VOL. 5, NO. 1, February 2016 ISSN 2307-2466
International Journal of Economics, Finance and Management

http://www.ejournalofscience.org

Managing Net Interest Margin in Small and Large U.S. Banks: Lessons from the 2007-2013 Financial Crises

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ABSTRACT

The U.S. banking industry has experienced significant structural change over the past decade. Understanding how the relationships between the Net Interest Margin (NIM) and both internal and external factors change with each structural change can provide useful insights into how to improve the NIM after each change. Using the generalized least square, the impacts of these factors on NIM, over the 2007-2013 financial crisis periods, were determined. Overall, results indicate that in both large and small banks, the bank risk related variables (interest rate risk, liquidity risk, capitalization risk and credit risk) appear to explain most of the variation in NIM (52% and 77%), followed by the market related variables (lending rate and portfolio diversification). Specific results indicate that in both large and small banks, NIM has a positive correlation with the interest rate risk, liquidity risk, and capitalization risk and credit risk variables. The lending rate, portfolio diversification, and macroeconomic variables were also positive. The correlation coefficient of each variable, except for interest rate risk, lending rate and the portfolio diversification variables, appear to be stronger in favor of large banks compared with small banks, suggesting that at the industry level, strategies aimed at improving liquidity risk, capitalization risk and credit risk could have a stronger impact on the NIM in large banks compared with small banks. Strategies to improve interest rate risk, lending rate and portfolio diversification in small banks are likely to have a greater impact on the NIM in small banks. The overall coefficient of determination (R-squared) is lower in small banks compared with large banks (about 70% vs 91 %), suggesting that additional factors need to be considered in order to more fully explain the NIM in small banks.

Keywords: *US banks, U.S. small banks, bank size, community bank, net interest margin.*

1. INTRODUCTION

Over the past few decades, the U.S. banking industry has undergone many structural changes [1]. In particular, between 1984 and 2013, the number of banks in the industry decreased from 17,866 in 1984 to 6,812 in 2013, with the number of smaller banks decreasing from 17,422 to 6,146 over the same period, - a transition which involved not just bank failures (about 17 %), but significant mergers and acquisitions. Over this period, the share of the industry's asset controlled by small banks decreased from 40.2 % to 9.3 %, with the smallest banks, those with less than 100 million in asset, controlling only 0.8 % of total asset (FDIC, 2014a). Banking has changed from the traditional "relationship" saving and loans banking to the now universal or full service banking. In this system, banks are extending their activities well beyond the regular banking and investment activities to the provision of services such as wealth and asset management, underwriting, financial advisory, among others. This gives rise to what has been recognized as fee revenue, an increasing dimension of bank revenue. And, with increasing internet capabilities, these new banks are now able to access markets in rural America, areas traditionally serviced only by community banks. The scale of banking activities is now no longer so much a function of the physical plants and their branches, but a function of market access enabled by the internet.

With each change, banks lose grips of their equilibrium of efficient allocation of resources, and struggle to attain a new equilibrium in order to cope with the new environment. It is important for banks to know, with each transition, how their key profitability parameters change and how each is being affected by factors, particularly the manageable factors, within their own structures and within their environments. Even though non-interest income is becoming increasingly important as a source of bank revenue, the Net Interest Margin (NIM) provides one of the most important instruments that could be used to gauge the performance of banks. The objective of this study is to determine the NIM in U.S. banks, both large and small, over the period 2007-2013 and compare how the NIM in each is impacted

[1] These changes were brought about mostly by legal/regulatory and technological changes in the banking industry. Specifically, two regulatory changes were particularly important: the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994, which repealed the McFadden Act and liberalized interstate banking, and the Graham-Leach-Bliley Financial Service Mobilization Act of 1999, which repealed the Glass Steagal Act and widened the scope for commercial banks to engage in non- banking activities (Sherman, 2009; DeYoung, 2014). These changes created the environment in which new technological improvement such as ATMs, internet and mobile phone banking, securitization of assets, automated deposition and bill payment provided a comparative advantage and promised new economies of scale and scope. This effectively spurred the growth of mergers and acquisitions, which ultimately created the environment for the emergence of the new universal banks.

by internal banking, as well as, environmental bank related factors.

