ROA (%)*	*ROE (%)*
Panel A: Average Before the Financial Crisis (Q1 2000 to Q4 2006)								
Group:								
0 (zero trading assets)	7,269	0	0.0	59.3	1.9	12.5	1.7	18.5
1 (lowest Trading Assets)	393	10	0.2	57.2	2.3	11.1	1.7	20.2
2 (medium Trading Assets)	467	177	1.0	62.8	2.7	9.7	1.9	21.7
3 (highest Trading Assets)	449	39,817	7.2	41.2	2.3	9.4	2.1	23.6
Difference:								
Group 1 - Group 0	7,662	10***	0.2***	-2.1	0.4	-1.4	0.0	1.7***
Group 2 - Group 0	7,736	177***	1.0***	3.4	0.8	-2.8***	0.2***	3.2***
Group 3 - Group 0	7,718	39,817***	7.2***	-18.1***	0.4	-3.1***	0.4***	5.1***
Panel B: Average During/After Financial Crisis (Q1 2007 – Q2 2012)								
Group:								
0 (zero trading assets)	5,368	0	0.0	30.2	19.4	23.9	0.3	0.5
1 (lowest Trading Assets)	489	11	0.3	34.0	15.0	18.0	0.6	4.5
2 (medium Trading Assets)	415	162	2.0	31.4	17.7	16.8	0.5	4.4
3 (highest Trading Assets)	432	60,843	5.1	23.6	16.3	14.5	0.7	6.6
Difference:								
Group 1 - Group 0	5,857	11***	0.3***	3.8**	-4.4***	-5.9**	0.3***	4.0***
Group 2 - Group 0	5,783	162***	2.0***	1.2	-1.7	-7.1***	0.2**	3.9***
Group 3 - Group 0	5,800	60,843***	5.1***	-6.6***	-3.1**	-9.4***	0.4***	6.1***

Table III Multivariate difference-in-difference tests

Table III reports multivariate difference-in-difference tests of risk and return across different groups of BHCs. The panel regressions are estimated as:

$$y_{it} = \alpha + \beta_1 Group + \beta_2 Crisis + \beta_3 Group \times Crisis + Controls' \beta' + \nu_i + \varepsilon_{it}$$

where the dependent variable y_{it} is a measure of risk (Z-score, EDF or idiosyncratic risk) or return (ROA, ROE). We split the sample into four groups based on the average quantity of trading assets in each quarter. Group 0 contains BHCs without significant trading assets (less than $2 million in a quarter). We sort the remaining observations into terciles (Groups 1 to 3), where Group 3 is the highest. The regressions are run with Group 0 (no trading assets) as the base case. Each regression contains: a Crisis dummy set to 1 for the period 1Q 2007-2Q 2012; a Group dummy, the interaction of Crisis x Group dummy, and a set of controls (not shown). The difference-in-difference is identified by the coefficient β_3 on the interaction term. A positive value indicates the group has a higher value than Group 0 for the period 1Q 2007-2Q 2012. The controls are lagged values of: Ln(Total Assets), Ln(Total Assets)^2, Equity/TA, (Equity/TA)^2, non-deposit funding/short-term funding, Loans/TA, Securitized Assets/TA, a TARP dummy for BHCs receiving support, and a constant. The panel regressions are estimated with random effects due to the time invariant group dummies. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

Comparison	Group 0 vs. 1 (1)	Group 0 vs. 2 (2)	Group 0 vs. 3 (3)	Group 0 vs. 1 (4)	Group 0 vs. 2 (5)	Group 0 vs. 3 (6)	Group 0 vs. 1 (7)	Group 0 vs. 2 (8)	Group 0 vs. 3 (9)
	Z-score			*EDF*			*Idiosyncratic risk*		
Group 1	-6.115			-3.370			-4.188		
Group 2		15.972			-1.152			0.583	
Group 3			186.308*			-116.850			-5.698
Crisis=1	-32.014***	-20.980***	-13.951**	24.027***	13.069***	9.298	15.934***	8.244***	9.438**
Group 1 x Crisis	-0.336			8.581*			5.780*		
Group 2 x Crisis		-5.634			3.571			-1.519	
Group 3 x Crisis			-27.745***			17.447*			4.560
Observations	86	86	86	98	98	98	98	98	98
Adjusted R-squared	0.673	0.840	0.698	0.745	0.526	0.474	0.720	0.577	0.522

Comparison	Group 0 vs. 1 (10)	Group 0 vs. 2 (11)	Group 0 vs. 3 (12)	Group 0 vs. 1 (13)	Group 0 vs. 2 (14)	Group 0 vs. 3 (15)
	ROA			*ROE*		
Group 1	0.281			4.312		
Group 2		1.249			12.438	
Group 3			8.120*			111.747*
Crisis=1	-1.646***	-1.003***	-0.739**	-21.803***	-13.808***	-9.824**
Group 1 x Crisis	-0.215			-4.637		
Group 2 x Crisis		-0.287			-1.035	
Group 3 x Crisis			-0.976**			-11.398*
Observations	98	98	98	98	98	98
Adjusted R-squared	0.761	0.715	0.691	0.749	0.704	0.687

