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Non-Interest Income and Bank Performance: Does Ring-Fencing Reduce Bank Risk?*

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Abstract

The optimum scope of bank activities is central to many proposals for banking system reform. For example, a core component of the Dodd-Frank Act (2010) and regulatory proposals in the UK and the EU has been the concept of "ring-fencing" – i.e., restricting banks' activities to their core retail and wholesale financial intermediation functions. It is argued that limiting the scope of bank activities reduces the likelihood of failure related to business lines that are highly risky. However, an alternative view holds that diversification of banks across traditional interest generating business and non-traditional businesses enhances bank profitability and reduces risk. Based on a sample of 368,006 quarterly observations on 10,341 US banks during the period 2002-2013, we find that a higher ratio of non-interest income (derived from fees and non-core activities such as investment banking, venture capital and trading) to interest income (associated with deposit-taking and lending to retail and commercial clients) is associated with higher profitability as well as lower failure probability. This finding is stronger during the crisis period than in either the pre- and post-crisis periods. We find similar results using trading (and investment banking) income instead of non-interest to interest income. Our results generally hold across bank size groups and are robust to the inclusion of bank fixed effects, bank size, and various measures of leverage and asset quality in the regressions. We find similar results in a sample of bank holding companies (BHCs), and in addition show that a higher fraction of non-traditional bank income is not associated with a higher contribution to systemic risk. Overall, our results question the benefits of "ring-fencing" bank activities.

Keywords: Core-banking activity, Non-traditional income, Bank size, Financial crises, Systemic risk
JEL Classification: G01, G21

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1. Introduction

The US Dodd-Frank Act, the UK Vickers Report, and the EU Liikanen Report have all sought to separate non-core from core banking activities by "ring-fencing" so-called core banking activities.[1] Ring-fencing is broadly designed to focus a bank on its traditional interest-generating retail and wholesale financial intermediation activities such as deposit taking and consumer / commercial lending, with non-core or non-traditional activities shifted into non-bank subsidiaries, possibly with significant scale limitations.[2]

In this paper, we seek to examine how banks' non-traditional activities – broadly reflected in non-interest income – affect profitability and risk taking during different market regimes. Our sample encompasses the period 2002-2013. This period includes 21 pre-crisis quarters (from Q1 2002 to Q1 2007), 8 crisis quarters (from Q2 2007 to Q1 2009), and extends through the post-crisis period, which includes another 19 quarters (from Q2 2009 to Q4 2013). We collect bank-level data on US commercial banks from Bank "Call Reports" reproduced on the Federal Reserve Bank of Chicago's website (until Q4 2010) and the FFIEC Central Data Repository's Public Data Distribution website (as of Q1 2011). Our sample includes 368,006 quarterly observations on 10,341 US banks. We confine our analysis to a data panel of US banks in order to preserve as much homogeneity as possible with regard to macro-conditions, currency, accounting standards and regulatory framework.

Our results show that a higher proportion of non-interest to interest income is associated with higher profitability. This finding holds in all three market regimes – pre-crisis, crisis, and post-crisis – and is strongest in the crisis period. We show that larger banks generate a higher

[1] The Dodd-Frank Wall Street Reform and Consumer Protection Act can be downloaded at https://www.congress.gov/bill/111th-congress/house-bill/4173. The Independent Commission on Banking Report, also referred to as Vickers Report, can be downloaded at www.parliament.uk/briefing-papers/SN06171.pdf. The Report of the European Commission's High-level Expert Group on Bank Structural Reform (Liikanen Report) can be downloaded at http://ec.europa.eu/internal_market/bank/docs/high-level_expert_group/liikanen-report/final_report_en.pdf.

[2] The objective is to confine bank activities that have access to lender of last resort support to those considered most critical and least risky inside the ring-fence while non-core activities remain outside with no taxpayer-bailout recourse.

proportion of their income from non-interest business. Hence, we control for bank size in all of our multivariate analyses and re-estimate our results across four bank size groups. We follow the Federal Reserve in allocating banks into four size groups with total assets below $100 million (small), total assets between $100 million and $1 billion (medium), total assets of between $1 billion and $10 billion (large), and total assets in excess of $10 billion (very large). We find that a positive relationship between non-interest to interest income and profitability holds across all bank size groups and time periods, with the exception of very large banks in the post-crisis period. This can most likely be attributed to a dramatic decline in the profitability of fixed income, currency, and commodities (FICC) trading activities by large banks in the post-crisis period.[3]

As a component of non-interest income, trading income accounts for approximately 18% of non-interest income across the entire sample of banks (on average) and is often considered to be the most controversial type of non-traditional bank income.[4] We therefore separately analyze the ratio of trading income to interest income. Again, we find a positive and significant relationship between trading income to interest income and bank profitability – a relationship that holds across all bank size groups and market regimes. The only exceptions are small banks during the crisis, possibly due to their minimal trading activity, and very large banks in the post-crisis period. In further tests, we also document a positive relationship between investment banking income – defined as investment banking, advisory, brokerage, and underwriting fees and commissions – to interest income and bank profitability. When looking at the three market regimes, however, we find that the positive relationship between investment banking income and profitability is confined to the crisis and post-crisis periods.[5]

[3] Consistent with this finding, further results show that the generally positive relationship between trading to interest income and bank profitability is substantially reduced in the post-crisis period.

[4] See § 619 (12 U.S.C. § 1851) of the Dodd–Frank Wall Street Reform and Consumer Protection Act, commonly known as the "Volcker Rule".

[5] As both M&A activity (e.g., Betton, Eckbo, and Thorburn, 2008; Ahern and Harford, 2014) and IPO activity (Doidge, Karolyi, and Stulz, 2013; Gao, Ritter, and Zhu, 2013) came nearly to a halt after the burst of the dot-com bubble, it is no surprise that investment banking income was generally lower during the pre-crisis period which includes the 21 quarters from Q1 2002 to Q1 2007.

We find some evidence that a higher non-interest (trading) income to interest income ratio increased bank risk exposure, as measured by the *Z-score*, in small and medium-sized banks. However, we find no evidence that higher non-interest (trading) income is associated with a higher insolvency risk in large and very large banks across all market regimes. Following Laeven and Levine (2009), Houston, Lin, Lin, and Ma (2010), and many others, we define a bank's *Z-score* as the sum of ROA and the capital asset ratio (defined as total assets minus total liabilities divided by total assets), divided by the volatility of a bank's ROA. Moreover, we show that a larger fraction of non-traditional income is associated with lower failure rates both during the crisis and throughout our whole sample.[6] A higher non-interest to interest income ratio before the crisis is not associated with a relatively larger decrease in profitability during the crisis. Hence, we find no evidence that the higher profitability of banks with a larger fraction of non-traditional income is associated with greater risk exposure. We also show that banks with a higher non-interest to interest income ratio at the end of the crisis period subsequently recovered more quickly and more completely.

In the final part of our empirical analysis, we investigate whether banks with higher non-interest (or trading or investment banking) income to interest income have a higher contribution to systemic risk as compared to bank-specific risk. Measures of systemic risk employed in the literature require market data. But only a tiny fraction of US commercial banks are publicly listed. So we compile a sample of Bank Holding Companies (BHCs) for the purpose of this analysis. Using two of the most widely used measures of systemic risk contribution of a bank, Marginal Expected Shortfall (Acharya, Pedersen, Philippon, and Richardson, 2012; Acharya, Engle, and Richardson, 2012) and ΔCoVaR (Adrian and Brunnermeier, 2016), we first corroborate our main findings from the commercial banks in the sample of US BHCs. We then show

[6] In unreported tests, we find a negative relationship between non-traditional income and failure rates across all four size groups, but with the result being insignificant in the sub-sample of small banks.

that a higher fraction of non-interest (or trading or investment banking) income to interest income is not associated with a larger contribution to systemic risk.

Taken together, the evidence in this paper suggests that a greater reliance on non-interest income is associated with (a) higher bank profitability, and (b) lower risk at the individual bank level when looking at failure probabilities (but higher insolvency risk in small and medium-sized banks when looking at the *Z-Score*), (c) while not being related to a higher contribution to systemic risk.

By investigating the relationship between the relative importance of the share of non-interest income in total bank earnings, bank size, and bank profitability, the paper contributes to the existing literature analyzing how income from non-traditional versus traditional bank activities affects bank profitability and risk taking. DeYoung and Roland (2001), for example, investigate the relationship between fee-based activities and earnings volatility in a balanced panel of 472 US commercial banks covering a period 1988-1995 that precedes our sample period. They find both higher profitability and higher earnings volatility for banks with more fee-based activities. Stiroh (2004) finds that greater reliance on non-interest income – trading income in particular – is associated with higher bank risk and lower risk-adjusted profits in a sample of US banks covering the time period 1984-2001, i.e., also a period prior to ours. In a sample of 1,334 international banks in 101 countries, Demirgüç-Kunt and Huizinga (2010) find that a higher ratio of non-interest to interest income is associated with higher profits but also greater bank risk. De Jonghe (2010) finds that European banks with a higher proportion of non-interest to interest income exhibit higher systemic risk as measured by tail beta (the probability of a sharp decline in a bank's stock price conditional on a sharp decline in a bank stock index). Elsas, Hackethal, and Holzhaeuser (2010) investigate an international sample of banks from nine countries covering the time period 1996-2008 and show that a larger share of non-interest income is associated with higher margins, translating into higher profitability and bank stock prices. DeYoung and Torna (2013) investigate the relationship between non-interest income and bank failure

probability in a sample of US commercial banks during the financial crisis. The authors find that failure probability decreases in non-interest to interest income.[7] King, Massoud, and Song (2014) investigate the relationship between banks' trading activity and return-based performance measures, profitability, and risk taking in a sample of US BHCs. The authors find that trading activity is positively related to bank risk taking and negatively to profitability and stock returns particularly during and after the 2007-2009 crisis.

A recent stream of research investigates the relationship between the non-interest income and systemic risk. Brunnermeier, Dong, and Palia (2012), for example, investigate a sample of US BHCs and find that a higher ratio of non-interest to interest income is associated with higher systemic risk. De Jonghe, Diepstraten, and Schepens (2015) find an overall negative relationship between non-interest to interest income and systemic risk based on an international sample. Engle, Moshirian, Sahgal, and Zhang (2014) and De Jonghe, Diepstraten, and Schepens (2015) find evidence of heterogeneity in the relationship between non-interest income and systemic risk across countries (i.e., institutional settings) and bank size.

We contribute to this research by investigating the relationship between the ratio of non-interest to interest income (or trading or investment banking to interest income) and profitability and risk-taking in a sample covering all US commercial banks filing the Report of Condition and Income, and across three recent market regimes – pre-crisis, crisis, and post-crisis. This allows us to investigate whether the relationship between the relative importance of non-traditional income, profitability, and risk taking depends on bank size – including whether it is restricted to relatively large banks, for example – and whether it varies across market regimes in general. Moreover, we corroborate our findings in a sample of US BHCs and show that a higher ratio of non-interest to interest income (or trading or investment banking to interest income) is

[7] In a related study, Berger, El Ghoul, Guedhami, and Roman (2015) show a positive relationship between bank internationalization and bank risk as measured by the Z-Score, with the relationship becoming stronger during the crisis.

not associated with a higher contribution to systemic risk of these institutions across all three market regimes.

The remainder of the paper is structured as follows. In Section 2, we describe our dataset and variables. In section 3, we discuss our empirical results, and Section 4 presents our conclusions.

2. Data and Methodology

2.1 Sample selection

To examine the relationship between the ratio of non-interest to interest income, bank size, bank performance, and bank risk taking we collect data on US commercial banks from the bank "Call Reports" available on the Federal Reserve Bank of Chicago website for quarters up to Q4 2010 and on the FFIEC Central Data Repository's Public Data Distribution website as of Q1 2011.[8] The Call Reports cover all banks filing the Report of Condition and Income – i.e., those regulated by one or some combination of the Federal Reserve System, the Federal Deposit Insurance Corporation (FDIC), and the Comptroller of the Currency. We collect data for the 48 quarters from Q1 2002 to Q4 2013. We define a pre-crisis period that begins in the first quarter of 2002, after the end of the recession from March to November 2001 (as defined by the NBER), and after September 11 2001, when the Fed began to lower interest rates. Our pre-crisis period includes 21 quarters and ends in Q1 2007. The crisis period includes the subsequent 8 quarters from Q2 2007 to Q1 2009. The end of the crisis follows the definition of the Federal Reserve Bank of St. Louis as the last extraordinary measures that were applied by the Fed and Treasury in Q1 2009. The majority of stock price indices, including the S&P 500 and DJ Industrial Average, reached their lowest levels in Q1 2009. The post-crisis period includes the 19 quarters from Q2 2009 to Q4 2013. The post-crisis period is affected by the Credit Card Accountability

[8] Data for the time period Q1 2002 to Q4 2010 can be downloaded at the FRB Chicago website at http://chicagofed.org/webpages/banking/financial_institution_reports/commercial_bank_data.cfm and data for the time period Q1 2011 to Q4 2013 at the FRB Chicago website at the FFIEC website at https://cdr.ffiec.gov/public/.

Responsibility and Disclosure (CARD) Act which was passed in April 2009 and significantly reduced fee income generated by all US financial institutions (Agarwal, Chomsisengphet, Mahoney and Stroebel, 2015).[9]

The Bank Regulatory database includes a total of 382,916 bank-quarter observations for our sample period. Due to missing observations for some of our variables, our final sample includes 368,006 bank-quarters on 10,341 US banks.[10] In some of our tests, we segment our 368,006 bank-quarters into four size groups based on banks' inflation-adjusted or real total assets (base year 2013).[11] The segment with the smallest banks includes all bank-quarters for banks with total assets below $100 million in the respective quarter. This size group includes a total of 135,391 bank-quarters. The segment with the second smallest banks includes all bank-quarters of banks with total assets between $100 million and $1 billion in the respective quarter. This group includes 203,073 bank-quarters. The third size group has total assets of between $1 billion and $10 billion and includes 24,650 bank-quarters. The fourth size group includes banks with total assets in excess of $10 billion and covers 4,892 bank-quarters.

2.2 Variables

To measure bank profitability for US banks, we use two accounting return measures, *ROE* and *ROA*.[12] *ROE* is defined as net income divided by total equity capital, *ROA* is defined as net income divided by total assets.[13] The variable of principal interest for the purposes of this paper

[9] The CARD Act was introduced in two parts, the first in February 2010 and the second in August 2010. Among other things, the CARD Act limits the ability of banks to charge certain types of credit card fees and attempts to affect customers' repayment behavior by requiring clear information on the costs of only making minimum payments on the credit card bill.

[10] Data on total assets are missing in 38 bank-quarters, while most of the other variables used in our paper are missing in 14,910 bank-quarters. Hence, we exclude these 14,910 observations from our sample as they would not be included in any of our multivariate analyses.

[11] The four size groups reflect the FDIC's characterization of bank size groups but using real assets rather than nominal assets; see for example the FDIC Quarterly Banking Profile: www.fdic.gov.

[12] We rely on accounting measures as the large majority of US commercial banks are not publicly traded on organized stock exchanges.

[13] Only a smaller subset of banking institutions – Bank Holding Companies – are publicly traded. Hence, in this paper, we cannot use market-based performance measures.

is the ratio of non-interest to (net) interest income (*Non-Interest to Interest Income*) which measures the relative size of non-traditional income to traditional interest income of banks. In some tests we use dummy variables for the non-interest to interest income quartiles instead of the non-interest to interest income ratio. In other tests we focus on the ratio of the most controversial type of non-traditional income, trading income, to net interest income (*Trading to Interest Income*). We also define group dummies based on the quartiles of the quarterly distribution of trading to interest income. As an alternative measure of bank activity, we also use investment banking income, defined as investment banking, advisory, brokerage, and underwriting fees and commissions, to net interest income in some tests.

We use the natural logarithm of total assets, *ln(Total Assets)*, or bank size group membership as measures of bank size. We also define a number of risk measures that reflect either a bank's leverage or asset quality. These are a bank's *Tier 1 Capital to Total Assets* defined as Tier 1 capital divided by total assets, *Deposits / Loans* defined as deposits divided by loans, and *Bad Loans / Total Assets* defined as the sum of non-accrual loans and loans past due 90 days or more divided by total assets. Following Laeven and Levine (2009), Houston, Lin, Lin, and Ma (2010) and many others, we use the *Z-score* as measure of bank risk taking. We define the *Z-score* as the sum of ROA and the capital asset ratio (CAR) divided by the volatility of ROA. CAR is calculated as total assets minus total liabilities, divided by total assets. We calculate the standard deviation of ROA in the denominator over a rolling window of 12 quarters (as well as in robustness tests of eight quarters).[14] The Z-score is inversely related to the probability of bank insolvency. To mitigate the effect of outliers, all variables with the exception of *ln(Total Assets)* are winsorized at their 5th and 95th percentiles.[15]

[14] The distribution of the Z-score is skewed. Hence, in unreported robustness tests, we use the natural logarithm of one plus the Z-score (see also Laeven and Levine, 2009). The results remain virtually unchanged.

[15] If we winsorize all variables at their 1st and 99th percentiles or omit any winsorization, our results are qualitatively similar. If anything, these results show a stronger positive relation between non-interest to interest income (and trading income) and profitability and a more negative relation between non-interest to interest income (and trading income) and the Z-score suggesting that winsorizing at the 5th and 95th percentiles results in conservative estimates.

2.3 Sample composition and attrition rate

Table 1 reports the total number of banks in our sample and the number of banks in the four size groups for each quarter of our sample period. Overall, there is a substantial decrease in sample size from 8,513 banks in Q1 2002 to 6,877 banks in Q4 2013, a decline of nearly 20%. The average quarterly sample attrition rate is 0.94% over the 12 sample years. Attrition either results from failure or takeovers of banks. The attrition rate in percentage terms increases monotonically in bank size across the four size groups, and is by far largest among the biggest banks with total assets in excess of $10 billion (see bottom part of Table 1). The average quarterly attrition rate of the very large banks is 1.47% and more than 50% higher than the average attrition rate of the smallest banks (0.89%). This result holds for both the pre-crisis and crisis periods, but not the post-crisis period when attrition rates are similar across the different size groups – and lowest for the very large banks.