The Net Interest Margin (NIM) reflects the difference between interest income and interest expense.

Interest income is revenue earned by a bank from the interest collected on various types of loans issued.

Interest expense is expenditure made by a bank on interest paid out to interest-bearing deposit accounts maintained by the bank. Under competitive conditions, the interest rate charged on loans is equal to the cost of capital plus compensation for credit risk, plus the marginal operating costs (Gonzales and Fumas, 2005).

Likewise, the interest rate paid on deposits is equal to the marginal cost of capital, less any processing cost. NIM is expected to increase if the demand for loans is high relative to the demand for savings. If the opposite happens, NIM is likely to decrease. Stiglitz and Weiss (1981) noted that under conditions of market frictions, transaction costs and information asymmetries may contribute significantly to the cost of intermediation. This intermediation cost could form a wedge between the interest rate paid and the interest rate earned, thus increasing the NIM. Intermediation cost could increase due to inefficiencies in the banking process, from banks having to screen and monitor borrowers, from financial regulations, etc. An increase in competitiveness in the banking system is expected to reduce intermediation costs and foster greater efficiency, and vice versa. The main objective of a bank is to maximize its NIM.

The period 2007-2013 [2] represent very trying times for U.S. banks. In particular, this period represents one of the worst financial crises since the Great Depression of the 1930s (Rosenblum et. al., 2008, Dowd, 2009). Over this period more than 450 U.S. banks failed, the majority of which were small banks. And, over four time as many small banks were lost through mergers and acquisitions. Under these conditions, banks were more than likely motivated to apply their best survival strategies. Examining how banks operated during this period can provide useful insights about the relationships between bank profitability parameters and internal and environmental bank-related variables. For the small banks in particular, which operate in niche markets providing banking service to small businesses, real estates and agricultural entities in small towns and rural and sub-urban communities, it is important to determine how their NIMs were related to internal and environmental influencing factors and how these compared with those of their larger counterparts. Although these small banks constituted about ten percent of total bank asset, they make up about ninety percent of the industry. Their profitability, measured in terms of rates of return on asset (ROA) and equity (ROE), are comparable to those of their larger counterparts, (10.86% and 12.01% and 1.17% and 1.14% in 2013), and in times of economic shocks, they even outperform their larger counterparts (FDIC, 2014b).Covas, et al. (2015) noted that over the 2007-2013period, although NIM in the industry was declining, the NIM of small banks was almost 70 basis points higher than that of large banks.

[2] The 2007-2013 crises were associated with the subprime problem that emerged in the U.S. in 2006. (Yanga, et. al., 2014; Jurek and Marszatek, 2014; Pais and Stork, 2011).

2. LITERATURE REVIEW AND DEFINITION OF THE INDEPENDENT VARIABLES

The factors affecting NIM can be categorized into two groups: those pertaining to the interest rate risk banks are exposed to and those affecting the degree of market competition (Ho and Saunders, 1981). This paper examines the relationships between nineteen independent variables in seven categories and Net Interest Margin (NIM) for small and large banks. The variables are shown in Table 1, together with an explanation of they are constructed and their hypothesized relationships with NIM. For convenience, the variables are classified into three major groups: bank specific risk related variables, market related variables and macroeconomic/ location related variables.

2.1 Bank Risk Related Variables

In this group, four variables are included: interest rate risk, liquidity risk, capitalization risk and credit risk. These variables reflect the key bank specific internal factors that affect NIM.

Interest rate risk (IRisk) is risk associated with fluctuating interest rates. This affects, not just a bank's net interest income, but also the current and future market values of its equity (Raghavan, 2003).