Table IV Determinants of Bank Risk and Profitability

Table IV reports multivariate regressions on three measures of BHC risk and profitability: *Z-score, EDF and ROE. Z-score* is the sum of Equity/TA plus ROA, divided by the standard deviation of ROA over the previous 8 quarters. A higher *Z-score* implies a lower risk of default. *EDF* (%) refers to the expected default frequency estimated using the KMV-Merton model. A higher *EDF* implies a higher risk of default. *ROE* (%) is the ratio of quarterly pre-tax income before extraordinary items-to-total equity, annualized by multiplying by 4. All control variables are described in Table I. Panel A, B and C show regression results based on three alternative measures of trading intensity: *TrRev/OpInc, TrAssets/TA,* and *Market share of Tr Assets*, respectively. For each measure, we examine the relationship over the period before the financial crisis (1Q 2000-4Q 2006) and the period during and after the financial crisis (1Q 2007-2Q 2012). We also compare the coefficients on the measures of trading activity before and after the subprime crisis using the Seemingly Unrelated Regression test. The *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

Panel A: Income Approach

	Z-score		*EDF(%)*		*ROE(%)*	
VARIABLES	before	after	before	after	before	after
LN(TA)$_{t-1}$	-50.256*	-38.890**	-2.355	16.703	-1.361	-32.955**
	[0.090]	[0.048]	[0.692]	[0.153]	[0.743]	[0.036]
[LN(TA)$_{t-1}$] squared	2.627	2.327**	0.355	-0.653	0.025	1.493**
	[0.160]	[0.023]	[0.346]	[0.305]	[0.920]	[0.048]
Equity/TA$_{t-1}$	907.860**	372.223***	-262.851***	-1,010.999***	-14.271	1,193.846***
	[0.041]	[0.004]	[0.003]	[0.000]	[0.860]	[0.000]
[Equity/TA$_{t-1}$] squared	-3,670.862*	-1,290.635**	902.346**	3,136.534***	-392.473	-4,835.174***
	[0.073]	[0.024]	[0.014]	[0.000]	[0.237]	[0.000]
Non-deposit funding $_{t-1}$	-10.193	7.841	0.594	-2.923	-4.833	25.632*
	[0.604]	[0.644]	[0.903]	[0.815]	[0.160]	[0.061]
Tr Revenues/Op Inc. $_{t-1}$	-28.942	-6.290	-18.020	49.383	-33.018**	-33.474
	[0.588]	[0.795]	[0.308]	[0.177]	[0.039]	[0.181]
Interest Income/Op Inc. $_{t-1}$	-2.851	-3.104	10.867***	15.653***	-7.952***	-21.373***
	[0.634]	[0.205]	[0.006]	[0.000]	[0.000]	[0.000]
Secz. Income/Op Inc. $_{t-1}$	-46.357	-40.349	39.646	22.672	-19.153	-36.428
	[0.288]	[0.170]	[0.181]	[0.470]	[0.184]	[0.246]
Tarp		0.769		7.103***		3.898*
		[0.820]		[0.000]		[0.059]
Constant	244.990**	174.097*	-2.631	-33.079	40.633**	118.721
	[0.050]	[0.054]	[0.905]	[0.553]	[0.027]	[0.129]
Firm effect	Yes	Yes	Yes	Yes	Yes	Yes
Quarter effect	Yes	Yes	Yes	Yes	Yes	Yes
Diff. of coeff. on *TrRev/OprInc.$_{t-1}$*	22.652		67.404*		-0.456	
after-before	[0.654]		[0.086]		[0.987]	
Observations	6,455	6,592	6,479	6,131	7,212	6,672
Adjusted R-squared	0.46	0.52	0.43	0.65	0.45	0.42

Table IV Determinants of Bank Risk and Profitability (cont.)