2.4 Descriptive statistics

Table 2 reports descriptive statistics for our eight main variables, including the two return variables, two income variables, and four risk performance variables for all sample banks during the pre-crisis (Panel A), crisis (Panel B), and post-crisis periods (Panel C), respectively. Panels D and E report tests for differences in means and medians between the pre-crisis and crisis sub-samples and between the crisis and post-crisis sub-samples, respectively.

The results show that for the full sample (i.e., all bank size groups) profitability as measured by ROE and ROA decreased significantly from the pre-crisis to the crisis period. This result is consistent with Fahlenbrach and Stulz (2011) and Berger and Bouwman (2013), for example. Moreover, Panel E shows that both ROE and ROA likewise decreased significantly from the crisis to the post-crisis period. Bank profitability did not recover to pre-crisis levels during our post-crisis period ending in 2013.

The non-interest to interest income ratio decreased significantly from the pre-crisis to the crisis period, indicating that many banks cut back non-core activities. After the crisis, the non-interest to interest income ratio remained largely at crisis-levels. Table 2 further shows that, consistent with the results on the non-interest to interest income ratio, the trading to interest income ratio decreased significantly from the pre-crisis to the crisis period, but then recovered in the post-crisis period to a level higher than in the pre-crisis period.

The average ratio of Tier 1 capital to total assets increased while the median value decreased from the pre-crisis period to the crisis period. In contrast, from the crisis to the post-crisis period the average ratio of Tier 1 capital to total assets decreased while the respective median values increased. The ratio of deposits to loans decreased substantially from the pre-crisis to the crisis period and significantly recovered from the crisis to the post-crisis period to a level exceeding that in the pre-crisis period. The ratio of bad loans to total assets increased significantly from the pre-crisis to the crisis period and also from the crisis to the post-crisis period. The *Z-score* increased marginally (but statistically significantly) from the pre-crisis to the crisis period and also from the crisis period to the post-crisis period.

2.5 The relationship between bank size and non-traditional income

To analyze how bank size is related to the non-interest to interest income ratio, in Table 3, we report the mean and median values of non-interest to interest income for the four bank size groups, as well as the Pearson correlation between non-interest to interest income and bank size, measured by the natural logarithm of total assets, within the four bank size groups. Panel A reports the results for the full sample period, Panel B for the pre-crisis period, Panel C for the crisis period, and Panel D for the post-crisis period.

In all four panels, both the mean and median of the non-interest to interest income ratio increases monotonically in bank size across the four bank size groups. Also within the four size groups the correlation between bank size and the non-interest to interest income ratio is positive

and significant for the full sample period as well as for the three sub-samples. The only exception is the smallest size group where the correlation is negative and significant in all four panels.

3. Empirical Analysis

3.1 The non-interest to interest income ratio and bank profitability

In this section, we investigate bank profitability before, during, and after the financial crisis in a multivariate framework. To this end, we estimate OLS regressions of ROE and ROA at the bank-quarter level. Our main independent variables are either the ratio of non-interest to interest income or dummies for banks' non-interest to interest income group. We are not only interested in the relationship between the ratio of non-interest to interest income and performance, but also how this relationship differs across our three different market regimes, i.e., pre-crisis, crisis, and post-crisis. Hence, we also include interaction terms between the income measures and a crisis and a post-crisis dummy variable in our regressions. We control for several additional bank characteristics such as bank size, Tier 1 capital to total assets, deposits to loans, and bad loans to total assets. We interact all of these control variables with the crisis and post-crisis dummy variables to assess how the effect of these variables on profitability changes in the crisis and the post-crisis period.

To mitigate endogeneity concerns resulting from an omitted-variables bias introduced by unobserved bank characteristics that are constant over time, we include bank fixed effects in all regressions. In addition, to mitigate concerns resulting from reverse causality, we lag all explanatory variables by one quarter (in robustness tests by four quarters). Since the observations for one specific bank (for different quarters) are not independent (within correlation), we compute cluster-robust standard errors and treat each bank as a cluster.

3.2 Non-interest income and ROE

Table 4 reports the results from fixed effects regressions with ROE as dependent variable. The regression in Column 1 only includes the ratio of non-interest to interest income and the natural logarithm of total assets (as a measure of bank size) as explanatory variables. The results show that over our 12-year sample period spanning the pre-crisis, crisis, and post-crisis sub-periods, a higher ratio of non-interest to interest income is associated with a higher ROE. In contrast, the relationship between bank size and ROE is insignificant. In Column 2, we add interaction terms between the ratio of non-interest to interest income and bank size and dummies for the crisis and post-crisis periods.[16] The results show that the positive relationship between the ratio of non-interest to interest income and ROE is even stronger both in the crisis and post-crisis periods than in the pre-crisis period, with the strongest relationship in the crisis. Bank size is significantly positively related to ROE in the pre-crisis period, but this positive relationship is significantly reduced in the crisis period and even more so in the post-crisis period.

The regression in Column 3 extends the specification in Column 1 by adding three bank-specific control variables, *Tier 1 Capital to Total Assets*, *Deposits* / *Loans*, and *Bad Loans* / *Total Assets*. While the coefficient on the ratio of non-interest to interest income remains positive and significant, the coefficient on bank size is now significant as well indicating a positive relationship between bank size and ROE over the full sample period from Q1 2002 to Q4 2013.

When we interact all independent variables with a crisis and a post-crisis dummy variable in Column 4, the results confirm those in Column 2, i.e., the relationship between the non-interest to interest income ratio and ROE is positive and significant in the pre-crisis period and even significantly stronger both in the crisis and post-crisis. In contrast, the generally positive relationship between bank size and ROE is significantly reduced in the crisis and the post-crisis-

[16] In all regressions which include interaction terms with the crisis and post-crisis dummy variables, we also add dummy variables for the crisis period and post-crisis periods (not reported for space reasons).

period. However, the coefficient on the interaction term is smaller than the coefficient on the size variable. Hence, the total effect of size is still positive in the crisis and the post-crisis period, but weaker than before the crisis.

The coefficient on Tier 1 capital to total assets is negative, indicating that a riskier capital structure is associated with higher ROE. However, the interaction terms of the crisis and post-crisis dummies with Tier 1 capital to total assets are positive and significant, indicating that Tier 1 capital boosted ROE both in the crisis and post-crisis period. The positive coefficient on Tier 1 capital to total assets interacted with the post-crisis dummy is of similar size as the negative coefficient on Tier 1 capital to total assets, indicating that the negative relationship, between Tier 1 capital to total assets and ROE disappeared altogether in the post-crisis period.

The coefficient on the deposits to loans ratio is negative and significant indicating that banks mostly rely on their own deposits to make loans to customers are on average less profitable. However, the interaction term between the deposits to loans ratio and the crisis dummy is positive and significant indicating that the negative relation between ROE and deposits to loans is substantially reduced in the crisis. As expected, non-performing loans are associated with lower profitability. The negative and significant coefficients on the interaction terms between *Bad Loans* / *Total Assets* and the crisis dummy and between *Bad Loans* / *Total Assets* and the post-crisis dummy show that profitability is even more sensitive to non-performing loans in the crisis and post-crisis periods, respectively.

In Columns 5 and 6, we repeat the analysis in Columns 3 and 4, but replace the non-interest to interest income ratio by three dummy variables for whether the bank is in the second smallest, second largest, or largest non-interest to interest income quartile in the respective quarter. The quartile of banks with the smallest non-interest to interest income ratio is the base case, which is included in the constant. Most importantly, in Column 5, the coefficients on all three non-interest to interest income group dummy variables are positive and significant and increase

monotonically in magnitude across non-interest to interest income groups, confirming the positive relationship between non-interest to interest income and ROE documented in Columns 1 to 4. In Column 6, the coefficients on the interaction terms between the non-interest to interest income group variables and the crisis and post-crisis dummies are all positive and significant, while only the largest non-interest to interest income group dummy is positive and significant. Hence, when splitting the sample into quartile-groups, the positive relationship between non-interest to interest income and ROE mostly shows in the crisis and post-crisis periods. The interaction terms between the non-interest to interest income group variables and the crisis dummy are larger than those between the non-interest to interest income and the post-crisis dummy for all three income groups indicating that the positive relationship between non-interest to interest income and ROE is strongest in the crisis.

3.3 Non-interest income and ROA

In Table 5, we replicate the analysis in Table 4 for ROA as an alternative and probably better measure of bank profitability given our focus on non-interest to interest income and performance and the effects of higher leverage (i.e., lower bank capital) in increasing a bank's ROE. In general, the results are very similar, and there is again, as with ROE, a positive relationship between non-interest to interest income and profitability which becomes even stronger in the crisis. The only notable difference between Tables 4 and 5 is that the relationship between Tier 1 capital over total assets and ROA is positive across all market regimes, and strongest in the post-crisis period, while the relation between Tier 1 capital over total assets and ROE is negative and becomes significantly less negative in the crisis and post-crisis period.

Our results are not only statistically but also economically highly significant. In Table 5, an increase in the non-interest to interest income ratio by one standard deviation (0.144) is associated with an increase in ROA of about 0.049 (Column 1) and 0.053 (Column 3) which

amounts to 9.1% and 9.9% of mean ROA, respectively. During the crisis, a one standard deviation increase in the non-interest to interest income ratio is associated with an increase in ROA of about 11.2% (Column 2) and 12.6% (Column 4) of mean ROA, respectively. The economic magnitude of the ROE results in Table 4 is very similar.[17]

3.4 Non-interest income and bank size-group profitability

Next, we investigate whether the positive relationship between non-interest to interest income and ROE and ROA during the three market regimes differs across bank size groups. To this end, we reestimate the regressions in Column 4 of Tables 4 and 5 for each bank size group separately. The results are reported in Table 6. Columns 1 to 4 report the results from regressions with ROE as dependent variable and Columns 5 to 8 report the results from regressions with ROA as dependent variable. In the sub-sample of small banks, the coefficient on non-interest to interest income is positive and significant in both the ROE (Column 1) and ROA (Column 5) regressions. The interaction terms between non-interest to interest income and the crisis dummy and post-crisis dummies are all positive and insignificant suggesting that for small banks the overall relationship between non-interest to interest income and ROE / ROA is positive and significant across all three market regimes.

In the sub-samples of medium sized and large banks in Columns 2 to 3 and 6 to 7, all coefficients on the non-interest to interest income ratio and the interaction terms between non-interest to interest income and the crisis and post-crisis dummies are positive and most of them significant at the 5% level or better. Moreover, the generally positive and significant relation between non-interest to interest income and ROE / ROA is strongest in the crisis for both medium sized and large banks.

[17]An increase in the non-interest to interest income ratio by one standard deviation (0.144) is associated with an increase in ROE of about 0.461 (Column 1) and 0.485 (Column 3) which amounts to 8.8% and 9.2% of mean ROE, respectively. The results in Columns 2 and 4 suggest an increase in ROE of 0.608 (11.6% of mean ROE) and 0.617 (11.8% of mean ROE) from an increase in the non-interest to interest income ratio by one standard deviation during the crisis.

In the sub-sample of very large banks, reported in Columns 4 (ROE) and 8 (ROA), the coefficient on non-interest to interest income and the coefficient on the interaction term between non-interest to interest income and the crisis dummy are both positive and insignificant. The coefficient on the interaction term between non-interest to interest income and the post-crisis dummy is negative, significant, and larger in magnitude than the coefficient on non-interest to interest income. The linear combination of the two variables is borderline significant in Column 4 (*t*-statistic of -1.70) and insignificant in Column 8 (*t*-statistic of -1.57). Still, non-interest income seems to be less valuable in very large banks than in the other size groups.

To summarize, the positive relation between non-interest to interest income and ROE (and ROA) holds across all bank size groups and time periods, with the exception of very large banks, in particular in the post-crisis period (up to 2013) where this positive relationship vanishes. We investigate this effect further in Sections 3.5 to 3.7 where we look at the relationships between very large banks' trading income (and investment banking income) relative to interest income. Since the post-crisis period incorporates a period following the Dodd-Frank Act and the collapse of the mortgage backed securities and CDS markets, along with the M&A activity contraction in investment banking income, this result is as might be expected.[18]

3.5 The ratio of trading to interest income and bank performance

Trading is usually considered to be the most controversial type of non-interest income generating activity, especially in the US since passage of the Dodd-Frank Act.[19] Hence, in this section, we investigate whether trading income, as measured by the ratio of trading to interest income, is associated with higher profitability in general and across the three market regimes covered by our sample period.

[18] In the pre-crisis years of 2005 and 2006, the aggregate amount of non-government debt issues was respectively $4.2 trillion and $4.4 trillion. This fell to between $2.7 and $2.9 billion in the 2011-2013 period.
[19] The Volcker Rule only became effective for some banks in July 2015.

To this end, we reestimate Table 4 and replace the non-interest to interest income based measures by measures based on trading to interest income. The results are reported in Table 7. Column 1 reports the results from the smallest specification which only includes the ratio of trading to interest income and bank size as explanatory variables. The coefficient on *Trading to Interest Income* is positive and significant suggesting a positive relation also between trading income and ROE. In Column 2, we add interaction terms between the two independent variables and the crisis and post-crisis dummies. While the coefficient on trading to interest income remains positive and significant, the coefficient on the interaction term between trading to interest income and the crisis dummy is negative and significant. However, the coefficient on the interaction term is smaller in magnitude than the coefficient on trading to interest income resulting in a still positive, albeit somewhat weaker, relation between trading income to interest income and ROE in the crisis period (the combined effect is 11.06 in the crisis with a *t*-statistic of 8.06). These results remain similar when three additional control variables and their interaction terms with the crisis and post-crisis dummies are added in Columns 3 and 4, respectively.

In Columns 5 and 6, we replace the trading to interest income ratio by three dummy variables for whether the bank is in the second smallest, second largest, or largest trading to interest income quartile in the respective quarter. With two exceptions (the coefficient on the interaction term between the second smallest income group and the post-crisis dummy which is negative and insignificant and the coefficient on the interaction term between the largest income group and the crisis dummy which is positive and insignificant), all coefficients on the income group dummies and their interaction terms with the crisis and post-crisis dummies are positive and significant at the 1% level. The coefficients do not increase monotonically but are largest for the largest trading income group and generally confirm a positive relation between trading to interest income and ROE across all three market regimes. The coefficients on all control variables are qualitatively unchanged when compared to Table 4. The results from replicating Table

7 with ROA instead of ROE as dependent variable are virtually identical to those reported in Table 7.[20]

3.6 Trading to interest income and bank size groups

Next, we investigate whether the generally positive relationship between trading to interest income and ROE and ROA differs across bank size groups by reestimating Table 6 with non-interest to interest income replaced by trading to interest income. The results are reported in Table A1 in the appendix. Columns 1 to 4 report the results on ROE and Columns 5 to 8 the results on ROA.

As can be seen, the coefficient on trading to interest income is positive and significant with respect to ROE for banks of all sizes. However, in the sub-sample of small banks, the coefficient on the interaction term between trading to interest income and the crisis dummy is negative, significant, and of the same magnitude as the coefficient on trading to interest income, resulting in an insignificant total effect during the crisis (the *t*-statistic is -0.04). The coefficient on the interaction term between trading to interest income and the post-crisis dummy is insignificant. Hence, in the sub-sample of small banks, the relationship between trading to interest income and ROE is positive and significant in the pre-crisis and post-crisis period but not during the crisis.[21] In the sub-samples of medium sized, large, and very large banks, the coefficients on the interaction terms between trading to interest income and the crisis and post-crisis dummies are all either positive and significant or insignificant resulting in a generally positive relationship between trading to interest income and ROE in these size groups.[22] The results on ROA in Columns 5 to 8 are very similar.

[20] We do not report these results in a table but they are available from the authors upon request.

[21] Note that the effect on small banks is expected to be lower given that they have virtual zero trading activity (the mean (median) values of trading to interest income in small banks amounts to 0.51% (0%) which compares to 2.57% (1.03%) in large and very large banks), and this is being reflected in the size and significance of the coefficient.

[22] There are two exceptions. The coefficient on the interaction term between trading to interest income and the crisis dummy is negative and borderline significant. However, the coefficient is much smaller in magnitude than the one trading to interest income resulting in a positive relationship in the crisis (the *t*-statistic is 5.25). The second

In summary, the relationship between trading to interest income and both ROE and ROA is positive and significant across nearly all market regimes for the three sub-groups medium sized, large, and very large banks, the latter of which are of most concern to regulators seeking to restrict or ring-fence trading activities.

3.7 Investment banking income to interest income and bank profitability

In additional tests, we replace trading by investment banking income, defined as investment banking, advisory, brokerage, and underwriting fees and commissions. The results are reported in Table 8. Column 1 reports the results from the smallest specification, which only includes the ratio of investment banking to interest income and bank size as explanatory variables. The coefficient on *IB to Interest Income* is positive and significant suggesting a positive relationship also between investment banking income and ROE. In Column 2, we add interaction terms between the two independent variables and the crisis and post-crisis dummies. While the coefficient on investment banking to interest income turns negative and significant, the coefficients on both interaction terms between investment banking to interest income and the crisis and post-crisis dummies are positive, significant, and much larger in magnitude resulting in a positive relationship between investment banking income and ROE which, however, is confined to the crisis and post-crisis periods. When we add three additional control variables to the specification in Column 1, the results remain similar (Column 3). When we interact all variables with the crisis and the post-crisis dummy variables, respectively, the results, reported in Column 4, remain similar to those in Column 2. The results from replicating Table 8 with ROA instead of ROE as dependent variable are virtually identical to those reported in Table 8. Hence, we do not report these results in a table.[23]

exception is the negative and significant coefficient on the interaction term between trading to interest income and the post-crisis dummy in Column 4. The coefficient is of similar magnitude as the coefficient on trading to interest income resulting in an insignificant relation between trading to interest income and ROE in the post-crisis period.

[23] These results are available from the authors upon request.