Table 1: Description of variables, their expected relationship NIM and the rationale for the relationships

Name	Description	Acronym	H_0	Rationale [a]
Dependent Variables				
Net Interest Margin	(Net Interest Income)/Equity	NIM_{ij}		Measure of bank profit from banking activities.
Independent Variables				
Bank Risk Related Variables				
Interest rate risk	Net Interest Income/ Total Income	$IRisk_{ij}$	+	As net interest income/total income ratio increases NIM also increases.
Liquidity risk	Total Deposit/Total Asset	$LRisk_{ij}$	+	As the ratio of deposit/total asset increases, NIM increases.
Capitalization risk	Equity/Total Asset	$CapRisk_{ij}$	+	Higher equity/asset ratio means better solvency and consumer's confidence, implies a positive impact on NIM.
Credit risk	Loan Loss Allowance/ Total Deposit	$CRrisk1_{ij}$	+	Greater loan loss allowance means increased bank protectiveness through higher lending and lower borrowing rates, implies a positive impact on NIM.
	Loan Loss Allowance/ Loan	$CRrisk2_{ij}$	+	
Market Related Variables				
Loan Market Competition	Net Loan/Total Asset	$Mkt1_{ij}$	+ or -	Greater loan/asset, loan/deposit ratios may mean better bank strategies, or less prudent lending, implies + or - NIM.
	Net Loan/Total Deposit	$Mkt2_{ij}$		
Diversification (Portfolio)	Non-Interest Income/Total Income	Dvr_{ij}	+ or -	In a competitive market, greater non-interest income/total income ratio implies lower NIM. In a controlled market, higher NIM is expected.
Macroeconomic/Location Related Variables				
Bank size (Dummy Variable)	**$Control_{small}$= <$100Million 1=$100-<1Billion,0 =otherwise $Control_{large}$=$1B-10Billion, 1=>$10Billion, 0=otherwise**	**$Size1_{ij}$ $Size2_{ij}$ $Size3_{ij}$ $Size4_{ij}$**	**–**	**As bank size increases, implies relative increase in non-banking activities, implies lower NIM.**
National Income	**GDP/Capita**	**INC_{ij}**	**+**	**Increased GDP/Capita means increased economic growth, implies increased lending and NIM.**
Location (Dummy Variable)	**1=Kansas City, 0 = otherwise 1=Chicago, 0 = otherwise 1=New York, 0 = otherwise Atlanta, 0 = Control 1=Dallas, 0 = otherwise 1=San Francisco,0 =otherwise**	**$LocKC_i$ $LocCH_i$ $LocNY_i$ $LocAT_i$ $LocDA_i$ $LocSF_i$**	**+or –**	**The sign for each of these variables is to be determined empirically.**

Interest income from loans constitutes the most important source of income for a bank. As interest rate increases, interest income increases, but so also does direct interest expense, especially if liquidity risk arises, and increases processing expense. The critical issue is how does net interest income increase. If the demand for loans is greater than the demand for savings, interest income is likely to increase more than interest expense, and net interest income is expected to increase. In a portfolio context, the value of net interest income depends

on the composition and volume of rate-sensitive earning assets and the composition and volume of rate-sensitive liabilities and how much the interest rate associated with each change.

To estimate the interest rate risk (IRisk), following the procedure used by Van den Heuvel (2014), the ratio of Net Interest Income to Total Income[3] is used.

Based on this formulation and that of NIM, any fluctuation that occurs in IRisk is also likely to occur in the NIM. From this standpoint, a positive correlation is expected between the two variables. This relationship has been empirically verified in many papers (Angbazo, 1997; Demirguc-Kunt and Huizunga, 1999; Saunders and Schumacer, 2000; Hawtrey and Liang, 2008; and Maudos and Guevara, 2004).