Panel B: Asset Approach

	Z-score		EDF(%)		ROE(%)	
VARIABLES	before	After	before	after	before	after
LN(TA)$_{t-1}$	-51.737*	-39.967**	0.480	17.905*	-3.106	-35.592**
	[0.075]	[0.040]	[0.937]	[0.100]	[0.504]	[0.019]
[LN(TA)$_{t-1}$] squared	2.712	2.437**	0.249	-0.625	0.032	1.559**
	[0.143]	[0.015]	[0.555]	[0.276]	[0.904]	[0.028]
Equity/TA$_{t-1}$	925.964**	362.135***	-328.584***	-1,139.922***	13.251	1,294.289***
	[0.035]	[0.006]	[0.002]	[0.000]	[0.868]	[0.000]
[Equity/TA$_{t-1}$] squared	-3,731.644*	-1,238.131**	1,129.510***	3,563.833***	-446.769	-5,113.805***
	[0.066]	[0.032]	[0.005]	[0.000]	[0.166]	[0.000]
Non-deposit funding $_{t-1}$	-8.948	9.251	-0.700	-5.511	-3.173	30.940**
	[0.644]	[0.583]	[0.882]	[0.668]	[0.406]	[0.027]
TrAssets/TA $_{t-1}$	113.791	-111.591***	-157.522	213.279***	35.778	-98.455**
	[0.368]	[0.000]	[0.249]	[0.000]	[0.553]	[0.032]
Loans/TA $_{t-1}$	24.224	18.628	-2.913	10.997	0.050	15.444
	[0.257]	[0.279]	[0.410]	[0.351]	[0.991]	[0.250]
Secz. /TA $_{t-1}$	-19.573	-28.730	0.671	74.576***	0.213	-15.690
	[0.236]	[0.405]	[0.199]	[0.000]	[0.734]	[0.309]
Tarp		1.018		6.390***		4.956**
		[0.762]		[0.001]		[0.022]
Constant	229.175*	161.465*	3.461	-28.515	40.570*	97.416
	[0.064]	[0.078]	[0.877]	[0.590]	[0.056]	[0.214]
Firm effect	Yes	Yes	Yes	Yes	Yes	Yes
Quarter effect	Yes	Yes	Yes	Yes	Yes	Yes
Diff. of coeff. on *TrAssets/TA$_{t-1}$*	-225.381*		370.801**		-134.233*	
after-before	[0.062]		[0.011]		[0.070]	
Observations	6,472	6,592	6,500	6,131	7,236	6,672
Adjusted R-squared	0.46	0.52	0.40	0.65	0.44	0.41

Table IV Determinants of Bank Risk and Profitability (cont.)

Panel C: Market Share Approach

	Z-score		EDF(%)		ROE(%)	
VARIABLES	before	after	before	after	before	after
LN(TA)$_{t-1}$	-54.925*	-44.213**	-2.887	27.298**	1.651	-41.432**
	[0.052]	[0.035]	[0.625]	[0.040]	[0.676]	[0.011]
[LN(TA)$_{t-1}$] squared	3.020*	2.645**	0.640	-1.216	-0.216	1.881**
	[0.095]	[0.018]	[0.119]	[0.107]	[0.371]	[0.020]
Equity/TA$_{t-1}$	905.282**	383.085***	-570.776***	-1,098.330***	-15.025	1,306.964***
	[0.041]	[0.003]	[0.000]	[0.000]	[0.832]	[0.000]
[Equity/TA$_{t-1}$] squared	-3,659.863*	-1,317.171**	2,104.010***	3,389.520***	-369.624	-5,158.490***
	[0.075]	[0.024]	[0.000]	[0.000]	[0.197]	[0.000]
Non-deposit funding $_{t-1}$	-11.932	9.443	0.753	-6.186	-2.918	31.359**
	[0.529]	[0.578]	[0.898]	[0.639]	[0.402]	[0.025]
Mkt share of Tr assets $_{t-1}$	158.723***	-135.487	36.454	-135.748**	-23.925	-104.633
	[0.007]	[0.123]	[0.236]	[0.025]	[0.480]	[0.187]
Mkt share of Secz. $_{t-1}$	-258.050***	21.657	-7.592	124.720***	9.676	-10.370
	[0.001]	[0.418]	[0.380]	[0.000]	[0.137]	[0.506]
Tarp		0.981		6.203***		4.962**
		[0.771]		[0.001]		[0.022]
Constant	252.257**	191.620**	23.962	-58.152	25.295	131.378
	[0.033]	[0.042]	[0.332]	[0.333]	[0.146]	[0.103]
Firm effect	Yes	Yes	Yes	Yes	Yes	Yes
Quarter effect	Yes	Yes	Yes	Yes	Yes	Yes
Diff. of coeff. on *Mkt share* of *TrAssets $_{t-1}$*	-294.210***		-172.202***		-80.707	
after - before	[0.002]		[0.003]		[0.423]	
Observations	6,499	6,592	7,309	6,131	8,193	6,672
Adjusted R-squared	0.46	0.52	0.40	0.64	0.41	0.41

Table V Impact of Deposits and Equity Capital during and after the crisis

Panel A of Table V interacts *TrAssets/TA* with the *High Deposit* dummy, which indicates whether a BHC belongs to the top tercile of average *Deposits/TA* before the crisis. The dependent variables are the proxies of bank risk (*Z-score*, *EDF*, *Idiosyncratic Risk*) and bank return (*ROA* and *ROE*). The regressions are run for the period during and after the financial crisis (1Q 2007-2Q 2012) for the full sample of 418 BHCs. The results are robust when restricting the sample by removing observations without significant trading assets ($2 million or more). Panel B interacts *TrAssets/TA* with the *High Equity Capital* dummy, which indicates whether a bank belongs to the top tercile of average *Equity Capital/TA* before crisis. The dependent variables are the proxies of bank risk (*Z-score*, *EDF*, *Idiosyncratic Risk*) and bank return (*ROA* and *ROE*). The regressions are run for the period during and after the financial crisis (1Q 2007-2Q 2012) for the full sample of 418 BHCs. The results are robust when restricting the sample by removing observations without significant trading assets ($2 million or more). Standard errors are clustered at BHC level and p-values are reported in brackets. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