3.8 Non-interest to interest income and bank risk exposure

Our results so far suggest that a higher ratio of non-interest to interest income, trading to interest income, and underwriting to interest income are associated with higher profitability as measured by both ROE and ROA. In this sub-section, we investigate whether higher ratios of non-interest to interest income and trading to interest income are associated with higher bank risk taking. If banks with a higher ratio of non-interest (and trading) income to interest income take on larger risks, higher profitability may merely reflect increased risk taking. Hence, we investigate whether higher ratios of non-interest to interest income and trading to interest income are associated with greater risk exposure as measured by the Z-score (see, Laeven and Levine, 2009).

We estimate regressions of the Z-score on non-interest to interest income or trading to interest income and bank size. We define the Z-score as the sum of ROA and the capital asset ratio, defined as total assets minus total liabilities, divided by total assets, divided by the volatility of ROA. Thus, a higher Z-score implies a lower insolvency risk. As before, to mitigate endogeneity and reverse causality concerns, all regressions include bank fixed effects and all explanatory variables are lagged by one quarter. The results from regressing the Z-score on non-interest to interest income, bank size, and the interaction terms between these variables and the crisis and post-crisis dummies are reported in Column 1 of Table 9.

The results show a negative and significant relationship between non-interest to interest income and the Z-score, suggesting that banks that generate a higher fraction of their income from non-traditional business have higher risk exposure. The interaction terms between non-interest to interest income and both the crisis and post-crisis dummies are negative and insignificant suggesting a similar positive relationship between non-traditional business and risk exposure as in the pre-crisis period.

In Columns 2 to 5, we investigate whether the relationship between the Z-score and the ratio of non-interest income to interest income differs across bank size groups. To this end, we

re-estimate the regression reported in Column 1 for each of the four bank size groups separately. The results show that the adverse relationship between non-traditional business and risk exposure is confined to small banks, where the relationship holds across all three market environments, and medium-sized banks, where an adverse relation between non-traditional business and risk exposure can be observed in the post-crisis period only. In the sub-samples of large and very large banks, all coefficients on the non-interest to interest income ratio and its interaction terms with the crisis and post-crisis dummies are insignificant. The only exception is the (weakly) significant positive coefficient on the interaction term between non-interest to interest income and the post-crisis dummy in the sub-sample of very large banks indicating a risk-reducing effect associated with a larger share of non-interest income.

The results from estimating the same set of regressions with non-interest to interest income replaced by trading to interest income are reported in Columns 6 to 10 of Table 9. The results on the full sample in Column 6 show that in the pre-crisis period a higher ratio of trading to interest income is associated with a higher insolvency risk. However, the interaction terms between trading to interest income and the crisis and post-crisis dummies are both positive, significant, and larger in magnitude indicating a lower insolvency risk of banks with a higher trading to interest income ratio both during and after the crisis. This risk-reducing effect, however is statistically insignificant (with *t*-statistics of 1.15 and 1.16, respectively). Looking at the bank size subsamples reveals that trading to interest income is associated with a higher probability of insolvency in small and medium-size banks before the crisis. In contrast, large banks with a higher trading to interest income are associated with a lower insolvency risk in the crisis. All other coefficients on trading to interest income, as well as its interactions with the crisis and post-crisis dummies, are insignificant in the sub-samples of large and very large banks. This suggests no significant relationship between trading to interest income and insolvency risk for the banks most involved in trading activity and which have been the focus of ring-fencing under Dodd-Frank.

In summary, we find some evidence that a high non-interest (trading) income to interest income ratio increased bank risk exposure in small and medium-sized banks. However, we find no evidence that higher non-interest (trading) income is associated with a higher insolvency risk in large and very large banks across all market regimes – i.e., the banks that are principally engaged in trading activity. In fact, trading activities are mostly confined to large and very large banks – i.e., of the four bank size groups considered here, only the top two really matter. The mean (median) trading to interest income amounts to 0.51% (0%) in the sub-sample of small banks and to 2.30% (0.82%) and 3.75% (2.20%) in the sub-samples of large and very large banks, respectively. Moreover, 69% and 78% of large and very large banks, respectively, report positive trading income, while only 17% of small banks do. The same is true of investment banking – underwriting and M&A activity – where mostly the top size group matters for these non-interest income producing activities (with 64% of banks reporting positive investment banking income versus 6% in the sub-sample of small banks).

3.9 The non-interest to interest income ratio and bank failures

To further investigate whether banks with a higher ratio of non-interest to interest income eventually face a higher risk of failure, we identify bank failures based on the FDIC List of Failed Banks.[24] Using bank name and location, we can manually match 478 bank failures (of 510) taking place during our sample period to our Call Report sample. We follow two alternative empirical strategies to analyze bank failures.

First, we estimate cross-sectional logit regressions with a dummy whether a bank failed during the financial crisis, defined from Q2 2007 to Q1 2009, as the dependent variable and non-interest to interest income and other bank-specific variables, measured before the crisis (i.e., as of Q4 2006), as explanatory variables. 62 of 478 banks (13.0%) in our sample failed

[24] The list can be retrieved at: https://www.fdic.gov/bank/individual/failed/banklist.html.

during the crisis. The results are reported in Columns 1 and 2 of Table 10 and show that the coefficient on the non-interest to interest income variable is negative and significant in both specifications. In terms of economic magnitudes, marginal effects (not reported) suggest that a one percentage point increase in the non-interest to interest income ratio (5.2% of the mean value) before the crisis is associated with a 1.55% decrease in bank failure probability during the crisis. The coefficients on the other control variables show that more Tier 1 capital and a higher deposits to loans ratio before the crisis are associated with lower failure rates while more non-performing loans are associated with a higher probability of failure.

Second, we estimate panel logit regressions of a failure indicator on non-interest to interest income and other bank-specific control variables. This test does not specifically account for the crisis and post-crisis periods and covers the complete sample period from Q1 2002 to Q4 2013. The results are reported in Columns 3 and 4 of Table 10. In Column 3, all explanatory variables are lagged by four quarters. In Column 4, explanatory variables are average values over the last four quarters (from t-5 to t-1). Again we find a negative relationship between bank failure and the non-interest to interest income ratio in both specifications which, however, is significant only in Column 3. In terms of economic significance, unreported marginal effects suggest that a one percentage point increase in the non-interest to interest income ratio (5.1% of the sample mean) is associated with a decrease in the failure probability by 0.005% (3.6% of the sample mean) in Column 3.

In further tests, we replace the non-interest to interest income by trading to interest income. The results are reported in Columns 1 to 4 of Table A2 in the appendix. The coefficient on trading to interest income is negative and insignificant across all four specifications suggesting that a higher ratio of trading to non-interest income is neither associated with a higher nor lower failure rate.

In summary, the results in Columns 1 and 2 of Table 10 show that a higher non-interest to interest income ratio before the crisis is not associated with a higher probability of failure in the

crisis. The results in Columns 3 and 4 show that more generally a higher non-interest to interest income ratio is associated with a lower probability of failure. Results on the trading to interest income (in Appendix A2) are weaker, but do not point to a positive relationship between trading to interest income and failure rates.

3.10 Robustness tests

3.10.1 Alternative control variables

We perform a number of robustness tests on our main results. First, we vary the set of control variables used in our multivariate regressions. Specifically, we replace the Tier 1 capital to total assets ratio as measure of a bank's leverage and asset quality by a number of alternatives including Tier 1 capital divided by net risk-weighted assets, the sum of Tier 1 and Tier 2 capital divided by net risk-weighted assets, and Core Capital (defined as Tier 1 capital minus intangible assets / goodwill) divided by total assets. We also replace the ratio of bad (i.e., non-performing) loans to total assets by total loan charge-offs divided by total assets and add loans and lease loss reserves divided by total loans and leases, the "fair value" of GSE-backed residential mortgage-backed securities divided by total assets, and all holdings of private-label, i.e., non-government-secured, residential mortgage-backed securities divided by total assets as additional control variables.[25] We find that our results remain qualitatively unchanged when we change the set of control variables.

3.10.2 Sample stability

In further robustness tests, we attempt to ensure that our results are not caused by banks entering and other banks dropping out of our sample. First, we reestimate Columns 3 and 4 of

[25] To mitigate the effect of outliers, all variables are winsorized at their 5th and 95th percentiles with the exception of the variable measuring the ratio of non-government-secured MBS to total assets. This variable takes on a positive value in 40,562 observations of a total of 368,006 observations only (or 11.0%). Hence, winsorizing at the 5th and 95th percentiles would result in a nearly zero-variance variable. Our results are also robust to not winsorizing this variable at all.

Tables 4 and 5 and restrict the sample to only those banks with at least one observation in the pre-crisis period and one observation in the crisis. This restriction reduces the sample size from 361,978 (361,979) to 321,098 bank-quarters, a decrease of approximately 11.3%. The results are reported in Table A3 and are very similar to those in Tables 4 and 5. In Table A4, we replicate the analysis in Table A3, but only include banks with full data coverage over the complete sample period from Q1 2002 to Q4 2013 resulting in a balanced panel. This restriction reduces the sample size by 106,889 (106,890) bank-quarters (29.5%). Again, the results remain very similar with the economic magnitude of the coefficients being slightly reduced but statistical significance virtually unchanged.

3.10.3. Reverse causality

To further raise the bar against reverse causality, we replicate in Table A5 the results in Columns 3 and 4 of Tables 4 and 5 by lagging all explanatory variables by four (instead of one) quarters. The results are very similar to those reported in Tables 4 and 5. Most importantly, the results confirm a positive relationship between non-interest to interest income and ROE (ROA) which becomes even stronger in the crisis period and is approximately of the same magnitude in the pre- and post-crisis environments. Moreover, the relationship between size and ROE (ROA) is positive and significant in the pre-crisis period but substantially reduced in the crisis and post-crisis periods.

3.10.4 Pre-crisis non-interest income and crisis performance

In the next robustness test, we change our empirical setup and instead of relating the profitability measures to lagged bank characteristics, we investigate whether the non-interest to interest income ratio before the crisis is significantly related to changes in profitability during the crisis. The dependent variable is the percentage change in ROE (ROA) during the crisis while the explanatory variables are measured as of Q4 2006, the end of the last year before the crisis.

This alternative setup also mitigates endogeneity concerns as the explanatory variables are measured before the crisis and therefore are unlikely to be determined by the subsequent performance change during the crisis. Moreover, the crisis represents a regime shock to the individual banks and allows us to investigate any benefits associated with non-interest income reliance in an extraordinary market environment. It is important to note that this test differs from prior analyses in that we now investigate *changes* in ROE and ROA. As banks with a higher non-interest to interest income ratio already have significantly higher profitability levels at the start of the crisis, even an insignificant coefficient indicates that they do not perform worse in the crisis and hence are able to hold their higher profitability levels throughout the crisis period. Hence the results from this analysis will provide additional evidence on whether a higher non-interest to interest income ratio helped or hurt banks in the crisis.

The results are reported in Columns 5 and 6 of Table 10 and show that the coefficients on non-interest to interest income are both positive and insignificant suggesting that banks with a larger share of non-traditional income before the crisis do not experience larger drops in ROE or ROA during the crisis than other banks. Results on trading to interest income are very similar and are reported in Columns 5 and 6 of Table A2 in the appendix.[26]

3.10.5 Crisis non-interest income and post-crisis recovery

We also investigate whether firms with a higher non-interest to interest income ratio either at the end of the crisis or right before the crisis are able to recover faster after the crisis. To this end, we estimate regressions of the percentage change in ROE (and ROA) in an early post-crisis or recovery period, defined to range from Q2 2009 to Q4 2010, on a set of explanatory variables measured either as of Q1 2009, the end of the crisis, or as of Q4 2006, the end of the last year before the crisis. The results are reported in Table 11. Columns 1 to 4 report the results with

[26] In a robustness test, we do not exclude banks which disappear from our sample during the crisis as long as they survive for at least four quarters, i.e., until Q4 2008, and hence the change in profitability can be calculated for the quarters Q2 2007 to Q1 2008 or longer and find very similar results.

explanatory variables measured as of the end of the crisis and Columns 5 to 8 as of the end of the last year before the crisis. Odd columns include the non-interest to interest income ratio as the main explanatory variable and even columns the non-interest to interest income group dummies.

The results in Columns 1 to 4 show that a higher non-interest to interest income ratio at the end of the crisis is associated with a stronger recovery in profitability. The coefficients on the non-interest to interest income ratio and the non-interest to interest income group dummies indicating the larger two quartiles of the distribution are positive and statistically significant. Hence, banks with a higher non-interest to interest income ratio at the end of the crisis recovered faster and more completely in the period after the crisis. A reason for this finding could be that revenues from non-core activities, such as new transaction fees, accrued more quickly than revenues from the origination and approvals on new loans.

In Columns 5 to 8, all coefficients on the non-interest to interest income ratio and the non-interest to interest income group dummies are positive as well, and most of them are significant. Hence, the relation between non-interest to interest income before the crisis (i.e., before Q1 2007) and the recovery in ROE and ROA after the crisis is generally positive and similar in magnitude as the relationship between non-interest to interest income at the end of the crisis and the recovery in ROE and ROA documented in Columns 1 to 4.

3.11 Non-traditional income and systemic risk

In this sub-section, we analyze whether banks with higher non-interest (or trading or investment banking) income to interest income have a higher contribution to systemic risk as compared to bank-specific risk as measured, for example, by the Z-Score.[27] As the measures of

[27] A number of recent studies investigates the relationship between non-interest income and systemic risk. Brunnermeier, Dong, and Palia (2012), for example, investigate a sample of US BHCs and find that a higher ratio of non-interest to interest income is associated with higher systemic risk. In contrast, De Jonghe, Diepstraten, and Schepens (2015) find a negative relation between non-interest to interest income and systemic risk. Engle,

systemic risk usually employed in the literature require market data and only a tiny fraction of US commercial banks are publicly listed, we compile a sample of Bank Holding Companies (BHCs) to analyze whether a larger fraction of non-traditional bank income is associated with a larger contribution to systemic risk. We collect balance sheet data from the FR Y-9C reports and merge these data with Compustat/CRSP data using the linking table provided by the Federal Reserve Bank of New York.[28] We are able to match 670 BHCs with a total of 19,058 quarterly observations over the period 2002-2013. Sample size, however, is reduced by availability of the systemic risk measures, as explained below, to a maximum of 15,744 quarterly observations on 542 BHCs.

In a first step, we replicate some of our key findings in this sample of BHCs. Specifically, we replicate the ROE-regressions in Columns 3 and 4 of Table 4 and also replace the non-interest to interest income variables by trading income to interest income and investment banking to interest income based variables. These results are reported in Panel A of Table A6. Panel B of Table A6 replaces ROE by the Z-Score as dependent variable (see analysis in Table 9). All regressions include bank fixed effects as well as lagged bank-specific control variables as specified in the table caption.[29] For space reasons, we only report the coefficients on the measures of banks' income activity and their interactions with the crisis and post-crisis dummies. The results are largely consistent with those reported in previous tables. We find a positive relationship between non-interest to interest income and ROE which holds across all three market regimes (Columns 1 and 2). A higher fraction of trading income is overall insignificantly related to ROE (Column 3), but negatively in the pre-crisis period and positively (and significantly so) in the crisis and post-crisis periods (Column 4).[30] A higher fraction of investment

Moshirian, Sahgal, and Zhang (2014) and De Jonghe, Diepstraten, and Schepens (2015) find evidence of heterogeneity in the relationship between non-interest income and systemic risk across countries (i.e., institutional settings) and bank size.

[28] The file is available at: http://www.ny.frb.org/research/banking_research/datasets.html.

[29] The set of control variables used in this sub-section is based on previous literature on BHCs (Ellul and Yerramilli, 2013; King, Massoud, and Song, 2014; De Jonghe, Diepstraten, and Schepens, 2015). Results are insensitive to different sets of control variables.

[30] The combined crisis effect is 1.655 (= -1.762 + 3.417) and significant at the 5% level (t-statistic = 2.04).

banking income is overall positively related to ROE (Column 5), however, the relationship is negative in the pre-crisis period and only marginally positive in the crisis. The results on the Z-Score in Panel B are also consistent with those in Table 9 in that we find no evidence that a higher fraction of non-traditional income is associated with a higher insolvency risk before, during, or after the crisis (with the only exception of investment banking income in the pre-crisis period). To the contrary, there is some evidence that a larger fraction of non-traditional bank income is associated with significantly lower insolvency risk in the crisis and post-crisis periods.

We use two alternative measures of a bank's contribution to systemic risk. The first variable, Marginal Expected Shortfall (MES), is based on the expected capital shortfall of a financial institution during a crisis and was introduced by Acharya, Pedersen, Philippon, and Richardson (2012) and Acharya, Engle, and Richardson (2012).[31] The second variable is the ΔCoVaR measure of Adrian and Brunnermeier (2016) which measures a bank's contribution to systemic risk as the difference between the conditional Value-at-Risk (CoVaR) of the financial system, conditional on this bank being in distress, and the conditional Value-at-Risk (CoVaR) of the financial system, conditional on this bank operating in its median state.[32]

In Table 12, we estimate bank fixed effects regressions of the two alterative measures of systemic risk on various bank income measures and controls. For space reasons, we only report the coefficients on the income variables and their interaction terms. Panel A reports the results with MES as measure of systemic risk contribution and Panel B with ΔCoVaR as systemic risk measure. Overall, our results show that all coefficients on the income variables and their interactions with the crisis and post-crisis dummies are either insignificant or negative and significant indicating that a higher fraction of non-interest (or trading or investment banking) income to interest income is not associated with a larger contribution to systemic risk.

[31] Data on MES was provided to us by Viral Acharya and Michael Robles from the NYU Volatility Institute.
[32] We obtained data on the ΔCoVaR measure on Markus Brunnermeier's website at: http://scholar.princeton.edu/markus/publications/covar.