Liquidity risk (LRisk) results when banks fail to retain needed funds for loan creation and withdrawals (Raghavan, 2003; Mohammad, 2013). Typically, liquidity funds are derived from retained deposits (as set out in the Required Reserve), cash reserves, short-term assets, such as short-term government securities, or from borrowing from other financial institutions. Depending on the circumstances, additional liquidity funds may be obtained by liquidating bank owned assets.

In this analysis, liquidity risk is measured, as in Gul, Irshad and Zaman (2011), using the liquidity ratio, Total Deposit/Total Asset. A low deposit rate is likely to expose banks to liquidity risks, which is expected to force banks to secure additional funds, usually at higher interest rates. This higher rate, being that it constitutes an interest expense item, is likely to be reflected in a decrease in NIM. Consequently, at least in the short run, the expected correlation between Total Deposit/Total Asset and NIM is likely to be positive, implying that as LRisk increases, NIM should increase as well. This positive relationship is supported by the work done by Angbazo (1997) and Demirguc-Kunt and Huizunga (1999).

Capitalization risk (CapRisk) is risk arising when banking institution fails to maintain adequate capital to cover potential losses under conditions of financial stress (Raghavan, 2003). Bank capitalization is usually measured in terms of the Capital Adequacy Ratio (CAR[4]), which is a standard commonly used as a measure of a bank's ability to accept losses and remain solvent. In this sense, Capitalization Risk could be regarded as a measure of liquidity under stressed market conditions. Capitalization plays a major role in the banking market. In particular, greater capitalization provides a greater potential to offset risky conditions and consequently is more likely to enhance consumer confidence in the banking institution (Berger and Bauwman, 2011, Holmstrom and Tirole, 1997).

In this analysis, following Moussa (2015) and Zribi and Boujelbène (2011), CapRisk is calculated as Equity /Total Asset. With regards to the correlation between CapRisk and NIM, banks with a greater Equity/Total Asset ratio are likely to have a greater financial leverage and to motivate greater consumer confidence. This in turn is likely to result in increased demands for their loans and as a result increase their net interest income. Thus, the relationship between CapRisk and NIM is expected to be positive, as has been verified in Demirguc-Kunt and Huizunga (1999), Athanasoglou et al.(2008).

Credit risk results from a borrower and/or other counter party defaulting in his/their obligation(s) to repay their loan to the lending banks, either totally or partially (Raghavan, 2003). Common instruments used to measures credit risks include non-performing loan to asset ratio and loan to asset ratio (Maudos and Fernandez de Guevara, 2004). Dietrich, and Wanzenried (2009) and later Samad (2012) used the loan loss provision as a measure of credit risk. In this model, two variables, using the loan loss provision, are used to estimate credit risk, CRisk1 and CRisk2. CRisk1 is estimated as in Samad (2012), as Loan Loss Allowance/Total deposit. CRisk2 is measured using the procedure outlined in Dietrick and Wanzenried (2009) and Samad (2012), Loan Loss Allowance/Total Loan.

High credit risks are associated with increased Loan Loss Allowance/Total Loan. This represents reduced loan repayments and, thus, reduced interest income from loans. Additionally, banks experiencing high default are more likely to apply a risk premium implicitly in their lending rates and/or to decrease deposit rates to offset losses in revenue due to credit risk (Maudos and Fernández de Guevara, 2004, and Brock and Franken, 2002). Consequently, as was found to be the case in Angbazo (1997), Demirguc-Kunt and Huizunga (1999) and Hawtrey and Liang (2008) the credit risk variable (CRisk) is expected to have a positive correlation with NIM.

2.2 Bank Market Related Variables

In this group, three variables that reflect the bank's business strategies are examined. Specifically, two variables are used to measure how competitive a bank is in marketing its loans. The other variable is used to determine whether banks diversifying into nonbanking markets, such as providing non-banking services (wealth and asset management, underwriting, etc.), investments, and real estate and/or insurance markets have a significant impact on NIM.

[3] Net interest income is calculated as interest income less interest expense. Total income is the sum of interest income and non-interest income.