Panel A: Impact of Deposits

VARIABLES	Z-score	EDF (%)	Idiosyn	ROA (%)	ROE (%)
$LN(TA)_{t-1}$	-28.062	14.956	0.015	-1.464*	-24.456*
	[0.166]	[0.214]	[0.789]	[0.055]	[0.057]
$[LN(TA)_{t-1}]$ squared	1.907*	-0.490	-0.004	0.058	1.068
	[0.060]	[0.428]	[0.197]	[0.137]	[0.102]
$Equity/TA_{t-1}$	303.485**	-1,143.149***	-7.493***	38.845***	1,321.395***
	[0.026]	[0.000]	[0.000]	[0.000]	[0.000]
$[Equity/TA_{t-1}]$ squared	-1,045.909*	3,646.217***	25.461***	-161.651***	-5,424.180***
	[0.076]	[0.000]	[0.000]	[0.000]	[0.000]
Non-deposit funding $_{t-1}$	9.027	-6.694	-0.131*	1.767**	30.277**
	[0.599]	[0.612]	[0.050]	[0.048]	[0.029]
TrAssets/TA $_{t-1}$	-119.019***	234.538***	0.583***	-8.734***	-137.058***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
High Deposit dummy	-43.999**	8.220	-0.084	-11.748***	-213.272***
	[0.044]	[0.540]	[0.159]	[0.000]	[0.000]
High Deposit×TrAssets/TA t-1	25.458	-1,020.313**	-0.843***	11.953***	175.322***
	[0.668]	[0.027]	[0.000]	[0.000]	[0.000]
Loans/TA $_{t-1}$	22.135	10.675	-0.163**	0.785	21.476
	[0.216]	[0.381]	[0.023]	[0.313]	[0.112]
Secz. /TA $_{t-1}$	-27.533	74.642***	0.038	-1.746	-14.230
	[0.420]	[0.000]	[0.475]	[0.167]	[0.357]
Tarp	1.846	6.537***	0.018*	0.114	4.821**
	[0.588]	[0.001]	[0.093]	[0.410]	[0.025]
Constant	89.205	-22.867	0.942***	6.972*	56.540
	[0.398]	[0.715]	[0.003]	[0.086]	[0.420]
Firm effect	Yes	Yes	Yes	Yes	Yes
Quarter effect	Yes	Yes	Yes	Yes	Yes
Observations	6,281	5,776	5,966	6,299	6,299
Adjusted R-squared	0.52	0.63	0.62	0.41	0.40

Table V Impact of Deposits and Equity Capital during and after the crisis (cont.)

Panel B: Impact of Equity Capital

VARIABLES	Z-score	EDF (%)	Idiosyn	ROA (%)	ROE (%)
LN(TA)$_{t-1}$	-28.142	16.445	0.018	-1.499**	-24.993*
	[0.165]	[0.181]	[0.748]	[0.050]	[0.052]
[LN(TA)$_{t-1}$] squared	1.912*	-0.593	-0.004	0.060	1.104*
	[0.060]	[0.358]	[0.166]	[0.124]	[0.094]
Equity/TA$_{t-1}$	303.168**	-1,142.478***	-7.484***	38.704***	1,319.378***
	[0.026]	[0.000]	[0.000]	[0.000]	[0.000]
[Equity/TA$_{t-1}$] squared	-1,044.415*	3,641.266***	25.423***	-160.975***	-5,414.475***
	[0.076]	[0.000]	[0.000]	[0.000]	[0.000]
Non-deposit funding $_{t-1}$	9.042	-6.334	-0.131*	1.770**	30.308**
	[0.598]	[0.633]	[0.051]	[0.047]	[0.029]
TrAssets/TA $_{t-1}$	-117.202***	234.822***	0.543***	-7.872***	-126.364***
	[0.000]	[0.000]	[0.001]	[0.001]	[0.003]
High Equity dummy	-33.753***	-6.038	0.169**	-1.212*	-28.266***
	[0.000]	[0.672]	[0.036]	[0.055]	[0.004]
High Equity×TrAssets/TA t-1	19.847	-401.700	-0.780***	9.241***	147.318***
	[0.770]	[0.190]	[0.006]	[0.004]	[0.006]
Loans/TA $_{t-1}$	22.214	8.915	-0.166**	0.824	22.069
	[0.215]	[0.463]	[0.021]	[0.289]	[0.102]
Secz. /TA $_{t-1}$	-27.577	74.654***	0.039	-1.767	-14.494
	[0.419]	[0.000]	[0.466]	[0.166]	[0.351]
Tarp	1.839	6.744***	0.019*	0.111	4.771**
	[0.590]	[0.000]	[0.087]	[0.423]	[0.027]
Constant	89.404	-18.737	0.767***	7.055*	57.744
	[0.397]	[0.746]	[0.003]	[0.082]	[0.410]
Firm effect	Yes	Yes	Yes	Yes	Yes
Quarter effect	Yes	Yes	Yes	Yes	Yes
Observations	6,281	5,776	5,966	6,299	6,299
Adjusted R-squared	0.52	0.63	0.62	0.41	0.40