4. Conclusions

In this paper, we investigate whether a higher ratio of non-interest income (broadly associated with non-core activities) to net interest income (broadly associated with traditional banking activity) is linked to higher profitability and risk taking across the banking sector and different market regimes. To this end, we use a sample of 368,006 quarterly observations on 10,341 US banks during the period 2002-2013 which covers a pre-crisis, crisis, and post-crisis period. Our results show that in general over all three market regimes a higher fraction of non-interest to interest income is associated with higher profitability, with the strongest results being observed during the crisis. This finding does not depend on bank size and holds across bank size groups. When we restrict our income measure to trading income alone (the most controversial form of non-interest bank income) as a proportion of interest income, we find similar results. For the ratio of investment banking to interest income, we likewise find similar results. Moreover, we show that larger banks are in general more profitable, but that this positive relationship between bank size and profitability is significantly reduced (albeit still positive) in the crisis and the post-crisis-periods.

In analyzing bank-level risk, we find that banks which generate a higher fraction of their income in non-traditional business do not have a higher probability of insolvency as measured by the *Z-score*, with the exception of small and medium-sized banks, and that a higher non-interest to interest income ratio before the crisis is neither associated with relatively larger decreases in profitability nor a higher probability of failure in the crisis. Indeed, our results suggest that a larger fraction of non-traditional income is associated with a lower failure rate both during the crisis and in general. Hence, we find no evidence that the higher profitability of larger banks with a higher fraction of non-traditional income results from greater bank risk taking. In the subset of smaller banks, the lower Z-Score values seem not to translate into higher failure rates. Finally, our results suggest that banks with a higher non-interest to interest income ratio at the end of the crisis recovered faster after the crisis. In short, at the individual bank level non-

traditional bank income is associated with higher bank profitability with little evidence that it is associated with higher risk. Using a sample of listed Bank Holding Companies, we also show that a higher fraction of non-interest (or trading or investment banking) income to interest income is not associated with a larger contribution to systemic risk.

Overall, our results call into question the current practices of US and European regulators of either ring-fencing or prohibiting certain non-core banking activities. Indeed, such restrictions may lead to reduced bank profitability without any fundamental gains in lowering banks' risk of insolvency and systemic risk contribution.

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Table 1: Sample composition and attrition rate over time

Quarter	Total	Attr.	Small	Attr.	Medium	Attr.	Large	Attr.	Very Large	Attr.
2002 Q1	8,513	69	3,747	28	4,234	37	423	1	109	3
2002 Q2	8,470	64	3,675	23	4,239	34	450	6	106	1
2002 Q3	8,432	78	3,578	33	4,292	36	454	8	108	1
2002 Q4	8,381	55	3,479	19	4,335	32	460	4	107	0
2003 Q1	8,357	60	3,482	28	4,300	26	466	4	109	2
2003 Q2	8,322	53	3,398	21	4,338	29	476	2	110	1
2003 Q3	8,302	84	3,363	30	4,343	35	487	15	109	4
2003 Q4	8,254	89	3,304	33	4,354	41	489	11	107	4
2004 Q1	8,194	58	3,282	16	4,325	28	486	14	101	0
2004 Q2	8,169	79	3,265	20	4,317	48	478	11	109	0
2004 Q3	8,129	74	3,216	37	4,321	28	481	4	111	5
2004 Q4	8,089	70	3,136	23	4,356	35	489	8	108	4
2005 Q1	8,050	99	3,184	19	4,288	67	477	10	101	3
2005 Q2	7,997	49	3,141	17	4,270	26	485	6	101	1
2005 Q3	7,991	80	3,089	32	4,302	45	499	2	101	1
2005 Q4	7,969	79	3,026	28	4,325	42	514	8	104	6
2006 Q1	7,934	63	3,077	24	4,250	35	504	4	103	0
2006 Q2	8,009	77	3,114	24	4,269	43	519	4	107	6
2006 Q3	7,978	106	3,082	41	4,268	48	526	13	102	4
2006 Q4	7,837	72	2,920	28	4,287	37	527	6	103	1
2007 Q1	7,896	79	3,011	24	4,262	49	524	6	99	0
2007 Q2	7,862	91	2,977	24	4,252	47	531	12	102	8
2007 Q3	7,811	69	2,939	24	4,247	41	530	4	95	0
2007 Q4	7,788	85	2,877	33	4,272	37	545	14	94	1
2008 Q1	7,740	67	2,913	26	4,213	32	522	8	92	1
2008 Q2	7,698	79	2,870	19	4,210	51	527	8	91	1
2008 Q3	7,640	89	2,801	33	4,222	47	525	6	92	3
2008 Q4	7,568	60	2,679	17	4,236	39	538	4	97	0
2009 Q1	7,520	57	2,631	15	4,248	33	545	9	96	0
2009 Q2	7,476	89	2,597	36	4,232	36	548	14	99	3
2009 Q3	7,393	77	2,521	27	4,235	42	538	6	99	2
2009 Q4	7,321	75	2,441	27	4,253	40	528	7	99	1
2010 Q1	7,250	103	2,469	26	4,166	57	525	19	90	1
2010 Q2	7,152	64	2,423	23	4,129	35	506	5	94	1
2010 Q3	7,094	101	2,381	25	4,098	71	521	5	94	0
2010 Q4	6,999	77	2,318	23	4,073	49	513	5	95	0
2011 Q1	6,923	55	2,293	13	4,028	36	508	5	94	1
2011 Q2	6,876	73	2,279	27	4,002	37	500	6	96	3
2011 Q3	6,820	68	2,234	29	3,984	31	508	7	94	1
2011 Q4	6,789	44	2,199	17	3,987	21	507	5	96	0
2012 Q1	7,377	62	2,375	20	4,328	39	565	3	109	0
2012 Q2	7,315	66	2,357	33	4,289	30	560	3	109	0
2012 Q3	7,249	99	2,309	36	4,274	55	556	7	110	1
2012 Q4	7,150	65	2,222	27	4,255	35	562	3	111	0
2013 Q1	7,085	80	2,218	36	4,202	36	556	6	109	2
2013 Q2	7,005	51	2,197	15	4,153	33	548	3	107	0

2013 Q3	6,955	81	2,172	27	4,113	46	563	8	107	0
2013 Q4	6,877	-	2,112	.	4,097	-	561	-	107	-
Total	368,006	3,464	135,391	1,206	203,073	1,857	24,650	329	4,892	72
Banks	10,341		5,271		6,904		1,096		207	
Attr. (%)	0.94%		0.89%		0.91%		1.33%		1.47%	
Pre-Crisis	0.90%		0.80%		0.89%		1.44%		2.12%	
Crisis	0.97%		0.84%		0.96%		1.52%		1.84%	
Post-Crisis	1.04%		1.11%		0.97%		1.22%		0.88%	

The table reports the total number of banks and the attrition rate in the sample as well as the number of banks and the attrition rate in the four size groups for each of the 48 sample quarters from Q1 2002 to Q4 2013. Data is collected from the Report of Condition and Income ("Call Report") available on the Federal Reserve Bank of Chicago website for quarters up to Q4 2010 and on the FFIEC Central Data Repository's Public Data Distribution website as of Q1 2011. The pre-crisis period includes the 21 quarters from Q1 2002 to Q1 2007, the crisis period includes the 8 quarters from Q2 2007 to Q1 2009, and the post-crisis period includes the 19 quarters from Q2 2009 to Q4 2013. Small banks are banks with total assets below $100 million in the respective quarter. Medium-sized banks are banks with total assets between $100 million and $1 billion in the respective quarter. Large banks are banks with total assets between $1 and $10 billion. Very large banks are defined as banks with total assets in excess of $10 billion. Bank size is measured by the banks' real total assets (base year 2013). The table also reports the attrition rate in percent for the pre-crisis and crisis periods.

Table 2: Descriptive statistics for all sample banks

Panel A: Q1/2002 – Q1/2007	Mean	Median	Stdv.	25% perc.	75th perc.	Observations	Nr. of Banks
ROE	0.0627	0.0539	0.0505	0.0272	0.0928	171,273	9,374
ROA	0.0063	0.0055	0.0052	0.0028	0.0094	171,273	9,374
Non-Interest to Interest Income	0.2052	0.1706	0.1389	0.1107	0.2567	171,225	9,369
Trading to Interest Income	0.0112	0.0000	0.0273	0.0000	0.0056	171,224	9,369
Tier 1 Capital to Total Assets	0.0922	0.1023	0.0322	0.0795	0.1150	171,272	9,373
Deposits / Loans	1.3803	1.2626	0.4077	1.0903	1.5440	169,976	9,233
Bad Loans / Total Assets	0.3510	0.1230	0.5614	0.0036	0.4485	171,271	9,373
Z-score	34.7353	31.5123	14.0553	24.3976	41.3190	162,680	8,759
Panel B: Q2/2007 – Q1/2009	**Mean**	**Median**	**Stdv.**	**25% perc.**	**75th perc.**	**Observations**	**Nr. of Banks**
ROE	0.0477	0.0410	0.0535	0.0138	0.0792	61,627	8,067
ROA	0.0049	0.0043	0.0058	0.0015	0.0083	61,627	8,067
Non-Interest to Interest Income	0.1991	0.1660	0.1418	0.1016	0.2530	61,574	8,062
Trading to Interest Income	0.0088	0.0000	0.0248	0.0000	0.0050	61,574	8,062
Tier 1 Capital to Total Assets	0.1059	0.0946	0.0342	0.0817	0.1193	61,627	8,067
Deposits / Loans	1.3004	1.1772	0.3938	1.0251	1.4330	60,683	7,941
Bad Loans / Total Assets	0.8895	0.5195	0.9940	0.1200	1.3044	61,627	8,067
Z-score	35.6586	31.8151	15.5603	23.9040	43.2173	57,263	7,637
Panel C: Q2/2009 – Q4/2013	**Mean**	**Median**	**Stdv.**	**25% perc.**	**75th perc.**	**Observations**	**Nr. of Banks**
ROE	0.0410	0.0348	0.0502	0.0117	0.0685	135,104	8,207
ROA	0.0044	0.0038	0.0056	0.0013	0.0075	135,105	8,207
Non-Interest to Interest Income	0.1993	0.1599	0.1521	0.0918	0.2562	135,013	8,203
Trading to Interest Income	0.0129	0.0000	0.0342	0.0000	0.0151	135,013	8,203
Tier 1 Capital to Total Assets	0.1038	0.0961	0.0298	0.0839	0.1150	135,106	8,207
Deposits / Loans	1.4350	1.3153	0.4159	1.1365	1.6132	133,083	8,073
Bad Loans / Total Assets	1.2852	0.9322	1.1515	0.2991	2.0637	135,106	8,207
Z-score	38.4106	34.4233	16.8707	25.2743	47.8719	127,353	7,508

Panel D: Difference Panel B – Panel A	Mean	Median	t-value (Mean)	p-value (Median)
ROE	-0.0150***	-0.0129***	-62.0501	0.0000
ROA	-0.0014***	-0.0012***	-55.3655	0.0000
Non-Interest to Interest Income	-0.0061***	-0.0046***	-9.2547	0.0000
Trading to Interest Income	-0.0024***	-0.0000***	-19.1771	0.0000
Tier 1 Capital to Total Assets	0.0036***	-0.0077***	23.0782	0.0000
Deposits / Loans	-0.0799***	-0.0854***	-41.8305	0.0000
Bad Loans / Total Assets	0.5385***	0.3965***	163.2339	0.0000
Z-score	0.9232***	0.3028***	-13.1379	0.0000

Panel E: Difference Panel C – Panel B	Mean	Median	t-value (Mean)	p-value (Median)
ROE	-0.0067***	-0.0062***	-27.0225	0.0000
ROA	-0.0005***	-0.0005***	-19.0442	0.0000
Non-Interest to Interest Income	0.0003	-0.0061***	0.3476	0.0000
Trading to Interest Income	0.0042***	0.0000***	26.7139	0.0000
Tier 1 Capital to Total Assets	-0.0021***	0.0015***	-14.0114	0.0007
Deposits / Loans	0.1346***	0.1381***	67.1807	0.0000
Bad Loans / Total Assets	0.3957***	0.4127***	73.6935	0.0000
Z-score	2. 7521***	2.6082***	-33.1994	0.0000

The table reports the descriptive statistics for all 10,341 US banks included in the sample split into three sub-periods. Panel A includes the pre-crisis period which includes the 21 quarters from Q1 2002 to Q1 2007, Panel B the crisis period including the 8 quarters from Q2 2007 to Q1 2009, and Panel C the post-crisis period including the 19 quarters from Q2 2009 to Q4 2013. Panel D reports the difference in means and medians between the pre-crisis period and the crisis period and Panel E the difference in means and medians between the crisis period and the post-crisis period. Data is collected from the Report of Condition and Income ("Call Report") available on the Federal Reserve Bank of Chicago website for quarters up to Q4 2010 and on the FFIEC Central Data Repository's Public Data Distribution website as of Q1 2011. The sample includes the 48 quarters from Q1 2002 to Q4 2013. *ROE* is defined as net income divided by total equity capital, *ROA* is defined as net income divided by total assets, *Non-Interest to Interest Income* is defined as non-interest income divided by interest income, *Trading to Interest Income* is defined as trading income divided by interest income, *Tier 1 Capital to Total Assets* is defined as Tier 1 capital divided by total assets, *Deposits / Loans* is defined as the deposits divided by loans, *Bad Loans / Total Assets* is defined as the sum of non-accrual loans and loans past due 90 days or more divided by total assets, *Z-score* is defined as the sum of ROA and the capital asset ratio (CAR) divided by the volatility of ROA. CAR is calculated as total assets minus total liabilities, divided by total assets. We calculate the standard deviation of ROA in the denominator over a rolling window of 12 quarters. All variables are winsorized at their 5th and 95th percentiles. The equality of means is tested using a standard *t*-test and the equality of medians using a Wilcoxon signed rank test. ***, **, * denotes statistical significance at the 1%, 5%, 10% level.

Table 3: The relation between bank size and non-interest to interest income

Panel A: Full sample period	Mean	Median	Correlation to ln(Total Assets)
Small (TA < 100m)	0.1749	0.1409	-0.1235 ***
Medium (100m < TA < 1bn)	0.2048	0.1751	0.1521 ***
Large (1bn < TA < 10bn)	0.2853	0.2514	0.1033 ***
Very large (10bn < TA)	0.4163	0.4578	0.3252 ***
Panel B: Pre-crisis period	Mean	Median	Correlation to ln(Total Assets)
Small (TA < 100m)	0.1757	0.1461	-0.0437 ***
Medium (100m < TA < 1bn)	0.2113	0.1819	0.1603 ***
Large (1bn < TA < 10bn)	0.2950	0.2574	0.1302 ***
Very large (10bn < TA)	0.4507	0.5015	0.3423 ***
Panel C: Crisis period	Mean	Median	Correlation to ln(Total Assets)
Small (TA < 100m)	0.1735	0.1401	-0.1751 ***
Medium (100m < TA < 1bn)	0.2021	0.1762	0.1683 ***
Large (1bn < TA < 10bn)	0.2728	0.2412	0.1131 ***
Very large (10bn < TA)	0.4158	0.4674	0.3087 ***
Panel D: Post-crisis period	Mean	Median	Correlation to ln(Total Assets)
Small (TA < 100m)	0.1745	0.1329	-0.2050 ***
Medium (100m < TA < 1bn)	0.1984	0.1663	0.1593 ***
Large (1bn < TA < 10bn)	0.2807	0.2491	0.0832 ***
Very large (10bn < TA)	0.3767	0.3749	0.3778 ***

The table reports the mean and median values of non-interest to interest income for the four bank size groups and the Pearson correlation between non-interest to interest income and banks size, as measured by the natural logarithm of total assets, within the four bank size groups. The analysis in Panel A is based on the full sample period from Q1 2002 to Q4 2013, the analysis in Panel B on the pre-crisis period from Q1 2002 to Q1 2007, the analysis in Panel C on the crisis period from Q2 2007 to Q1 2009, and the analysis in Panel D on the post-crisis period from Q2 2009 to Q4 2013. Banks are assigned to four size-groups: Small banks are banks with total assets below USD 100 million in the respective quarter. Medium-sized banks are banks with total assets between USD 100 million and USD one billion in the respective quarter. Large banks are banks with total assets between USD one and 10 billion. Very large banks are defined as banks with total assets in excess of USD 10 billion. Data is collected from the Report of Condition and Income ("Call Report") available on the Federal Reserve Bank of Chicago website for quarters up to Q4 2010 and on the FFIEC Central Data Repository's Public Data Distribution website as of Q1 2011. *Non-Interest Income to Interest Income* is winsorized at the 5th and 95th percentiles. ***, **, * denotes statistical significance at the 1%, 5%, 10% level.