[4] In estimating CAR, two types of capital are measured: 1) tier one capital, which can absorb losses without a bank being required to cease trading, 2) and tier two capital, which can absorb losses in the event of a winding-up and so provides a lesser degree of protection to depositors (Estrella et.al.,2000).

Table 2: Mean and standard deviation of variables

Banks			**Small Banks** (<1 B Dollars)		**Large** (≥1B Dollars)	
Standard			**Mean**	**Standard Deviation**		**Mean**
Dependent (Credit Risk) Variables						
Independent Variable						
Net Interest Margin	Net Interest Income /Total Asset	NIM	0.0382	0.0017	0.0311	0.0022
Independent Variable						
Bank Risk Related Variables						
Interest Rate Risk	Net Interest Income/ Total Income	Irisk	0.5171	0.1804	0.5922	0.1733
Liquidity Risk	Total Deposit/Total Asset	Lrisk	0.7180	0.1233	0.6810	0.0681
Capitalization Risk	Equity/Total Asset	CapRisk	0.1161	0.0390	0.0963	0.0180
Credit Risk	Loan Loss Allowance/Total Deposit	CRisk1	0.1048	0.0688	0.1116	0.0277
	Loan Loss Allowance/Total Loan	CRisk2	0.0179	0.0113	0.0240	0.0134
Market Related Variables						
Loan Market	Net Loan/Total Asset	Mkt1	0.6345	0.1114	0.4906	0.1358
Competition	Net Loan/Total Deposit	Mkt2	0.9082	0.2815	0.7202	0.1737
Diversification	Non-InterestIncome/Total Income	Dvr	0.0091	0.0085	0.0116	0.0039
Macroeconomic/Location Related Variables						
Bank Size Dummy Variables	<$100Million, Small Bank Control	Size1	0.3722	0.4725		
	1=$100-<1Billion, 0 =otherwise,	Size2	0.5344	0.4501		
	$1B-10Billion, LargeBank Control	Size3			0.8028	0.3314
	1 =$10Billion, 0=otherwise	Size4			0.1912	0.2423
National Income	Income/Capita	Gdp/Capita	43342.3	10148.4	40348.7	2244.7
Bank Location (Dummy Variables) Atlanta,Control	1=Kansas City, 0 = otherwise	Kansas City	0.2450	0.2358	0.1363	0.2877
	1=Chicago, 0 = otherwise	Chicago	0.2201	0.3820	0.1110	0.4469
	1=New York, 0 = otherwise	New York	0.1171	0.4911	0.2139	0.4469
	1=New York, 0 = otherwise	Atlanta	0.1277	0.3114	0.1584	0.1873
	1=Dallas, 0 = otherwise	Dallas	0.1949	0.3972	0.1753	0.3337
	1=San Francisco,0 =otherwise	San Francisco	0.0952	0.2314	0.2047	0.4140

Loan Market Competition: Competition tends to force banks towards greater efficiency and lower default rates (Das and Ghosh, 2007) and to erode profit margins. However, the opposite may occur if banks lose sight of lending standards and become less prudent in order to increase loan sales (Honohan, 1997, Shaffer, 1998; Boot and Thakor, 2000).

Banking market competition is usually analyzed through examining banking market structure, banking industry organization (Berger and Hannan, 1989; Berger,

1995), banking market restrictions and regulations, or other barriers to full competition (Besanko and Thakor, 1992; Boone, Van Ours, Van der Wiel, 2007; Boone, 2008). This analysis looks at the rate at which banks create loans as a measure of market competition. To estimate loan market competition, Mkt1, constructed following Gul, Irshad and Zaman (2011) as Net Loan/Total Asset, and Mkt2, constructed following the suggestion of the Federal Reserve Bank of Chicago (2011) and Dexheimer (2013), as Net Loans/Total Deposit are used.