Table VI Robustness using BHCs with $2 million or more in trading assets

Table VI reports robustness on the results in Table IV when the sample is restricted to BHCs with $2 million in trading assets or greater. The table reports multivariate regressions on three measures of BHC risk and profitability: *Z-score, EDF and ROE. Z-score* is the sum of Equity/TA plus ROA, divided by the standard deviation of ROA over the previous 8 quarters. A higher *Z-score* implies a lower risk of default. *EDF* (%) refers to the expected default frequency estimated using the KMV-Merton model. A higher *EDF* implies a higher risk of default. *ROE* (%) is the ratio of quarterly pre-tax income before extraordinary items-to-total equity, annualized by multiplying by 4. All control variables are described in Table I. Panel A, B and C show regression results based on three alternative measures of trading intensity:*/Operating Income, TrAssets/TA,* and *Market share of Tr Assets,* respectively. For each measure, we examine the relationship over the period before the financial crisis (1Q 2000-4Q 2006) and the period during and after the financial crisis (1Q 2007-2Q 2012). We also compare the coefficients on the measures of trading activity before and after the subprime crisis using the Seemingly Unrelated Regression test. The *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

	Z-score		EDF(%)		ROE(%)	
VARIABLES	before	after	before	after	before	after
LN(TA)$_{t-1}$	-90.428**	2.546	1.717	9.992	-4.653	-0.671
	[0.047]	[0.918]	[0.840]	[0.519]	[0.381]	[0.965]
[LN(TA)$_{t-1}$] squared	3.698	0.209	0.068	-0.073	0.134	-0.035
	[0.125]	[0.854]	[0.887]	[0.923]	[0.656]	[0.961]
Equity/TA$_{t-1}$	1,123.621*	368.081*	-338.460**	-939.293***	40.305	896.048***
	[0.095]	[0.073]	[0.028]	[0.002]	[0.724]	[0.001]
[Equity/TA$_{t-1}$] squared	-4,184.820	-1,433.935	1,164.261**	2,964.886*	-718.169	-3,325.313***
	[0.162]	[0.108]	[0.045]	[0.078]	[0.120]	[0.002]
Non-deposit funding $_{t-1}$	14.361	-25.927	9.597	11.558	-10.436**	18.630
	[0.621]	[0.124]	[0.136]	[0.599]	[0.013]	[0.365]
TrAssets/TA $_{t-1}$	76.703	-93.350***	-168.452	184.623***	37.053	-88.811**
	[0.539]	[0.002]	[0.184]	[0.000]	[0.514]	[0.019]
Loans/TA $_{t-1}$	32.916	15.855	-5.401	7.453	2.323	-13.605
	[0.280]	[0.513]	[0.361]	[0.645]	[0.574]	[0.501]
Secz. /TA $_{t-1}$	-11.397	7.494	0.189	69.556***	0.417	-4.835
	[0.459]	[0.790]	[0.818]	[0.000]	[0.690]	[0.761]
Tarp		-4.350		12.350***		-1.621
		[0.308]		[0.000]		[0.606]
Constant	482.840**	-25.309	7.703	-34.593	50.028**	-29.696
	[0.035]	[0.844]	[0.827]	[0.664]	[0.050]	[0.751]
Firm effect	Yes	Yes	Yes	Yes	Yes	Yes
Quarter effect	Yes	Yes	Yes	Yes	Yes	Yes
Diff. of coeff. on *TrAssets/TA$_{t-1}$*	-170.052		353.076***		-125.864*	
after - before	[0.153]		[0.007]		[0.057]	
Observations	2,359	2,135	2,382	1,990	2,600	2,147
Adjusted R-squared	0.46	0.60	0.37	0.67	0.36	0.43

Table VII Robustness using Three Periods

e results reported in Table IV, Panel B: Asset Approach to splitting the sample into three sub-periods: before the financial crisis (1Q 2000-4Q Q 2007-4Q2009), and after the financial crisis (1Q 2010-2Q 2012). All variables are defined in Table IV. At the bottom of the table, we report coefficients on the measures of trading activity before vs. during the financial crisis, and before vs. after the financial crisis. The *, **, and *** nd 1%, respectively.