Table 4: Fixed effects regressions of ROE on non-interest to interest income, bank-specific control variables, and interaction terms with the crisis and post-crisis dummy variables

Dependent Variable: ROE	(1)		(2)		(3)		(4)		(5)		(6)	
Intercept	5.143	***	-23.516	***	-0.878		-14.924	***	-0.524		-14.390	***
	(6.785)		(-27.600)		(-1.150)		(-15.292)		(-0.685)		(-14.732)	
Non-Interest to Interest Income	3.203	***	2.748	***	3.366	***	2.836	***				
	(13.296)		(10.226)		(16.320)		(11.672)					
Non-Interest to Interest Income * Crisis			1.471	***			1.452	***				
			(5.360)				(5.661)					
Non-Interest to Interest Income * Post-Crisis			0.886	***			0.731	**				
			(2.789)				(2.574)					
Income Q2 Group									0.296	***	-0.013	
									(7.336)		(-0.240)	
Income Q2 Group * Crisis											0.663	***
											(9.908)	
Income Q2 Group * Post-Crisis											0.257	***
											(3.688)	
Income Q3 Group									0.399	***	0.048	
									(7.844)		(0.770)	
Income Q3 Group * Crisis											0.822	***
											(11.445)	
Income Q3 Group * Post-Crisis											0.276	***
											(3.505)	
Income Q4 Group									0.783	***	0.441	***
									(12.164)		(5.794)	
Income Q4 Group * Crisis											0.776	***
											(9.214)	
Income Q4 Group * Post-Crisis											0.405	***
											(4.282)	
ln(Total Assets)	-0.046		2.500	***	0.944	***	2.111	***	0.937	***	2.106	***
	(-0.716)		(34.345)		(15.786)		(27.057)		(15.606)		(26.952)	
ln(Total Assets) * Crisis			-0.607	***			-0.438	***			-0.423	***
			(-22.855)				(-16.629)				(-16.118)	
ln(Total Assets) * Post-Crisis			-0.732	***			-0.290	***			-0.290	***
			(-22.435)				(-9.636)				(-9.679)	
Tier 1 Capital / Total Assets					-0.181	***	-0.182	***	-0.182	***	-0.188	***
					(-18.486)		(-17.048)		(-18.473)		(-17.492)	
Tier 1 Capital / Total Assets * Crisis							0.053	***			0.069	***
							(5.707)				(7.371)	
Tier 1 Capital / Total Assets * Post-Crisis							0.192	***			0.199	***
							(16.120)				(16.593)	
Deposits / Loans					-1.906	***	-1.496	***	-1.873	***	-1.468	***
					(-25.835)		(-17.674)		(-25.346)		(-17.346)	
Deposits / Loans * Crisis							0.674	***			0.667	***
							(9.195)				(9.121)	
Deposits / Loans * Post-Crisis							-0.189	**			-0.195	**
							(-2.387)				(-2.456)	
Bad Loans / Total Assets					-1.641	***	-0.510	***	-1.639	***	-0.508	***
					(-76.977)		(-15.162)		(-76.936)		(-15.095)	
Bad Loans / Total Assets * Crisis							-0.886	***			-0.888	***
							(-22.658)				(-22.740)	
Bad Loans / Total Assets * Post-Crisis							-0.997	***			-0.997	***
							(-24.225)				(-24.195)	
Obs	365,867		365,867		361,978		361,978		361,978		361,978	
Banks	10,320		10,320		10,159		10,159		10,159		10,159	
R-Squared (within)	0.003		0.077		0.110		0.139		0.108		0.137	

Table 4 – continued
The table reports the results from fixed effects regressions of *ROE* on non-interest to interest income and other bank-specific control variables and interaction terms between the bank-specific variables and the crisis and post-crisis dummy variables. Data is collected from the Report of Condition and Income ("Call Report") available on the Federal Reserve Bank of Chicago website for quarters up to Q4 2010 and on the FFIEC Central Data Repository's Public Data Distribution website as of Q1 2011. The sample includes the 48 quarters from Q1 2002 to Q4 2013. The pre-crisis period includes the 21 quarters from Q1 2002 to Q1 2007, the crisis period includes the 8 quarters from Q2 2007 to Q1 2009, and the post-crisis period includes the 19 quarters from Q2 2009 to Q4 2013. *ROE* is defined as net income divided by total equity capital. *Non-Interest to Interest Income* is the ratio of non-interest to interest income. *Income Q2* is a dummy variable which is equal to one for banks with *Non-Interest to Interest Income* in the second smallest quartile in the respective quarter. *Income Q3* is a dummy variable which is equal to one for banks with *Non-Interest to Interest Income* in the second largest quartile in the respective quarter. *Income Q4* is a dummy variable which is equal to one for banks with *Non-Interest to Interest Income* in the largest quartile in the respective quarter. *ln(Total Assets)* is the natural logarithm of total assets. *Tier 1 Capital to Total Assets* is defined as Tier 1 capital divided by total assets. *Deposits / Loans* is defined as the deposits divided by loans. *Bad Loans / Total Assets* is defined as the sum of non-accrual loans and loans past due 90 days or more divided by total assets. All variables are winsorized at their 5th and 95th percentiles. All control variables are lagged by one quarter. Regressions with interaction terms with the crisis and post crisis dummies also include dummy variables for the crisis and post-crisis periods (not reported). The *t*-statistics (in parentheses) are based on the cluster-robust variant of the Huber-White sandwich estimator, which accounts for the dependence of observations within clusters (different quarterly observations for one specific bank). ***, **, * denotes statistical significance at the 1%, 5%, 10% level.

Table 5: Fixed effects regressions of ROA on non-interest to interest income, bank-specific control variables, and interaction terms with the crisis and post-crisis dummy variables

Dependent Variable: ROA	(1)		(2)		(3)		(4)		(5)		(6)	
Intercept	0.345	***	-2.330	***	-1.031	***	-2.419	***	-0.991	***	-2.361	***
	(4.465)		(-21.386)		(-11.940)		(-21.210)		(-11.430)		(-20.637)	
Non-Interest to Interest Income	0.338	***	0.266	***	0.368	***	0.317	***				
	(13.322)		(9.209)		(16.705)		(11.963)					
Non-Interest to Interest Income * Crisis			0.154	***			0.146	***				
			(5.054)				(5.111)					
Non-Interest to Interest Income * Post-Crisis			0.142	***			0.072	**				
			(4.009)				(2.308)					
Income Q2 Group									0.033	***	0.007	
									(7.572)		(1.264)	
Income Q2 Group * Crisis											0.070	***
											(9.583)	
Income Q2 Group * Post-Crisis											0.014	*
											(1.893)	
Income Q3 Group									0.043	***	0.011	*
									(7.775)		(1.660)	
Income Q3 Group * Crisis											0.087	***
											(11.376)	
Income Q3 Group * Post-Crisis											0.020	**
											(2.405)	
Income Q4 Group									0.084	***	0.052	***
									(12.092)		(6.271)	
Income Q4 Group * Crisis											0.077	***
											(8.452)	
Income Q4 Group * Post-Crisis											0.038	***
											(3.722)	
ln(Total Assets)	0.011		0.249	***	0.155	***	0.268	***	0.154	***	0.267	***
	(1.640)		(26.672)		(22.570)		(28.981)		(22.350)		(28.813)	
ln(Total Assets) * Crisis			-0.055	***			-0.044	***			-0.043	***
			(-19.229)				(-16.107)				(-15.653)	
ln(Total Assets) * Post-Crisis			-0.058	***			-0.027	***			-0.027	***
			(-17.026)				(-8.471)				(-8.600)	
Tier 1 Capital / Total Assets					0.006	***	0.009	***	0.006	***	0.008	***
					(5.270)		(6.768)		(5.174)		(6.330)	
Tier 1 Capital / Total Assets * Crisis							-0.001				0.001	
							(-0.808)				(0.680)	
Tier 1 Capital / Total Assets * Post-Crisis							0.013	***			0.013	***
							(8.639)				(9.024)	
Deposits / Loans					-0.209	***	-0.165	***	-0.205	***	-0.162	***
					(-25.689)		(-17.535)		(-25.192)		(-17.197)	
Deposits / Loans * Crisis							0.065	***			0.064	***
							(7.951)				(7.897)	
Deposits / Loans * Post-Crisis							-0.040	***			-0.040	***
							(-4.514)				(-4.578)	
Bad Loans / Total Assets					-0.166	***	-0.049	***	-0.166	***	-0.049	***
					(-73.765)		(-13.507)		(-73.673)		(-13.458)	
Bad Loans / Total Assets * Crisis							-0.091	***			-0.091	***
							(-21.419)				(-21.507)	
Bad Loans / Total Assets * Post-Crisis							-0.109	***			-0.109	***
							(-24.411)				(-24.390)	
Obs	365,868		365,868		361,979		361,979		361,979		361,979	
Banks	10,320		10,320		10,159		10,159		10,159		10,159	
R-Squared (within)	0.003		0.064		0.103		0.129		0.101		0.127	

Table 5 – continued
The table reports the results from fixed effects regressions of *ROA* on non-interest to interest income and other bank-specific control variables and interaction terms between the bank-specific variables and the crisis and post-crisis dummy variables. Data is collected from the Report of Condition and Income ("Call Report") available on the Federal Reserve Bank of Chicago website for quarters up to Q4 2010 and on the FFIEC Central Data Repository's Public Data Distribution website as of Q1 2011. Data for the years 2009 to 2013 is obtained directly from the FRB Chicago website. The sample includes the 48 quarters from Q1 2002 to Q4 2013. The pre-crisis period includes the 21 quarters from Q1 2002 to Q1 2007, the crisis period includes the 8 quarters from Q2 2007 to Q1 2009, and the post-crisis period includes the 19 quarters from Q2 2009 to Q4 2013. *ROA* is defined as net income divided by total assets. *Non-Interest to Interest Income* is the ratio of non-interest to interest income. *Income Q2* is a dummy variable which is equal to one for banks with *Non-Interest to Interest Income* in the second smallest quartile in the respective quarter. *Income Q3* is a dummy variable which is equal to one for banks with *Non-Interest to Interest Income* in the second largest quartile in the respective quarter. *Income Q4* is a dummy variable which is equal to one for banks with *Non-Interest to Interest Income* in the largest quartile in the respective quarter. *ln(Total Assets)* is the natural logarithm of total assets. *Tier 1 Capital to Total Assets* is defined as Tier 1 capital divided by total assets. *Deposits / Loans* is defined as the deposits divided by loans. *Bad Loans / Total Assets* is defined as the sum of non-accrual loans and loans past due 90 days or more divided by total assets. All variables are winsorized at their 5th and 95th percentiles. All control variables are lagged by one quarter. Regressions with interaction terms with the crisis and post crisis dummies also include dummy variables for the crisis and post-crisis periods (not reported). The *t*-statistics (in parentheses) are based on the cluster-robust variant of the Huber-White sandwich estimator, which accounts for the dependence of observations within clusters (different quarterly observations for one specific bank). ***, **, * denotes statistical significance at the 1%, 5%, 10% level.

Table 6: Fixed effects regressions of ROE and ROA on non-interest to interest income and controls – bank size sub-samples

Dependent variable:	ROE		ROE		ROE		ROE		ROA		ROA		ROA		ROA	
Bank size group:	Small		Medium		Large		Very Large		Small		Medium		Large		Very Large	
	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
Intercept	-16.241	***	-16.623	***	2.265		10.025		-2.678	***	-2.512	***	-1.034	***	-0.153	
	(-8.691)		(-13.687)		(0.688)		(1.036)		(-11.451)		(-19.802)		(-3.086)		(-0.190)	
Non-Interest to Interest Income	1.763	***	2.829	***	3.241	***	2.997		0.190	***	0.294	***	0.324	***	0.203	
	(4.143)		(9.065)		(4.484)		(1.436)		(3.828)		(9.318)		(4.153)		(1.041)	
Non-Interest to Interest Income	0.613		1.618	***	1.567	**	1.199		0.078		0.148	***	0.180	**	0.180	
* Crisis	(1.311)		(4.967)		(2.229)		(0.680)		(1.387)		(4.283)		(2.501)		(1.124)	
Non-Interest to Interest Income	0.308		1.255	***	1.075		-5.965	***	0.053		0.128	***	0.142	*	-0.469	**
* Post-Crisis	(0.552)		(3.663)		(1.303)		(-2.665)		(0.823)		(3.588)		(1.650)		(-2.205)	
ln(Total Assets)	2.367	***	2.188	***	0.365		-0.043		0.317	***	0.258	***	0.096	***	0.046	
	(14.449)		(22.587)		(1.624)		(-0.080)		(15.326)		(25.643)		(4.176)		(1.024)	
ln(Total Assets) * Crisis	-0.031		-0.272	***	-0.396	**	-0.151		0.000		-0.025	***	-0.034	*	-0.019	
	(-0.353)		(-4.372)		(-2.186)		(-0.490)		(0.008)		(-3.945)		(-1.879)		(-0.719)	
ln(Total Assets) * Post-Crisis	0.137		-0.174	**	0.384	*	0.837	**	0.031	**	-0.015	**	0.039	*	0.067	**
	(1.311)		(-2.380)		(1.770)		(2.365)		(2.519)		(-2.027)		(1.833)		(2.190)	
Tier 1 Capital / Total Assets	-0.119	***	-0.124	***	-0.025		-0.062		0.012	***	0.025	***	0.043	***	0.036	***
	(-6.555)		(-8.468)		(-0.456)		(-0.638)		(5.318)		(14.039)		(7.005)		(3.791)	
Tier 1 Capital / Total Assets *	0.047	***	0.099	***	0.166	***	0.351	***	0.001		0.000		0.007		0.030	**
Crisis	(3.659)		(7.413)		(3.324)		(3.000)		(0.936)		(0.254)		(1.176)		(2.132)	
Tier 1 Capital / Total Assets *	0.119	***	0.238	***	0.318	***	0.235	*	0.006	***	0.014	***	0.018	***	0.004	
Post-Crisis	(7.246)		(14.569)		(4.596)		(1.815)		(2.962)		(6.993)		(2.592)		(0.242)	
Deposits / Loans	-1.554	***	-1.629	***	-0.088		-0.762		-0.174	***	-0.166	***	-0.022		-0.119	
	(-13.367)		(-13.479)		(-0.273)		(-0.669)		(-12.950)		(-13.567)		(-0.706)		(-1.250)	
Deposits / Loans * Crisis	0.664	***	0.953	***	-0.494		0.092		0.073	***	0.085	***	-0.074	**	0.011	
	(6.846)		(8.568)		(-1.427)		(0.087)		(6.270)		(7.124)		(-2.163)		(0.126)	
Deposits / Loans * Post-Crisis	-0.247	**	0.281	**	0.139		-0.543		-0.045	***	0.022	*	0.013		-0.018	
	(-2.176)		(2.459)		(0.360)		(-0.519)		(-3.426)		(1.858)		(0.320)		(-0.182)	
Bad Loans / Total Assets	-0.324	***	-0.724	***	-0.610	***	-0.938	*	-0.033	***	-0.073	***	-0.063	***	-0.065	
	(-7.500)		(-13.848)		(-2.707)		(-1.727)		(-6.900)		(-13.895)		(-2.603)		(-1.135)	
Bad Loans / Total Assets * Crisis	-0.544	***	-0.833	***	-1.851	***	-1.864	***	-0.059	***	-0.082	***	-0.184	***	-0.196	***
	(-10.068)		(-14.466)		(-8.336)		(-3.125)		(-9.704)		(-14.059)		(-7.714)		(-3.009)	
Bad Loans / Total Assets *	-0.675	***	-0.901	***	-1.463	***	-1.168	**	-0.074	***	-0.097	***	-0.156	***	-0.149	***
Post-Crisis	(-11.589)		(-14.893)		(-5.922)		(-2.178)		(-11.394)		(-15.638)		(-5.880)		(-2.661)	
Obs	131,008		201,774		24,346		4,850		131,009		201,774		24,346		4,850	
Banks	5,082		6,838		1,082		205		5,082		6,838		1,082		205	
R-Squared (within)	0.080		0.152		0.232		0.218		0.081		0.150		0.232		0.190	

Table 6 – continued

The table reports the results from fixed effects regressions of *ROE* (Columns 1 to 4) and *ROA* (Columns 5 to 8) on non-interest to interest income and other bank-specific control variables and interaction terms between the bank-specific variables and the crisis and post-crisis dummy variables for sub-samples based on bank size. Banks are assigned to the four size-groups as follows: Small banks are banks with total assets below USD 100 million in the respective quarter. Medium-sized banks are banks with total assets between USD 100 million and USD one billion in the respective quarter. Large banks are banks with total assets between USD one and 10 billion. Very large banks are defined as banks with total assets in excess of USD 10 billion. Data is collected from the Report of Condition and Income ("Call Report") available on the Federal Reserve Bank of Chicago website for quarters up to Q4 2010 and on the FFIEC Central Data Repository's Public Data Distribution website as of Q1 2011. The sample includes the 48 quarters from Q1 2002 to Q4 2013. The pre-crisis period includes the 21 quarters from Q1 2002 to Q1 2007, the crisis period includes the 8 quarters from Q2 2007 to Q1 2009, and the post-crisis period includes the 19 quarters from Q2 2009 to Q4 2013. *ROE* is defined as net income divided by total equity capital. *ROA* is defined as net income divided by total assets. *Non-Interest to Interest Income* is the ratio of non-interest to interest income. *ln(Total Assets)* is the natural logarithm of total assets. *Tier 1 Capital to Total Assets* is defined as Tier 1 capital divided by total assets. *Deposits / Loans* is defined as the deposits divided by loans. *Bad Loans / Total Assets* is defined as the sum of non-accrual loans and loans past due 90 days or more divided by total assets. All variables are winsorized at their 5th and 95th percentiles. All control variables are lagged by one quarter. All regressions include dummy variables for the crisis and post-crisis periods (not reported). The *t*-statistics (in parentheses) are based on the cluster-robust variant of the Huber-White sandwich estimator, which accounts for the dependence of observations within clusters (different quarterly observations for one specific bank). ***, **, * denotes statistical significance at the 1%, 5%, 10% level.