In terms of the expected correlation between Mkt1 and Mkt2 and NIM, two opposing arguments are encountered: banks depend on interest income from loans as their main source of income, and a reduction in Net Loan is likely to result in reduced bank income, which, consequently, means a decreased NIM. However, banks may take a less prudent approach to granting loans and increase the lending rate, which could, at least in the short run, increase NIM. (In the long run, this is likely to become more costly and decrease NIM). Based on these relationships, the correlation between Mkt1 and Mkt2 and NIM becomes less predictable. Hence, an a priori prediction regarding the correlation cannot be determined.

Diversification. Diversification of assets reduces the chances of financial distress (Boot and Schmeits, 2000, Acharya et. al., 2002). In order to estimate the effect of diversification, the variable, Non-Interest Income/Total Income, (sum of interest and non-interest income), Dvr, is used. This variable reflects the effect of non-banking activities rather than banking activities on NIM. In terms of the expected correlation between Dvr and NIM, based on the formulation of the two variables (net interest margin vs non-interest income), a negative correlation is expected. Estrada et al. (2006) agreed that this negative relationship is likely, but in the case where the market exhibits market power, and banks can control both their NIMs and their non-interest income, a positive correlation is likely. Demirguc-Kunt & Huizinga (1999) and Afanasieff (2002) observed a positive correlation between Dvr and NIM. DeYoung and Rice (2004) proposed that non-interest income from traditional banking activities, such as fees and service charges on loans might outweigh non-interest income from non-traditional banking activities, such as investments and insurances activities. Based on this, there is likely to be a closer correlation between income earned from interest and income earned from fees from traditional banking activities. In this analysis, since the empirical evidences about the relationship between Dvr and NIM are conflicting, the correlation between these two variables cannot be determined a priori.

2.3 Macro/Location Related Variables

In this group, eleven variables representing three groups are examined. These reflect the relationship between NIM and factors that are external or more of a macroeconomic nature to the banks. The three groups of variables are per capita income, bank size and bank location.

Macroeconomic conditions: Macroeconomic indicators, such as inflation, rate of GDP growth, and exchange rate reflect the state of economic conditions and as such reflect bank profitability. In this study, the per capita GDP, calculated as GDP/population (INC), is used as an indicator of macroeconomic activities. In a general sense, the variable, INC, is expected to reflect prevailing macroeconomic upswings and downswings. Assuming ceteris paribus conditions, as economic condition in a country improves, and economic growth becomes stranger, loan creation is expected to increase, default rates and insolvency are expected to decrease. Consequently, a positive correlation between the variable, INC, and the NIM is expected.

Bank size: For this analysis, banks are classified into standardized size groups (Size1 to Size4) based on their asset values (following FDIC, 2012) and then placed into the Small Bank group (Size1, Size2) or the Large Bank group (Size3, Size4) based on their sizes. The objective is to determine whether there is a difference in NIM response between bank sizes within each group.

Dummy variables (Table 1) are used to proxy for each bank size, with Size 1 and Size 3 being the control in the Small Bank and Large Bank groups, respectively.

In terms of the expected correlation between Bank Size and NIM, many researchers believe that larger banks, by virtue of them having a more diversified base, and perhaps their being less exposed to risks, tend to show lower NIM. Hamadi and Ali (2012) provided evidence to support this relationship. Aboagye et al. (2008), however, observed a positive correlation between NIM and bank size. Other studies (Das and Ghosh, 2007; FDIC, 2014b) have observed similar results and have attributed this to their observation that bigger banks tend to have more problem loans, which is likely to increase the default rate and increase the NIM. Demirgüç-Kunt, et. al. (2003) suggest that conditions that endow banks with market power would allow them to manipulate the market such that a positive correlation between NIM and bank size could result. Since, in this study, it cannot be verified whether small banks or the large banks operated under different market conditions, there is no a priori expectation about the correlations between Size and NIM in either group compared with the control.

Bank Location: During the 2007-2013 financial crises, the distribution of failed banks across the FDIC banking regions was fairly even, with the exception being the Atlantic Region (Aubuchon and Wheelock, 2010). The other FDIC regions are as follows: 1. Kansas, 2.