Z-score			*EDF (%)*			*ROE (%)*		
before	during	after	before	during	after	before	during	after
-51.737*	-22.351	-78.697	0.480	-16.102	14.555	-3.106	-1.563	-34.953
[0.075]	[0.376]	[0.129]	[0.937]	[0.394]	[0.627]	[0.504]	[0.958]	[0.266]
2.712	0.365	5.286*	0.249	-0.037	0.576	0.032	1.039	-0.107
[0.143]	[0.781]	[0.084]	[0.555]	[0.969]	[0.739]	[0.904]	[0.416]	[0.953]
925.964**	102.242	72.534	-328.584***	-1,337.733***	-592.858**	13.251	2,717.401***	-67.862
[0.035]	[0.638]	[0.732]	[0.002]	[0.000]	[0.040]	[0.868]	[0.000]	[0.839]
-3,731.644*	-541.796	441.373	1,129.510***	3,756.453***	1,910.245	-446.769	-9,573.403***	194.870
[0.066]	[0.508]	[0.715]	[0.005]	[0.002]	[0.174]	[0.166]	[0.000]	[0.905]
-8.948	-15.034	33.539	-0.700	-13.725	18.558	-3.173	15.099	-5.235
[0.644]	[0.499]	[0.251]	[0.882]	[0.428]	[0.294]	[0.406]	[0.419]	[0.809]
113.791	-119.782***	-27.738	-157.522	199.203***	29.444	35.778	-82.733	-40.758*
[0.368]	[0.002]	[0.513]	[0.249]	[0.000]	[0.544]	[0.553]	[0.217]	[0.095]
24.224	-31.391	17.765	-2.913	-33.795	23.814	0.050	98.790***	-90.658***
[0.257]	[0.151]	[0.441]	[0.410]	[0.105]	[0.205]	[0.991]	[0.001]	[0.000]
-19.573	-12.994	-4.160	0.671	62.009**	-58.500	0.213	-0.381	20.768
[0.236]	[0.809]	[0.905]	[0.199]	[0.013]	[0.337]	[0.734]	[0.988]	[0.531]
	5.834*			12.416***			0.799	
	[0.066]			[0.000]			[0.789]	
229.175*	231.076*	291.938	3.461	243.367***	-119.028	40.570*	-271.704*	358.118**
[0.064]	[0.055]	[0.178]	[0.877]	[0.010]	[0.375]	[0.056]	[0.087]	[0.015]
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	-233.572*			356.725***			-118.512	
	[0.058]			[0.009]			[0.178]	
		-145.799			183.340			-75.926
		[0.242]			[0.190]			[0.237]
6,472	3,840	2,752	6,500	3,571	2,560	7,236	3,899	2,773
0.46	0.57	0.70	0.40	0.68	0.76	0.44	0.45	0.51

Table VIII Determinants of Buy-and-Hold Stock Returns

Table VIII reports the determinants of quarterly buy-and-hold returns(BHR) and buy-and-hold abnormal returns (BHAR). Firm i's BHAR is quarter q is defined as $BHAR_{i,q} = \prod_{t=1}^{T}(1 + r_{i,t}) - \prod_{t=1}^{T}(1 + r_{m,t})$, where $r_{i,t}$ is firm i's daily stock returns in quarter q, and $r_{m,t}$ is the daily returns on CRSP value-weighted market index. The specification of explanatory variables is similar to that in Panel B of Table IV, except we use the contemporaneous values of *TrAssets/TA, Loans/TA* and *Sec/TA*.

	BHR		BHAR	
VARIABLES	before	after	before	after
LN(TA)$_{t-1}$	-0.157***	-0.149**	-0.158***	-0.151**
	[0.000]	[0.047]	[0.000]	[0.044]
[LN(TA)$_{t-1}$] squared	0.008***	0.002	0.008***	0.002
	[0.000]	[0.698]	[0.000]	[0.687]
Equity/TA$_{t-1}$	0.091	1.189	0.082	1.163
	[0.876]	[0.243]	[0.888]	[0.251]
[Equity/TA$_{t-1}$] squared	-0.884	-4.918	-0.875	-4.823
	[0.729]	[0.259]	[0.731]	[0.265]
Non-deposit funding $_{t-1}$	-0.013	0.004	-0.014	0.002
	[0.686]	[0.964]	[0.670]	[0.983]
TrAssets/TA $_{t}$	0.520	-0.519**	0.521	-0.516**
	[0.386]	[0.045]	[0.385]	[0.046]
Loans/TA $_{t}$	0.014	-0.164**	0.014	-0.165**
	[0.737]	[0.031]	[0.728]	[0.030]
Secz. /TA $_{t}$	-0.005	0.103	-0.005	0.104
	[0.706]	[0.359]	[0.707]	[0.357]
Tarp		0.019*		0.019*
		[0.092]		[0.095]
Constant	0.771***	1.137***	0.699***	1.184***
	[0.000]	[0.002]	[0.000]	[0.001]
Firm effect	Yes	Yes	Yes	Yes
Quarter effect	Yes	Yes	Yes	Yes
Diff. in coeff. on *TrAssets/TA$_{t-1}$*	-0.911		-0.909	
after - before	[0.149]		[0.149]	
Observations	6,975	6,349	6,975	6,349
Adjusted R-squared	0.21	0.29	0.33	0.22

Table IX Determinants of Systemic Risk

Table IX reports multivariate regressions of systemic risk, which is measured as Marginal Expected Shortfall (MES) of capital. A higher MES implies a higher risk of systemic risk. We include 5 specifications in this table. In specification (1) we include *Mkt share of Tr. Assets* $_{t-1}$ to measure the degree of trading activity. The dummy *D_0709* is set equal to 1 for the period 1Q 2007 to 4Q 2009, and zero otherwise. In regression (2) we add the interaction of *Mkt share of Tr. Assets* $_{t-1}$ and *Crisis dummy*. In regression (3) we further include the *Mkt share of loans*$_{t-1}$ and *Mkt share of Secz*$_{t-1}$. Regression (4) differs from (3) in that firm fixed effects are included. All control variables are described in Table I. The *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