Table 7: Fixed effects regressions of ROE on trading to interest income and controls

Dependent Variable: ROE	(1)		(2)		(3)		(4)		(5)		(6)	
Intercept	6.534	***	-21.740	***	0.858		-13.114	***	-1.345	*	-14.416	***
	(8.541)		(-25.803)		(1.116)		(-13.441)		(-1.740)		(-14.773)	
Trading to Interest Income	19.026	***	16.845	***	14.303	***	11.071	***				
	(23.547)		(16.869)		(21.759)		(12.396)					
Trading to Interest Income			-5.786	***			-2.879	**				
* Crisis			(-3.941)				(-2.200)					
Trading to Interest Income			2.491	*			4.980	***				
* Post-Crisis			(1.930)				(4.451)					
Income Q2 Group									0.942	***	0.643	***
									(24.435)		(12.119)	
Income Q2 Group * Crisis											0.257	***
											(2.979)	
Income Q2 Group * Post-Crisis											-0.084	
											(-1.136)	
Income Q3 Group									0.880	***	0.362	***
									(22.930)		(6.561)	
Income Q3 Group * Crisis											0.551	***
											(5.762)	
Income Q3 Group * Post-Crisis											0.414	***
											(5.408)	
Income Q4 Group									1.271	***	0.846	***
									(28.581)		(13.525)	
Income Q4 Group * Crisis											0.141	
											(1.456)	
Income Q4 Group * Post-Crisis											0.447	***
											(5.316)	
ln(Total Assets)	-0.126	*	2.379	***	0.837	***	1.993	***	0.947	***	2.063	***
	(-1.957)		(33.004)		(13.821)		(25.558)		(15.596)		(26.481)	
ln(Total Assets) * Crisis			-0.515	***			-0.366	***			-0.381	***
			(-19.652)				(-14.207)				(-14.120)	
ln(Total Assets) * Post-Crisis			-0.699	***			-0.276	***			-0.318	***
			(-22.265)				(-9.572)				(-10.444)	
Tier 1 Capital / Total Assets					-0.188	***	-0.188	***	-0.187	***	-0.189	***
					(-19.148)		(-17.695)		(-19.024)		(-17.824)	
Tier 1 Capital / Total Assets *							0.045	***			0.044	***
Crisis							(4.885)				(4.754)	
Tier 1 Capital / Total Assets *							0.194	***			0.194	***
Post-Crisis							(16.529)				(16.591)	
Deposits / Loans					-1.840	***	-1.448	***	-1.750	***	-1.436	***
					(-24.849)		(-17.054)		(-23.829)		(-16.931)	
Deposits / Loans * Crisis							0.725	***			0.733	***
							(9.971)				(10.067)	
Deposits / Loans * Post-Crisis							-0.105				-0.105	
							(-1.316)				(-1.314)	
Bad Loans / Total Assets					-1.611	***	-0.499	***	-1.564	***	-0.499	***
					(-76.109)		(-14.860)		(-76.008)		(-14.939)	
Bad Loans / Total Assets * Crisis							-0.881	***			-0.855	***
							(-22.587)				(-21.959)	
Bad Loans / Total Assets *							-0.964	***			-0.950	***
Post-Crisis							(-23.512)				(-23.255)	
Obs	365,866		365,866		361,977		361,977		361,977		361,977	
Banks	10,320		10,320		10,159		10,159		10,159		10,159	
R-Squared (within)	0.009		0.081		0.112		0.140		0.113		0.140	

Table 7 – continued
The table reports the results from fixed effects regressions of *ROE* on non-interest to interest income and other bank-specific control variables and interaction terms between the bank-specific variables and the crisis and post-crisis dummy variables. Data is collected from the Report of Condition and Income ("Call Report") available on the Federal Reserve Bank of Chicago website for quarters up to Q4 2010 and on the FFIEC Central Data Repository's Public Data Distribution website as of Q1 2011. The sample includes the 48 quarters from Q1 2002 to Q4 2013. The pre-crisis period includes the 21 quarters from Q1 2002 to Q1 2007, the crisis period includes the 8 quarters from Q2 2007 to Q1 2009, and the post-crisis period includes the 19 quarters from Q2 2009 to Q4 2013. *ROE* is defined as net income divided by total equity capital. *Trading to Interest Income* is the ratio of trading income to interest income. *Income Q2* is a dummy variable which is equal to one for banks with *Trading to Interest Income* in the second smallest quartile in the respective quarter. *Income Q3* is a dummy variable which is equal to one for banks with *Trading to Interest Income* in the second largest quartile in the respective quarter. *Income Q4* is a dummy variable which is equal to one for banks with *Trading to Interest Income* in the largest quartile in the respective quarter. *ln(Total Assets)* is the natural logarithm of total assets. *Tier 1 Capital to Total Assets* is defined as Tier 1 capital divided by total assets. *Deposits* / *Loans* is defined as the deposits divided by loans. *Bad Loans* / *Total Assets* is defined as the sum of non-accrual loans and loans past due 90 days or more divided by total assets. All variables are winsorized at their 5th and 95th percentiles. All control variables are lagged by one quarter. Regressions with interaction terms with the crisis and post crisis dummies also include dummy variables for the crisis and post-crisis periods (not reported). The *t*-statistics (in parentheses) are based on the cluster-robust variant of the Huber-White sandwich estimator, which accounts for the dependence of observations within clusters (different quarterly observations for one specific bank). ***, **, * denotes statistical significance at the 1%, 5%, 10% level.

Table 8: Fixed effects regressions of ROE on investment banking to interest income and controls

Dependent Variable: ROE	(1)		(2)		(3)		(4)	
Intercept	4.207	***	-22.743	***	-0.872		-14.038	***
	(5.604)		(-26.905)		(-1.128)		(-14.452)	
IB to Interest Income	126.716	***	-17.546	***	59.381	***	-16.465	***
	(21.804)		(-2.888)		(13.133)		(-3.307)	
IB to Interest Income * Crisis			36.926	***			35.660	***
			(3.318)				(3.872)	
IB to Interest Income * Post-Crisis			33.448	**			25.985	**
			(2.459)				(2.415)	
ln(Total Assets)	0.073		2.485	***	0.978	***	2.086	***
	(1.151)		(34.299)		(16.099)		(26.823)	
ln(Total Assets) * Crisis			-0.598	***			-0.420	***
			(-21.959)				(-16.005)	
ln(Total Assets) * Post-Crisis			-0.736	***			-0.288	***
			(-22.442)				(-9.626)	
Tier 1 Capital / Total Assets					-0.177	***	-0.186	***
					(-17.823)		(-17.460)	
Tier 1 Capital / Total Assets * Crisis							0.048	***
							(5.119)	
Tier 1 Capital / Total Assets * Post-Crisis							0.197	***
							(16.682)	
Deposits / Loans					-1.819	***	-1.458	***
					(-24.584)		(-17.161)	
Deposits / Loans * Crisis							0.773	***
							(10.618)	
Deposits / Loans * Post-Crisis							-0.167	**
							(-2.086)	
Bad Loans / Total Assets					-1.617	***	-0.518	***
					(-75.528)		(-15.396)	
Bad Loans / Total Assets * Crisis							-0.879	***
							(-22.475)	
Bad Loans / Total Assets * Post-Crisis							-0.986	***
							(-23.878)	
Obs	365,867		365,867		361,978		361,978	
Banks	10,320		10,320		10,159		10,159	
R-Squared (within)	0.007		0.073		0.108		0.135	

The table reports the results from fixed effects regressions of *ROE* on IB to interest income and other bank-specific control variables and interaction terms between the bank-specific variables and the crisis and post-crisis dummy variables. Data is collected from the Report of Condition and Income ("Call Report") available on the Federal Reserve Bank of Chicago website for quarters up to Q4 2010 and on the FFIEC Central Data Repository's Public Data Distribution website as of Q1 2011. The sample includes the 48 quarters from Q1 2002 to Q4 2013. The pre-crisis period includes the 21 quarters from Q1 2002 to Q1 2007, the crisis period includes the 8 quarters from Q2 2007 to Q1 2009, and the post-crisis period includes the 19 quarters from Q2 2009 to Q4 2013. *ROE* is defined as net income divided by total equity capital. *IB to Interest Income* is the ratio of investment banking, advisory, brokerage, and underwriting fees and commissions to interest income. *ln(Total Assets)* is the natural logarithm of total assets. *Tier 1 Capital to Total Assets* is defined as Tier 1 capital divided by total assets. *Deposits / Loans* is defined as the deposits divided by loans. *Bad Loans / Total Assets* is defined as the sum of non-accrual loans and loans past due 90 days or more divided by total assets. All variables are winsorized at their 5th and 95th percentiles. All control variables are lagged by one quarter. Regressions with interaction terms with the crisis and post crisis dummies also include dummy variables for the crisis and post-crisis periods (not reported). The *t*-statistics (in parentheses) are based on the cluster-robust variant of the Huber-White sandwich estimator, which accounts for the dependence of observations within clusters (different quarterly observations for one specific bank). ***, **, * denotes statistical significance at the 1%, 5%, 10% level.

Table 9: Fixed effects regressions of Z-score on income-based measures and bank size

Dependent Variable: Z-Score										
Bank size group:	All	Small	Medium	Large	V. Large	All	Small	Medium	Large	V. Large
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Intercept	72.001 ***	105.122 ***	52.079 ***	7.293	-35.341	70.616 ***	103.167 ***	51.015 ***	5.268	-27.557
	(17.650)	(12.823)	(10.370)	(0.540)	(-0.936)	(17.377)	(12.686)	(10.214)	(0.396)	(-0.730)
Non-Interest to Interest Income	-3.001 ***	-5.294 ***	-1.452	0.141	4.202					
	(-3.275)	(-3.422)	(-1.203)	(0.050)	(0.594)					
Non-Interest to Interest Income	-0.234	1.484	-1.878	-0.462	6.101					
* Crisis	(-0.261)	(0.885)	(-1.552)	(-0.186)	(1.285)					
Non-Interest to Interest Income	-0.897	1.898	-2.506 *	-0.790	11.761 *					
* Post-Crisis	(-0.839)	(0.956)	(-1.750)	(-0.243)	(1.751)					
Trading to Interest Income						-13.566 ***	-27.044 ***	-11.886 ***	11.475	20.963
						(-3.810)	(-3.923)	(-2.717)	(1.193)	(0.837)
Trading to Interest Income						18.759 ***	13.250	17.764 ***	21.272 *	34.114
* Crisis						(4.038)	(1.363)	(3.099)	(1.728)	(1.427)
Trading to Interest Income						17.169 ***	33.226 ***	17.156 ***	-11.713	18.714
* Post-Crisis						(3.810)	(3.190)	(3.134)	(-0.913)	(0.708)
ln(Total Assets)	-3.096 ***	-6.264 ***	-1.516 ***	1.749 *	3.770 *	-3.018 ***	-6.156 ***	-1.440 ***	1.875 **	3.358
	(-8.928)	(-8.087)	(-3.665)	(1.863)	(1.734)	(-8.715)	(-7.983)	(-3.486)	(2.010)	(1.525)
ln(Total Assets) * Crisis	0.112	0.062	-0.820 ***	-0.260	-0.691	0.005	-0.008	-1.001 ***	-0.253	-0.635
	(1.193)	(0.171)	(-3.417)	(-0.369)	(-1.149)	(0.059)	(-0.022)	(-4.183)	(-0.361)	(-0.997)
ln(Total Assets) * Post-Crisis	0.991 ***	1.143 **	0.719 **	1.243	-0.017	0.868 ***	1.031 **	0.491	1.243	0.427
	(7.614)	(2.206)	(2.181)	(1.201)	(-0.013)	(6.843)	(1.990)	(1.495)	(1.207)	(0.330)
Obs	347,212	123,237	195,631	23,694	4,650	347,211	123,236	195,631	23,694	4,650
Banks	9,573	4,391	6,440	1,003	190	9,573	4,391	6,440	1,003	190
R-Squared (within)	0.022	0.017	0.024	0.039	0.079	0.022	0.017	0.024	0.040	0.078

The table reports the results from fixed effects regressions of *Z-score* on non-interest (Columns 1 to 5) or trading income (Columns 6 to 10) to interest income, bank size, and interaction terms between the bank-specific variables and the crisis and post-crisis dummy variables for the full sample as well as sub-samples based on bank size. Banks are assigned to the four size-groups as follows: Small banks are banks with total assets below USD 100 million in the respective quarter. Medium-sized banks are banks with total assets between USD 100 million and USD one billion in the respective quarter. Large banks are banks with total assets between USD one and 10 billion. Very large banks are defined as banks with total assets in excess of USD 10 billion. Data is collected from the Report of Condition and Income ("Call Report") available on the Federal Reserve Bank of Chicago website for quarters up to Q4 2010 and on the FFIEC Central Data Repository's Public Data Distribution website as of Q1 2011. The sample includes the 48 quarters from Q1 2002 to Q4 2013. The pre-crisis period includes the 21 quarters from Q1 2002 to Q1 2007, the crisis period includes the 8 quarters from Q2 2007 to Q1 2009, and the post-crisis period includes the 19 quarters from Q2 2009 to Q4 2013. *Z-score* is defined as the sum of ROA and the capital asset ratio (CAR) divided by the volatility of ROA. CAR is calculated as total assets minus total liabilities, divided by total assets. We calculate the standard deviation of ROA in the denominator over a rolling window of 12 quarters. *Non-Interest to Interest Income* is the ratio of non-interest to interest income. *Trading to Interest Income* is the ratio of trading to interest income. *ln(Total Assets)* is the natural logarithm of total assets. All variables are winsorized at their 5th and 95th percentiles. All control variables are lagged by one quarter. All regressions include dummy variables for the crisis and post-crisis periods (not reported). The *t*-statistics (in parentheses) are based on the cluster-robust variant of the Huber-White sandwich estimator, which accounts for the dependence of observations within clusters (different quarterly observations for one specific bank). ***, **, * denotes statistical significance at the 1%, 5%, 10% level.

Table 10: Non-interest to interest income, bank failures, and ROE / ROA changes

	Failed (dummy)				ΔROE	ΔROA
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-4.823 **	-4.965 **	-1.297 *	0.866	-1.118 ***	-1.241 ***
	(-2.270)	(-2.357)	(-1.795)	(1.025)	(-2.622)	(-2.930)
Non-Interest to Interest Income	-8.850 ***	-8.847 ***	-0.583 *	-0.457	0.137	0.062
	(-4.522)	(-4.527)	(-1.764)	(-1.355)	(0.479)	(0.236)
ln(Total Assets)	0.451 ***	0.456 ***	0.027	0.013	-0.009	0.001
	(4.397)	(4.421)	(0.727)	(0.326)	(-0.316)	(0.034)
Tier 1 Capital / Total Assets	-0.122 *	-0.113 *	-0.602 ***	-1.013 ***	-0.003	0.007
	(-1.955)	(-1.847)	(-14.598)	(-16.254)	(-0.186)	(0.592)
Deposits / Loan	-3.005 ***	-3.002 ***	-1.519 ***	-0.737 ***	0.389 **	0.309 ***
	(-3.096)	(-3.096)	(-6.221)	(-3.131)	(2.502)	(4.025)
Bad Loans / Total Assets	0.564 ***	0.565 ***	1.036 ***	1.044 ***	-0.075	-0.095 *
	(3.691)	(3.702)	(17.645)	(13.305)	(-1.376)	(-1.745)
ROE	-0.018		-0.143 ***	-0.210 ***		
	(-0.725)		(-9.166)	(-9.541)		
ROA		-0.185				
		(-0.760)				
Obs	7,790	7,790	356,624	356,379	7,117	7,117
Banks	7,790	7,790	10,123	10,110	7,117	7,117
R-Squared	-	-	-	-	0.003	0.003
Pseudo R-Squared	0.161	0.161	0.314	0.402	-	-

The table reports the results from panel logit (Columns 1 to 4) and cross-sectional (Columns 5 and 6) regressions of a failure indicator on non-interest to interest income and other bank-specific control variables. In Columns 1 and 2, the dependent variable is a dummy for whether the bank failed during the financial crisis from Q2 2007 to Q1 2009. The explanatory variables are measured as of Q4 2006, the last year end before the crisis. In Columns 3 and 4, the dependent variable is a dummy for whether the bank failed in the respective quarter. In Column 3, all explanatory variables are lagged by four quarters. In Column 4, explanatory variables are average values over the last four quarters (t-5 to t-1). Columns 5 and 6 report the results from cross-sectional OLS regressions of *ΔROE* (Column 5) and *ΔROA* (Column 6) during the crisis (Q2 2007 to Q1 2009) on non-interest to interest income and other bank-specific control variables measured before the crisis (Q4 2006). Data is collected from the Report of Condition and Income ("Call Report") available on the Federal Reserve Bank of Chicago website for quarters up to Q4 2010 and on the FFIEC Central Data Repository's Public Data Distribution website as of Q1 2011. Bank failures are identified based on FDIC's Failed Bank List. *Non-Interest to Interest Income* is the ratio of non-interest to interest income. *ln(Total Assets)* is the natural logarithm of total assets. *Tier 1 Capital to Total Assets* is defined as Tier 1 capital divided by total assets. *Deposits / Loans* is defined as the deposits divided by loans. *Bad Loans / Total Assets* is defined as the sum of non-accrual loans and loans past due 90 days or more divided by total assets. *ΔROE* is defined as the percentage change in *ROE* during the crisis, calculated as *ROE* in Q1 2009 minus *ROE* in Q2 2007 divided by *ROE* in Q2 2007, where *ROE* is defined as net income divided by total equity capital. *ΔROA* is defined as the percentage change in *ROA* during the crisis, calculated as *ROA* in Q1 2009 minus *ROA* in Q2 2007 divided by *ROA* in Q2 2007, where *ROA* is defined as net income divided by total assets. All variables are winsorized at their 5th and 95th percentiles. *t*-statistics are reported in parentheses. Standard errors in Columns 5 and 6 are heteroskedasticity-robust. ***, **, * denotes statistical significance at the 1%, 5%, 10% level.