Chicago, 3. New York, 4. Dallas and 5. San Francisco (FDIC 2012). The states included in each

region are shown below [5]. The objective here is to determine whether NIM dependent on banking regions.

To examine this, dummy variables, as in Dietrick and Wanzenried (2009), are used. The assignment of the dummy variables are as shown in Table 1, with the Atlantic Region (LocAT) being the control. The dummy variables are expected to reflect regional characteristics such as banking risks, governance, politics and banking regulations. Because the impact of each region on NIM cannot be determined a priory, there is no a priori expectation regarding the signs of the dummy variables.

3. THE DEPENDENT VARIABLES AND MODEL

3.1 Dependent Variables

In this paper, NIM is measured as Net Interest Income/Equity. As explained above, Net Interest Income is calculated as the spread between interest income and interest expense (Raghavan, 2003, English, 2002).

Interest income is revenue accruing from banking activities such as issuing loans and leases, and from trading accounts. Interest expenses are non-operating expenditures made on liabilities and debts.

3.2 The Model

The economic models used are as shown in Equations (1), (2) and (3) in which the variables are as described in Table 1. The models estimated for small banks are as follows:

$$NIM_{Smallbank} = f(IRisk, LRisk, CAPRisk1, CRisk1, CRrisk2) \quad \text{Model 1} \tag{1}$$

$$NIM_{Smallbank} = f(Model1, Mkt1, Mkt2, DVR) \quad \text{Model 2} \tag{2}$$

$$NIM_{Smallbank} = f(Model2, SIZE1, SIZE2, SIZE3, SIZE4, INC, INCSQ, LocKC, LocCH, LocNE, LocMA, LocMS, LocSW, LocSF) \quad \text{Model 3} \tag{3}$$

These models are repeated for large banks. The econometric model is as shown in Equation (4)

$$Y_{ij} = \alpha_1 X_{ij} + e_{ij} \tag{4}$$

where i and j represent Bank i and Year j respectively; Y_{ij} is the dependent variable representing the NIM risk measure (i.e. NIM) of Bank i in Year j; the other variables, $X_{ij,}$ are the independent variables as defined above and in Table 1 for Bank i in Year j; and e_{ij} represents unexplained random errors for Bank i in Year j.

4. THE DATA AND ANALYSIS

The main source of the data used in this study was the Quarterly Call Report, Federal Reserve Bank of Chicago[6]. The final data set consisted of 4832 non-failed commercial banks over the period, 2007-2013. For each year, the data set was filtered and then annualized. For the year, 2007, for example, 3000 banks (out of about 7,200 banks) were randomly selected and failed banks, banks that were difficult to track because of mergers, name changing, etc., and banks with inconsistencies in their records resulting from non-submission, omission, recording errors, etc. were removed from the data set, and annualized. The final data set consisted of observations for 726 banks. This procedure was repeated for each of the years, 2008-2013. The data for annual GDP per capita by state were obtained from the U.S. Dept. of Commerce, Bureau of Economic Analysis, Federal Reserve Banks of St, Louis. The means and standard deviations for Small Banks and Large Banks variables used are as shown in Table 2.

From Table 2, important points to note regarding the data are i) At least 10.0% (or 483 observations) were taken from each of six geographic regions. ii) Small banks made up 88 % of the observations. The highest percentage of small banks was from the Kansas City region (24%). The highest percent of large banks was from the New York region (24%). ii) Of the small banks, 53% were bank of asset size $100M –$1B. Of the large banks, 80% were in the $1B-$10B asset size group. iii) The mean for NIM was higher for small banks compared with those for large banks (3.8 % vs. 3.1 %), but the standard deviation was lower for small banks compared with large banks.
Other important points to note are the means of the risk variables and the marketing variables.

Heteroscedasticity is a common problem encountered when dealing with cross-sectional data. To correct for unobservable heteroscedasticity, the generalized least square regression procedure was used to estimate coefficients.