VARIABLES	(1)	(2)	(3)	(4)
LN(TA)$_{t-1}$	0.02362***	0.02393***	0.02584***	0.00924**
	[0.000]	[0.000]	[0.000]	[0.046]
[LN(TA)$_{t-1}$*] squared*	-0.00106***	-0.00108***	-0.00119***	-0.00020
	[0.000]	[0.000]	[0.000]	[0.455]
Equity/TA$_{t-1}$	0.14102*	0.13849*	0.13617	0.16499*
	[0.091]	[0.097]	[0.104]	[0.061]
[Equity/TA$_{t-1}$*] squared*	-0.37749	-0.36765	-0.35650	-0.57477
	[0.319]	[0.332]	[0.350]	[0.112]
Non-deposit funding $_{t-1}$	-0.00395	-0.00413	-0.00429	0.00470
	[0.503]	[0.483]	[0.463]	[0.378]
D_0709 dummy	0.00660***	0.00647***	0.00646***	0.00715***
	[0.000]	[0.000]	[0.000]	[0.000]
Mkt share of Tr. Assets $_{t-1}$	0.05490***	0.04598***	0.04557***	0.08032***
	[0.000]	[0.000]	[0.000]	[0.000]
D_0709 × Mkt share of Tr. Assets $_{t-1}$		0.04617***	0.04300**	0.02879***
		[0.009]	[0.012]	[0.004]
Mkt share of Secz.			0.03479	0.00142
			[0.111]	[0.942]
Tarp	0.00174	0.00171	0.00156	0.00245**
	[0.113]	[0.119]	[0.158]	[0.017]
Constant	-0.11408***	-0.11522***	-0.12273***	-0.05250**
	[0.000]	[0.000]	[0.000]	[0.019]
Firm effect	No	No	No	Yes
Quarter effect	Yes	Yes	Yes	Yes
Observations	10,442	10,442	10,442	10,442
Adjusted R-squared	0.50	0.50	0.50	0.67

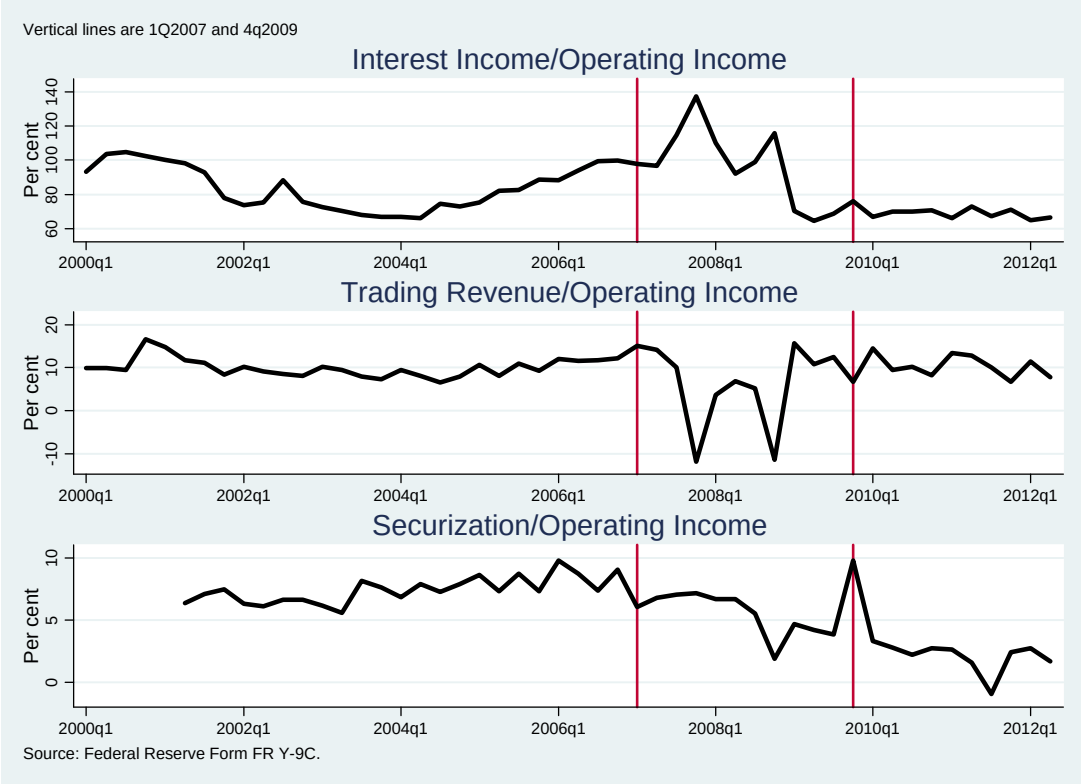
Appendix I: Definition of Variables (alphabetical order)