Table 11: Cross-sectional regressions of ROE and ROA changes in the post-crisis on crisis non-interest to interest income and controls

Dependent Variable	ΔROE	ΔROE	ΔROA	ΔROA	ΔROE	ΔROE	ΔROA	ΔROA
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	2.376	1.463	1.577	0.598	1.145	-0.046	0.428	-0.895
	(1.016)	(0.618)	(0.648)	(0.239)	(0.478)	(-0.018)	(0.165)	(-0.314)
Non-Interest to Interest Income	3.859 **		4.232 **		3.972 *		4.084 *	
	(2.251)		(2.235)		(1.851)		(1.719)	
Income Q2 Group		1.240		1.358		1.240		1.207
		(1.373)		(1.419)		(1.287)		(1.167)
Income Q3 Group		2.228 **		2.281 **		1.975 *		2.214 **
		(2.569)		(2.462)		(1.833)		(1.978)
Income Q4 Group		2.083 **		2.236 **		1.921 **		1.968 *
		(2.568)		(2.536)		(1.983)		(1.883)
ΔROE (crisis)	-0.030	-0.030						
	(-0.736)	(-0.727)						
ΔROA (crisis)			-0.037	-0.037				
			(-0.730)	(-0.720)				
ROE					0.034	0.024		
					(0.764)	(0.517)		
ROA							0.398	0.287
							(1.012)	(0.669)
ln(Total Assets)	-0.244	-0.241	-0.205	-0.198	-0.267	-0.229	-0.235	-0.195
	(-1.475)	(-1.514)	(-1.196)	(-1.194)	(-1.614)	(-1.449)	(-1.327)	(-1.148)
Tier 1 Capital / Total Assets	0.032	0.063	0.018	0.050	0.051	0.086	0.035	0.078
	(0.463)	(0.882)	(0.274)	(0.735)	(0.730)	(1.132)	(0.538)	(1.026)
Deposits / Loans	0.337	0.283	0.572	0.519	0.188	0.144	0.431	0.384
	(0.591)	(0.501)	(1.032)	(0.948)	(0.363)	(0.277)	(0.766)	(0.679)
Bad Loans / Total Assets	-0.657 ***	-0.642 **	-0.667 **	-0.652 **	0.555 *	0.525	0.555	0.526
	(-2.628)	(-2.552)	(-2.385)	(-2.322)	(1.691)	(1.630)	(1.580)	(1.520)
Obs	6,667	6,667	6,667	6,667	6,577	6,577	6,577	6,577
R-Squared	0.002	0.003	0.002	0.003	0.001	0.002	0.001	0.002

The table reports the results from cross-sectional regressions of *ΔROE* (Columns 1, 2, 5, and 6) and *ΔROA* (Columns 3, 4, 7, and 8) during the early post-crisis period, i.e., from Q2 2009 to Q4 2010, on non-interest to interest income and other bank-specific control variables. The explanatory variables are measured at the end of the crisis, i.e., at Q1 2009, in Columns 1 to 4 and at the end of the pre-crisis period, i.e., at Q4 2006, in Columns 5 to 8. Data is collected from the Report of Condition and Income ("Call Report") available on the Federal Reserve Bank of Chicago website for quarters up to Q4 2010 and on the FFIEC Central Data Repository's Public Data Distribution website as of Q1 2011. *ΔROE* is defined as the percentage change in *ROE* during the early post-crisis period, calculated as *ROE* in Q4 2010 minus *ROE* in Q2 2009 divided by *ROE* in Q2 2009, where *ROE* is defined as net

income divided by total equity capital. *ΔROA* is defined as the percentage change in *ROA* during the post-crisis period, calculated as *ROA* in Q4 2010 minus *ROA* in Q2 2009 divided by *ROA* in Q2 2009, where *ROA* is defined as net income divided by total assets. *Non-Interest to Interest Income* is the ratio of non-interest to interest income. *Income Q2* is a dummy variable which is equal to one for banks with *Non-Interest to Interest Income* in the second smallest quartile in the respective quarter. *Income Q3* is a dummy variable which is equal to one for banks with *Non-Interest to Interest Income* in the second largest quartile in the respective quarter. *Income Q4* is a dummy variable which is equal to one for banks with *Non-Interest to Interest Income* in the largest quartile in the respective quarter. *ΔROE (crisis)* is defined as the percentage change in *ROE* during the crisis, calculated as *ROE* in Q1 2009 minus *ROE* in Q2 2007 divided by *ROE* in Q2 2007. *ΔROA (crisis)* is defined as the percentage change in *ROA* during the crisis, calculated as *ROA* in Q1 2009 minus *ROA* in Q2 2007 divided by *ROA* in Q2 2007. *ROE* is defined as net income divided by total equity capital. *ROA* is defined as net income divided by total assets. *ln(Total Assets)* is the natural logarithm of total assets. *Tier 1 Capital to Total Assets* is defined as Tier 1 capital divided by total assets. *Deposits* / *Loans* is defined as the deposits divided by loans. *Bad Loans* / *Total Assets* is defined as the sum of non-accrual loans and loans past due 90 days or more divided by total assets. All variables are winsorized at their 5th and 95th percentiles. The *t*-statistics (in parentheses) are based on heteroskedasticity-robust White standard errors. ***, **, * denotes statistical significance at the 1%, 5%, 10% level.

Table 12: Fixed effects regressions of MES and ΔCoVaR on income-based measures – BHC sample

Panel A: Dependent Variable: MES						
Non-Traditional Income =	Non-Interest Income		Trading Income		Investment Banking Income	
	(1)	(2)	(3)	(4)	(5)	(6)
Non-Traditional Income to Interest Income	-0.169	0.115	-10.807 **	-0.607	2.817	2.316
	(-0.755)	(0.638)	(-2.078)	(-0.182)	(1.626)	(1.133)
Non-Traditional Income to Interest Income		-0.515		-4.422		2.739
* Crisis		(-1.058)		(-1.246)		(0.651)
Non-Traditional Income to Interest Income		-0.283		-16.642 ***		0.666
* Post-Crisis		(-1.435)		(-3.014)		(0.264)
Obs	2,108	2,108	2,108	2,108	2,108	2,108
R-Squared (within)	0.632	0.674	0.639	0.682	0.633	0.673
Panel B: Dependent Variable: ΔCoVaR						
Non-Traditional Income =	Non-Interest Income		Trading Income		Investment Banking Income	
	(1)	(2)	(3)	(4)	(5)	(6)
Non-Traditional Income to Interest Income	-0.000	-0.001 *	-0.034 **	-0.002	-0.012 ***	-0.000
	(-0.640)	(-1.919)	(-2.345)	(-0.162)	(-3.068)	(-0.043)
Non-Traditional Income to Interest Income		0.001		-0.011		0.004
* Crisis		(1.352)		(-1.289)		(0.362)
Non-Traditional Income to Interest Income		-0.000		0.011		-0.002
* Post-Crisis		(-0.117)		(0.459)		(-0.592)
Obs	15,744	15,738	15,743	15,737	15,744	15,738
R-Squared (within)	0.501	0.602	0.503	0.602	0.502	0.602

The table reports the results from fixed effects regressions of *MES* (Panel A) or ΔCoVaR (Panel B) on non-interest (Columns 1 and 2), trading (Columns 3 and 4), or investment banking income (Columns 5 and 6) to interest income, bank-level controls, and interaction terms between the bank-specific variables and the crisis and post-crisis dummy variables (Columns 2, 4, and 6). Data is collected from the FR Y-9C reports and Compustat/CRSP data using the linking table provided by the Federal Reserve Bank of New York. The sample includes the 48 quarters from Q1 2002 to Q4 2013. The pre-crisis period includes the 21 quarters from Q1 2002 to Q1 2007, the crisis period includes the 8 quarters from Q2 2007 to Q1 2009, and the post-crisis period includes the 19 quarters from Q2 2009 to Q4 2013. *MES* is the Marginal Expected Shortfall and is based on Acharya, Pedersen, Philippon, and Richardson (2012) and Acharya, Engle, and Richardson (2012). ΔCoVaR is measures a bank's contribution to systemic risk as the difference between the conditional Value-at-Risk (CoVaR) of the financial system, conditional on this bank being in distress, and the conditional Value-at-Risk (CoVaR) of the financial system, conditional on this bank operating in its median state and is based on Adrian and Brunnermeier (2016). *Non-Interest to Interest Income* is the ratio of non-interest to interest income. *Trading to Interest Income* is the ratio of trading to interest income. *Investment Banking to Interest Income* is the ratio of investment banking, advisory, brokerage, and underwriting fees and commissions to interest income. The control variables are: the natural logarithm of total assets, Tier 1 capital divided by risk-weighted assets, deposits divided by loans, securitized assets (the sum of off-balance sheet assets securitized and sold during a quarter) divided by total assets, the ratio of non-deposit-funding to short-term funding (sum of deposits, Federal Funds, repo, commercial paper, and other borrowed money with less than one year maturity), and net income divided by total equity capital (*ROE*). In Columns 2, 4, and 6, all independent variables are additionally interacted with both the crisis and post-crisis dummies. All independent variables are lagged by one quarter and, except *ln(Total Assets)*, are winsorized at their 5th and 95th percentiles. All regressions include quarter fixed effects and regressions in Columns 2, 4, and 6 include dummy variables for the crisis and post-crisis periods (not reported). The *t*-statistics (in parentheses) are based on the cluster-robust variant of the Huber-White sandwich estimator, which accounts for the dependence of observations within clusters (different quarterly observations for one specific bank). ***, **, * denotes statistical significance at the 1%, 5%, 10% level.

Table A1: Fixed effects regressions of ROE and ROA on trading to interest income and controls – bank size sub-samples

Dependent variable:	ROE		ROE		ROE		ROE		ROA		ROA		ROA		ROA	
Bank size group:	Small		Medium		Large		Very Large		Small		Medium		Large		Very Large	
	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
Intercept	-15.285	***	-14.560	***	5.371	*	9.408		-2.570	***	-2.300	***	-0.702	**	-0.230	
	(-8.220)		(-12.063)		(1.662)		(0.975)		(-11.007)		(-18.125)		(-2.128)		(-0.286)	
Trading to Interest Income	10.005	***	10.490	***	8.294	***	16.008	**	0.955	***	1.073	***	0.795	***	1.191	**
	(6.038)		(9.876)		(3.475)		(2.587)		(5.229)		(10.341)		(3.313)		(2.216)	
Trading to Interest Income	-10.106	***	-2.615	*	4.115		10.132		-0.887	***	-0.307	**	0.666	*	1.359	*
* Crisis	(-3.608)		(-1.710)		(1.201)		(1.195)		(-2.683)		(-2.012)		(1.961)		(1.691)	
Trading to Interest Income	2.847		5.916	***	5.700	*	-18.522	**	0.639	**	0.634	***	0.745	**	-1.456	*
* Post-Crisis	(1.189)		(4.441)		(1.783)		(-2.340)		(2.371)		(4.775)		(2.311)		(-1.712)	
ln(Total Assets)	2.297	***	2.051	***	0.194		0.043		0.309	***	0.244	***	0.077	***	0.053	
	(14.045)		(21.225)		(0.862)		(0.081)		(14.934)		(24.149)		(3.355)		(1.186)	
ln(Total Assets) * Crisis	0.011		-0.189	***	-0.328	*	-0.122		0.004		-0.017	***	-0.027		-0.018	
	(0.126)		(-3.060)		(-1.807)		(-0.460)		(0.401)		(-2.680)		(-1.449)		(-0.739)	
ln(Total Assets) * Post-Crisis	0.136		-0.165	**	0.440	**	0.727	**	0.030	**	-0.015	*	0.046	**	0.059	**
	(1.305)		(-2.271)		(2.089)		(2.244)		(2.430)		(-1.936)		(2.226)		(1.987)	
Tier 1 Capital / Total Assets	-0.122	***	-0.131	***	-0.026		-0.061		0.012	***	0.024	***	0.043	***	0.036	***
	(-6.707)		(-9.007)		(-0.476)		(-0.624)		(5.209)		(13.716)		(7.099)		(3.725)	
Tier 1 Capital / Total Assets *	0.045	***	0.088	***	0.149	***	0.301	***	0.001		-0.001		0.005		0.025	*
Crisis	(3.599)		(6.647)		(3.031)		(2.695)		(0.808)		(-0.393)		(0.883)		(1.884)	
Tier 1 Capital / Total Assets *	0.120	***	0.238	***	0.320	***	0.223	*	0.006	***	0.014	***	0.018	***	0.003	
Post-Crisis	(7.473)		(14.616)		(4.883)		(1.859)		(3.080)		(6.979)		(2.756)		(0.217)	
Deposits / Loans	-1.516	***	-1.570	***	-0.076		-0.907		-0.171	***	-0.160	***	-0.022		-0.132	
	(-13.008)		(-12.926)		(-0.237)		(-0.825)		(-12.697)		(-12.993)		(-0.702)		(-1.423)	
Deposits / Loans * Crisis	0.646	***	1.025	***	-0.393		-0.036		0.071	***	0.091	***	-0.062	*	-0.005	
	(6.642)		(9.390)		(-1.114)		(-0.037)		(6.138)		(7.741)		(-1.775)		(-0.062)	
Deposits / Loans * Post-Crisis	-0.203	*	0.397	***	0.257		-0.397		-0.038	***	0.034	***	0.028		-0.006	
	(-1.748)		(3.465)		(0.685)		(-0.392)		(-2.866)		(2.865)		(0.685)		(-0.067)	
Bad Loans / Total Assets	-0.320	***	-0.706	***	-0.555	**	-0.975	*	-0.032	***	-0.071	***	-0.058	**	-0.067	
	(-7.458)		(-13.442)		(-2.451)		(-1.824)		(-6.866)		(-13.460)		(-2.358)		(-1.178)	
Bad Loans / Total Assets * Crisis	-0.530	***	-0.836	***	-1.928	***	-1.815	***	-0.057	***	-0.083	***	-0.192	***	-0.195	***
	(-9.831)		(-14.555)		(-8.662)		(-3.127)		(-9.482)		(-14.140)		(-8.019)		(-3.074)	
Bad Loans / Total Assets *	-0.660	***	-0.877	***	-1.448	***	-1.015	*	-0.072	***	-0.095	***	-0.154	***	-0.139	**
Post-Crisis	(-11.362)		(-14.510)		(-5.863)		(-1.924)		(-11.181)		(-15.232)		(-5.811)		(-2.476)	
Obs	131,007		201,774		24,346		4,850		131,008		201,774		24,346		4,850	
Banks	5,082		6,838		1,082		205		5,082		6,838		1,082		205	
R-Squared (within)	0.081		0.153		0.231		0.218		0.082		0.151		0.231		0.190	

Table A1 – continued

The table reports the results from fixed effects regressions of *ROE* (Columns 1 to 4) and *ROA* (Columns 5 to 8) on trading to interest income and other bank-specific control variables and interaction terms between the bank-specific variables and the crisis and post-crisis dummy variables for sub-samples based on bank size. Banks are assigned to the four size-groups as follows: Small banks are banks with total assets below USD 100 million in the respective quarter. Medium-sized banks are banks with total assets between USD 100 million and USD one billion in the respective quarter. Large banks are banks with total assets between USD one and 10 billion. Very large banks are defined as banks with total assets in excess of USD 10 billion. Data is collected from the Report of Condition and Income ("Call Report") available on the Federal Reserve Bank of Chicago website for quarters up to Q4 2010 and on the FFIEC Central Data Repository's Public Data Distribution website as of Q1 2011. The sample includes the 48 quarters from Q1 2002 to Q4 2013. The pre-crisis period includes the 21 quarters from Q1 2002 to Q1 2007, the crisis period includes the 8 quarters from Q2 2007 to Q1 2009, and the post-crisis period includes the 19 quarters from Q2 2009 to Q4 2013. *ROE* is defined as net income divided by total equity capital. *ROA* is defined as net income divided by total assets. *Trading to Interest Income* is the ratio of trading to interest income. *ln(Total Assets)* is the natural logarithm of total assets. *Tier 1 Capital to Total Assets* is defined as Tier 1 capital divided by total assets. *Deposits* / *Loans* is defined as the deposits divided by loans. *Bad Loans* / *Total Assets* is defined as the sum of non-accrual loans and loans past due 90 days or more divided by total assets. All variables are winsorized at their 5th and 95th percentiles. All control variables are lagged by one quarter. All regressions include dummy variables for the crisis and post-crisis periods (not reported). The *t*-statistics (in parentheses) are based on the cluster-robust variant of the Huber-White sandwich estimator, which accounts for the dependence of observations within clusters (different quarterly observations for one specific bank). ***, **, * denotes statistical significance at the 1%, 5%, 10% level.

Table A2: Trading to interest income, bank failures, and ROE / ROA changes

	Failed (dummy)				ΔROE	ΔROA
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-3.037	-3.282 *	-1.178	0.977	-1.138 ***	-1.252 ***
	(-1.517)	(-1.645)	(-1.642)	(1.161)	(-2.759)	(-3.106)
Trading to Interest Income	-0.581	-0.594	0.903	1.324	0.017	-0.005
	(-0.432)	(-0.441)	(0.724)	(0.967)	(0.199)	(-0.089)
ln(Total Assets)	0.271 ***	0.277 ***	0.009	-0.003	-0.005	0.003
	(3.031)	(3.061)	(0.242)	(-0.065)	(-0.202)	(0.122)
Tier 1 Capital / Total Assets	-0.086	-0.072	-0.601 ***	-1.014 ***	-0.004	0.006
	(-1.444)	(-1.230)	(-14.578)	(-16.246)	(-0.238)	(0.539)
Deposits / Loan	-4.025 ***	-4.009 ***	-1.541 ***	-0.759 ***	0.397 ***	0.312 ***
	(-3.967)	(-3.954)	(-6.318)	(-3.241)	(2.635)	(4.114)
Bad Loans / Total Assets	0.570 ***	0.573 ***	1.041 ***	1.050 ***	-0.074	-0.095 *
	(3.715)	(3.747)	(17.785)	(13.427)	(-1.349)	(-1.735)
ROE	-0.030		-0.146 ***	-0.214 ***		
	(-1.188)		(-9.388)	(-9.711)		
ROA		-0.287				
		(-1.163)				
Obs	7,790	7,790	356,623	356,375	7,117	7,117
Banks	7,790	7,790	10,123	10,110	7,117	7,117
R-Squared	-	-	-	-	0.003	0.003
Pseudo R-Squared	0.109	0.109	0.313	0.402	-	-

The table reports the results from panel logit (Columns 1 to 4) and cross-sectional (Columns 5 and 6) regressions of a failure indicator on trading to interest income and other bank-specific control variables. In Columns 1 and 2, the dependent variable is a dummy for whether the bank failed during the financial crisis from Q2 2007 to Q1 2009. The explanatory variables are measured as of Q4 2006, the last year end before the crisis. In Columns 3 and 4, the dependent variable is a dummy for whether the bank failed in the respective quarter. In Column 3, all explanatory variables are lagged by four quarters. In Column 4, explanatory variables are average values over the last four quarters (t-5 to t-1). Columns 5 and 6 report the results from cross-sectional OLS regressions of *ΔROE* (Column 5) and *ΔROA* (Column 6) during the crisis (Q2 2007 to Q1 2009) on non-interest to interest income and other bank-specific control variables measured before the crisis (Q4 2006). Data is collected from the Report of Condition and Income ("Call Report") available on the Federal Reserve Bank of Chicago website for quarters up to Q4 2010 and on the FFIEC Central Data Repository's Public Data Distribution website as of Q1 2011. Bank failures are identified based on FDIC's Failed Bank List. *Trading to Interest Income* is the ratio of trading to interest income. *ln(Total Assets)* is the natural logarithm of total assets. *Tier 1 Capital to Total Assets* is defined as Tier 1 capital divided by total assets. *Deposits / Loans* is defined as the deposits divided by loans. *Bad Loans / Total Assets* is defined as the sum of non-accrual loans and loans past due 90 days or more divided by total assets. *ΔROE* is defined as the percentage change in *ROE* during the crisis, calculated as *ROE* in Q1 2009 minus *ROE* in Q2 2007 divided by *ROE* in Q2 2007, where *ROE* is defined as net income divided by total equity capital. *ΔROA* is defined as the percentage change in *ROA* during the crisis, calculated as *ROA* in Q1 2009 minus *ROA* in Q2 2007 divided by *ROA* in Q2 2007, where *ROA* is defined as net income divided by total assets. All variables are winsorized at their 5th and 95th percentiles. *t*-statistics are reported in parentheses. Standard errors in Columns 5 and 6 are heteroskedasticity-robust. ***, **, * denotes statistical significance at the 1%, 5%, 10% level.