Variables	**Definition**
Deposits	Sum of deposits in domestic offices, both noninterest bearing (BHDM6631) and interest-bearing (BHDM6636), plus deposits in foreign offices, both noninterest bearing (BHFN6631) and interest-bearing (BHFN6636).
Deposits / TA	The ratio of deposits-to-total assets.
During and after crisis dummy (*Crisis*)	A dummy variable set to 1 for each quarter from 1Q 2007 to 2Q 2012.
Expected Default Frequency (EDF)	Expected Default Frequency estimated based on KMV-Merton model, in percent. See: Bharath and Shumway (2008).
Equity / TA	The ratio of total equity (BHCKG105)-to-total assets (BHCK2170).
Group 0	BHCs with no significant trading assets (less than $2 million) in a quarter.
Groups 1, 2, and 3	BHCs with trading assets are sorted into terciles with Group 1 containing observations with the smallest quantity of trading assets and Group 3 containing the highest quantity in each quarter.
High Deposits dummy	High Deposits is an indicator that equals to 1 if a bank is in the top tercile of deposits and 0 otherwise. We calculate the average Deposits/TA ratio over the pre-crisis period and sort the sample into terciles by the average equity to asset ratio.
High Equity dummy	High Equity is an indicator that equals to 1 if a bank is in the top tercile of equity capital and 0 otherwise. We calculate the average Equity/TA ratio over the pre-crisis period and sort the sample into terciles by the average equity to asset ratio.
Idiosyncratic Risk	The standard deviation of daily return residuals from Fama-French regressions (four-factors including momentum) over a quarter, times the square root of number of observations in a quarter.
Interest Income / Operating Income (*IntInc/OpInc*)	Gross income from interest earning assets (BHCK4107) divided by operating income.
Loans	The sum of loans available for sale (BHCK5369) and loans held to maturity , net of allowances (BHCKB529), in millions of US dollars.
Loans/TA	The ratio of loans-to-total assets.
Market share of Trading Assets (*Mkt share of Tr. Assets*), Loans (*Mkt share of Loans*) and Securitized Assets (*Mkt share of Secz*)	For each quarter we calculate the aggregate trading assets, loans, and securitized assets across all banks in our sample. The market share is the ratio of a given BHC's trading assets, loans, or securitized assets to the aggregate for that category.
Marginal expected shortfall (MES)	The one-day loss expected on a BHC's total stock return based on a 2% daily decline in the overall stock market. A higher MES implies a higher risk of systemic risk. See Acharya et al. (2012, 2013).
Nondeposit funding / ST funding	The ratio of (ST funding – Deposits) / ST funding, where short-term funding is defined above.
Operating Income	Net interest income (BHCK4074) + noninterest income (BHCK4079)
ROA	The ratio of quarterly income before taxes and extraordinary items (BHCK4301)-to-total assets (BHCK2170), averaged over four quarters. We annualize this ratio by multiplying it with 4.

ROE	The ratio of quarterly income before taxes and extraordinary items (BHCK4301)-to-total equity. capital (BHCKG105), averaged capital over four quarters. We annualize this ratio by multiplying it with 4.
Securitization Income	The sum of servicing fees (BHCKB492) and net securitization income (BHCKB4923).
Securitization Income/Operating Income (*Secz/OpInc*)	The ratio of securitization income to operating income.
Securitized Assets	The sum of off-balance-sheet assets securitized and sold during a quarter reported on Schedule HC-S, in millions of US dollars. These assets are classified as: family residential (BHCKB705), home equity lines (BHCKB706), credit card receivables (BHCKB707), auto loans (BHCKB708), other consumer loans (BHCKB709), commercial and industrial loans (BHCKB710), and all other assets (BHCKB711).
Securitized Assets / TA (*Secz/TA*)	The ratio of loans to securitized assets.
Size	The natural logarithm of total assets.
Short-term funding (ST funding)	Sum of deposits, Federal Funds (BHCMB993), repo (BHCKB995), commercial paper (BHCK2309), Federal Funds and other borrowed money with less than 1 year to maturity (BHCK2332), in millions of US dollars.
TARP	An dummy variable set to 1 if a firm receives funding under the Troubled Asset Relief Program in a given quarter.
Total Assets (TA)	Total assets for the consolidated bank holding company, in millions of US dollars (BHCK2170).
Trading Assets (*Tr Assets*)	Quarterly average trading assets in millions of US dollars (BHCK3401).
Trading Assets / TA (*TrAssets/TA*)	The ratio of quarterly average trading assets-to-total assets..
Trading Revenue (*Tr Rev*)	Trading revenue (BHCKA220) + Interest income from trading assets (BHCK4069) reported on Schedule HI, in US dollars in millions.
Trading Revenue / Operating Income (*TrRev/OpInc*)	The ratio of trading revenue to operating income.
Z-score	The sum of Equity/TA and ROA, divided by standard deviation of ROA estimated over rolling windows of 8 quarters.

Figure I: Income and Asset Shares by Business Line

Panel A: Income as a Share of Operating Income (weighted average based on total assets)



Panel B: Assets as a Share of Total Assets (weighted average based on total assets)