Table A3: Fixed effects regressions of ROE and ROA on non-interest to interest income groups – Only banks with at least one pre-crisis and one crisis observation

Dependent Variable	ROE	ROE	ROA	ROA
	(1)	(2)	(3)	(4)
Intercept	0.116	-14.234 ***	-0.896 ***	-2.303 ***
	(0.143)	(-13.445)	(-9.891)	(-18.701)
Non-Interest to Interest Income	3.279 ***	2.712 ***	0.353 ***	0.301 ***
	(14.860)	(10.387)	(15.119)	(10.607)
Non-Interest to Interest Income *		1.488 ***		0.140 ***
Crisis		(5.586)		(4.737)
Non-Interest to Interest Income *		0.743 **		0.071 **
Post-Crisis		(2.531)		(2.221)
ln(Total Assets)	0.868 ***	2.061 ***	0.143 ***	0.257 ***
	(13.619)	(24.225)	(19.629)	(25.651)
ln(Total Assets) * Crisis		-0.444 ***		-0.045 ***
		(-16.288)		(-15.970)
ln(Total Assets) * Post-Crisis		-0.295 ***		-0.028 ***
		(-9.620)		(-8.574)
Tier 1 Capital / Total Assets	-0.161 ***	-0.172 ***	0.011 ***	0.012 ***
	(-15.469)	(-15.190)	(8.249)	(8.094)
Tier 1 Capital / Total Assets *		0.076 ***		0.003 **
Crisis		(7.973)		(2.442)
Tier 1 Capital / Total Assets *		0.212 ***		0.015 ***
Post-Crisis		(17.158)		(9.894)
Deposits / Loans	-1.989 ***	-1.508 ***	-0.215 ***	-0.164 ***
	(-25.353)	(-16.654)	(-25.177)	(-16.329)
Deposits / Loans * Crisis		0.614 ***		0.055 ***
		(8.147)		(6.512)
Deposits / Loans * Post-Crisis		-0.209 **		-0.042 ***
		(-2.574)		(-4.621)
Bad Loans / Total Assets	-1.662 ***	-0.474 ***	-0.168 ***	-0.045 ***
	(-75.339)	(-12.948)	(-72.203)	(-11.307)
Bad Loans / Total Assets * Crisis		-0.922 ***		-0.095 ***
		(-22.279)		(-21.058)
Bad Loans / Total Assets *		-1.053 ***		-0.115 ***
		(-24.014)		(-23.942)
Obs	321,098	321,098	321,098	321,098
Banks	7,158	7,158	7,158	7,158
R-Squared (within)	0.117	0.146	0.110	0.136

The table reports the results from fixed effects regressions of *ROE* (Columns 1 and 2) and *ROA* (Columns 3 and 4) on bank size, non-interest to interest income, other bank-specific control variables, and interaction terms between the bank-specific variables and the crisis and post-crisis dummy variables. Data is collected from the Report of Condition and Income ("Call Report") available on the Federal Reserve Bank of Chicago website for quarters up to Q4 2010 and on the FFIEC Central Data Repository's Public Data Distribution website as of Q1 2011. The sample includes the 48 quarters from Q1 2002 to Q4 2013. The pre-crisis period includes the 21 quarters from Q1 2002 to Q1 2007, the crisis period includes the 8 quarters from Q2 2007 to Q1 2009, and the post-crisis period includes the 19 quarters from Q2 2009 to Q4 2013. *ROE* is defined as net income divided by total equity capital. *ROA* is defined as net income divided by total assets. *Non-Interest to Interest Income* is the ratio of non-interest to interest income. *ln(Total Assets)* is the natural logarithm of total assets. *Tier 1 Capital to Total Assets* is defined as Tier 1 capital divided by total assets. *Deposits / Loans* is defined as the deposits divided by loans. *Bad Loans / Total Assets* is defined as the sum of non-accrual loans and loans past due 90 days or more divided by total assets. All variables are winsorized at their 5th and 95th percentiles. All control variables are lagged by one quarter. Regressions with interaction terms with the crisis and post crisis dummies also include dummy variables for the crisis and post-crisis periods (not reported). The sample includes only banks with data on at least one quarter before the crisis (i.e., before Q2 2007) and one quarter after the crisis (i.e., after Q1 2009). The *t*-statistics (in parentheses) are based on the cluster-robust variant of the Huber-White sandwich estimator, which accounts for the dependence of observations within clusters (different quarterly observations for one specific bank). ***, **, * denotes statistical significance at the 1%, 5%, 10% level.

Table A4: Fixed effects regressions of ROE and ROA on non-interest to interest income groups – Only banks with full data coverage from Q1 2002 to Q4 2013

Dependent Variable	ROE	ROE	ROA	ROA
	(1)	(2)	(3)	(4)
Intercept	8.764 ***	-6.308 ***	0.108	-1.241 ***
	(8.982)	(-4.721)	(1.055)	(-8.583)
Non-Interest to Interest Income	2.592 ***	2.140 ***	0.262 ***	0.208 ***
	(10.316)	(7.038)	(10.092)	(6.454)
Non-Interest to Interest Income *		1.258 ***		0.143 ***
Crisis		(4.326)		(4.515)
Non-Interest to Interest Income *		0.824 **		0.103 ***
Post-Crisis		(2.572)		(3.025)
ln(Total Assets)	0.090	1.357 ***	0.041 ***	0.152 ***
	(1.132)	(12.327)	(4.936)	(12.715)
ln(Total Assets) * Crisis		-0.373 ***		-0.037 ***
		(-12.539)		(-12.162)
ln(Total Assets) * Post-Crisis		-0.201 ***		-0.017 ***
		(-6.237)		(-5.087)
Tier 1 Capital / Total Assets	-0.064 ***	-0.091 ***	0.033 ***	0.034 ***
	(-4.692)	(-6.172)	(20.357)	(19.287)
Tier 1 Capital / Total Assets *		0.091 ***		0.003 ***
Crisis		(8.658)		(2.644)
Tier 1 Capital / Total Assets *		0.158 ***		0.004 **
Post-Crisis		(12.116)		(2.369)
Deposits / Loans	-1.856 ***	-1.413 ***	-0.183 ***	-0.145 ***
	(-20.771)	(-13.480)	(-19.629)	(-13.037)
Deposits / Loans * Crisis		0.361 ***		0.033 ***
		(4.270)		(3.565)
Deposits / Loans * Post-Crisis		-0.178 **		-0.022 **
		(-1.980)		(-2.254)
Bad Loans / Total Assets	-1.617 ***	-0.617 ***	-0.163 ***	-0.065 ***
	(-65.275)	(-14.934)	(-63.903)	(-14.836)
Bad Loans / Total Assets * Crisis		-0.725 ***		-0.072 ***
		(-15.603)		(-14.459)
Bad Loans / Total Assets *		-0.902 ***		-0.093 ***
		(-18.264)		(-17.586)
Obs	255,089	255,089	255,089	255,089
Banks	5,435	5,435	5,435	5,435
R-Squared (within)	0.112	0.132	0.110	0.127

The table reports the results from fixed effects regressions of *ROE* (Columns 1 and 2) and *ROA* (Columns 3 and 4) on bank size, non-interest to interest income, other bank-specific control variables, and interaction terms between the bank-specific variables and the crisis and post-crisis dummy variables. Data is collected from the Report of Condition and Income ("Call Report") available on the Federal Reserve Bank of Chicago website for quarters up to Q4 2010 and on the FFIEC Central Data Repository's Public Data Distribution website as of Q1 2011. The sample includes the 48 quarters from Q1 2002 to Q4 2013. The pre-crisis period includes the 21 quarters from Q1 2002 to Q1 2007, the crisis period includes the 8 quarters from Q2 2007 to Q1 2009, and the post-crisis period includes the 19 quarters from Q2 2009 to Q4 2013. *ROE* is defined as net income divided by total equity capital. *ROA* is defined as net income divided by total assets. *Non-Interest to Interest Income* is the ratio of non-interest to interest income. *ln(Total Assets)* is the natural logarithm of total assets. *Tier 1 Capital to Total Assets* is defined as Tier 1 capital divided by total assets. *Deposits / Loans* is defined as the deposits divided by loans. *Bad Loans / Total Assets* is defined as the sum of non-accrual loans and loans past due 90 days or more divided by total assets. All variables are winsorized at their 5th and 95th percentiles. All control variables are lagged by one quarter. Regressions with interaction terms with the crisis and post crisis dummies also include dummy variables for the crisis and post-crisis periods (not reported). The sample includes only banks with complete data coverage for the full sample period from Q1 2002 to Q4 2013. The *t*-statistics (in parentheses) are based on the cluster-robust variant of the Huber-White sandwich estimator, which accounts for the dependence of observations within clusters (different quarterly observations for one specific bank). ***, **, * denotes statistical significance at the 1%, 5%, 10% level.

Table A5: Fixed effects regressions of ROE and ROA on non-interest to interest income and bank size groups – lagged explanatory variables (4 lags)

Dependent Variable	ROE	ROE	ROA	ROA
	(1)	(2)	(3)	(4)
Intercept	10.398 ***	-5.214 ***	0.272 ***	-1.296 ***
	(14.897)	(-6.146)	(3.664)	(-13.611)
Non-Interest to Interest Income	2.369 ***	2.131 ***	0.247 ***	0.218 ***
	(11.420)	(8.893)	(11.107)	(8.397)
Non-Interest to Interest Income *		1.247 ***		0.132 ***
Crisis		(4.653)		(4.441)
Non-Interest to Interest Income *		0.073		0.025
Post-Crisis		(0.246)		(0.775)
ln(Total Assets)	0.003	1.339 ***	0.049 ***	0.180 ***
	(0.059)	(19.841)	(8.452)	(23.609)
ln(Total Assets) * Crisis		-0.481 ***		-0.048 ***
		(-17.189)		(-16.613)
ln(Total Assets) * Post-Crisis		-0.253 ***		-0.022 ***
		(-8.319)		(-6.812)
Tier 1 Capital / Total Assets	-0.323 ***	-0.283 ***	-0.012 ***	-0.004 ***
	(-34.121)	(-27.291)	(-10.965)	(-3.435)
Tier 1 Capital / Total Assets *		0.041 ***		-0.003 ***
Crisis		(4.376)		(-2.865)
Tier 1 Capital / Total Assets *		0.133 ***		0.003 **
Post-Crisis		(11.719)		(2.042)
Deposits / Loans	-0.921 ***	-1.012 ***	-0.097 ***	-0.108 ***
	(-13.555)	(-12.934)	(-13.020)	(-12.583)
Deposits / Loans * Crisis		0.838 ***		0.083 ***
		(11.505)		(10.215)
Deposits / Loans * Post-Crisis		0.479 ***		0.038 ***
		(5.928)		(4.217)
Bad Loans / Total Assets	-1.396 ***	-0.387 ***	-0.141 ***	-0.037 ***
	(-64.692)	(-10.942)	(-61.197)	(-9.613)
Bad Loans / Total Assets * Crisis		-0.796 ***		-0.082 ***
		(-17.729)		(-16.785)
Bad Loans / Total Assets *		-0.812 ***		-0.089 ***
		(-19.052)		(-19.015)
Obs	356,622	356,622	356,623	356,623
Banks	10,123	10,123	10,123	10,123
R-Squared (within)	0.087	0.114	0.069	0.094

The table reports the results from fixed effects regressions of *ROE* (Columns 1 and 2) and *ROA* (Columns 3 and 4) on bank size, non-interest to interest income, other bank-specific control variables, and interaction terms between the bank-specific variables and the crisis and post-crisis dummy variables. All independent variables (except the crisis and post-crisis dummies) are lagged by four quarters. Data is collected from the Report of Condition and Income ("Call Report") available on the Federal Reserve Bank of Chicago website for quarters up to Q4 2010 and on the FFIEC Central Data Repository's Public Data Distribution website as of Q1 2011. The sample includes the 48 quarters from Q1 2002 to Q4 2013. The pre-crisis period includes the 21 quarters from Q1 2002 to Q1 2007, the crisis period includes the 8 quarters from Q2 2007 to Q1 2009, and the post-crisis period includes the 19 quarters from Q2 2009 to Q4 2013. *ROE* is defined as net income divided by total equity capital. *ROA* is defined as net income divided by total assets. *Non-Interest to Interest Income* is the ratio of non-interest to interest income. *ln(Total Assets)* is the natural logarithm of total assets. *Tier 1 Capital to Total Assets* is defined as Tier 1 capital divided by total assets. *Deposits / Loans* is defined as the deposits divided by loans. *Bad Loans / Total Assets* is defined as the sum of non-accrual loans and loans past due 90 days or more divided by total assets. All variables are winsorized at their 5th and 95th percentiles. Regressions with interaction terms with the crisis and post crisis dummies also include dummy variables for the crisis and post-crisis periods (not reported). The *t*-statistics (in parentheses) are based on the cluster-robust variant of the Huber-White sandwich estimator, which accounts for the dependence of observations within clusters (different quarterly observations for one specific bank). ***, **, * denotes statistical significance at the 1%, 5%, 10% level.

Table A6: Fixed effects regressions of ROE and Z-Score on measures of non-traditional bank income – BHC sample

Panel A: Dependent Variable: ROE						
Non-Traditional Income =	Non-Interest Income		Trading Income		Investment Banking Income	
	(1)	(2)	(3)	(4)	(5)	(6)
Non-Traditional Income to Interest Income	0.165 ***	0.102 ***	-0.364	-1.762 ***	1.372 ***	-1.207 ***
	(4.228)	(2.820)	(-0.492)	(-2.661)	(3.422)	(-3.707)
Non-Traditional Income to Interest Income * Crisis		0.129 ***		3.417 ***		1.365 ***
		(3.957)		(3.933)		(3.182)
Non-Traditional Income to Interest Income * Post-Crisis		0.127 ***		2.790 ***		1.121 **
		(3.198)		(3.275)		(2.101)
Obs	15,738	15,738	15,737	15,737	15,738	15,738
R-Squared (within)	0.130	0.238	0.124	0.230	0.128	0.231
Panel B: Dependent Variable: Z-Score						
Non-Traditional Income =	Non-Interest Income		Trading Income		Investment Banking Income	
	(1)	(2)	(3)	(4)	(5)	(6)
Non-Traditional Income to Interest Income	0.875	-2.121	36.966	-11.328	11.689	-32.726 *
	(0.688)	(-1.491)	(1.315)	(-0.328)	(0.855)	(-1.959)
Non-Traditional Income to Interest Income * Crisis		4.791 **		130.712 **		38.939 **
		(2.173)		(2.177)		(2.037)
Non-Traditional Income to Interest Income * Post-Crisis		6.447 ***		26.980		86.349 **
		(3.060)		(0.793)		(2.320)
Obs	15,091	15,091	15,090	15,090	15,091	15,091
R-Squared (within)	0.048	0.086	0.049	0.083	0.049	0.085

The table reports the results from fixed effects regressions of *ROE* (Panel A) or Z-Score (Panel B) on non-interest (Columns 1 and 2), trading (Columns 3 and 4), or investment banking income (Columns 5 and 6) to interest income, bank-level controls, and interaction terms between the bank-specific variables and the crisis and post-crisis dummy variables (Columns 2, 4, and 6). Data is collected from the FR Y-9C reports and Compustat/CRSP data using the linking table provided by the Federal Reserve Bank of New York. The sample includes the 48 quarters from Q1 2002 to Q4 2013. The pre-crisis period includes the 21 quarters from Q1 2002 to Q1 2007, the crisis period includes the 8 quarters from Q2 2007 to Q1 2009, and the post-crisis period includes the 19 quarters from Q2 2009 to Q4 2013. *ROE* is defined as net income divided by total equity capital. *Z-score* is defined as the sum of ROA and the capital asset ratio (CAR) divided by the volatility of ROA. CAR is calculated as total assets minus total liabilities, divided by total assets. We calculate the standard deviation of ROA in the denominator over a rolling window of 12 quarters. *Non-Interest to Interest Income* is the ratio of non-interest to interest income. *Trading to Interest Income* is the ratio of trading to interest income. *Investment Banking to Interest Income* is the ratio of investment banking, advisory, brokerage, and underwriting fees and commissions to interest income. The control variables are: the natural logarithm of total assets, Tier 1 capital divided by risk-weighted assets, deposits divided by loans, securitized assets (the sum of off-balance sheet assets securitized and sold during a quarter) divided by total assets, and the ratio of non-deposit-funding to short-term funding (sum of deposits, Federal Funds, repo, commercial paper, and other borrowed money with less than one year maturity). In Columns 2, 4, and 6, all independent variables are additionally interacted with both the crisis and post-crisis dummies. All independent variables are lagged by one quarter and, except *ln(Total Assets)*, are winsorized at their 5th and 95th percentiles. The regressions in Columns 2, 4, and 6 include dummy variables for the crisis and post-crisis periods (not reported). The *t*-statistics (in parentheses) are based on the cluster-robust variant of the Huber-White sandwich estimator, which accounts for the dependence of observations within clusters (different quarterly observations for one specific bank). ***, **, * denotes statistical significance at the 1%, 5%, 10% level.