[5] 1. Kansas City – Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota. 2. Chicago – Illinois, Indiana, Michigan, Ohio, Wisconsin. 3. New York- Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont , Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, Puerto Rico, U.S. Virgin Islands . 4. Atlantic - Alabama, Florida, Georgia, North Carolina, South Carolina, Virginia, West Virginia .5. Dallas - Arkansas, Kentucky, Louisiana, Mississippi, Tennessee, Colorado, New Mexico, Oklahoma, Texas. 6. San Francisco- Alaska, American Samoa, Arizona, California, Guam, Hawaii, Idaho, Montana, Nevada, Oregon, States of Micronesia, Utah, Washington, Wyoming (FDIC, 2012).

[6] The Quarterly Call Reports maintains quarterly data from call reports submitted by Federal Reserve banks (2013).

Table 3: Coefficients of variables for Nim– small banks

Independent Variables		**Coefficients**	**t Stat**		**Coefficients**	**t Stat**		**Coefficients**	**t Stat**	
	Intercept	-0.0138	-3.4200	***	-0.0415	-7.2886	***	-0.0600	-10.3079	***
Bank Risk Related Variables										
Interest Rate Risk	Irisk	0.0239	9.3736	***	0.0332	12.9954	***	0.0353	14.4821	***
Liquidity Risk	Lrisk	0.0071	1.9810	**	0.0183	2.9227	***	0.0194	3.3679	***
Capitalization Risk	CAPrisk	0.0431	2.5563	**	0.0075	0.3974		0.0022	0.1250	
Credit Risk	CRrisk1	0.0069	0.4571		0.0598	3.3869	***	0.0303	1.9428	**
	CRrisk2	0.0158	8.2492	***	0.0418	9.2843	***	0.0180	8.5813	***
Market Related Variables										
Market	Mkt1				0.0177	2.3848	**	0.0233	3.4376	***
	Mkt2				0.0070	1.9397	**	0.0040	1.1573	
Diversification	Dvr				0.4204	8.0849	***	0.3995	7.8891	***
Macroeconomic/Location Related Variable										
Bank Size	Size2							0.0019	1.405	
	Size 4									
National Income	INC							0.0000	4.9395	***
Bank Location	Kansas City							0.0058	1.6031	
	Chicago							-0.0010	-0.3524	
Atlanta	New York							-0.0010	-0.3613	
(Control)	Dallas							0.0011	0.3546	
	San Francisco							-0.0015	-0.4862	
	RSquared	0.5285			0.6327			0.7027		

This method also accommodates for any possible negative values in the dependent variables, which was likely in this case. For each bank group, small and large, three regression models were estimated, and the RSquared for each was noted as shown in Tables 3 and 4.

5. RESULTS AND DISCUSSION

The results obtained are as shown in Tables 3 and 4[7]. Table 3 shows the result of the three models for small banks. Table 4 shows similar results for large banks. The asterisks ***, ** and * indicate significance at the 99 %, 95% and 90% levels, respectively. Each coefficient is interpreted as the number of units increase or decrease in the NIM variable for a one unit increase in the associated variable (except for the dummy variables).

The coefficient of determination (R-Squared) for each regression is as shown in each table.

Based on the results for small banks (Table 3), all the variables together explained about 70 % of the variability of NIM (RSquared = 0.7027). Fifty-three percent (53 %) of the variability is explained by the risk related variables and about 10 % is explained by the market related variables. For large banks (Table4), the same variables altogether explained about 91 percent (RSquared = 0.9141) of the variability of NIM, with the risk related variables and the market related variables explaining 77% and 10 % respectively. These results suggest that in both groups of banks, most of the variability in NIM is explained by the risk related variables[8].

[7] Some variables are significant in one model, but not significant in other models. This might be due to unavoidable multicollinearity in which the effects of one variable might be captured indirectly by other variables added to the models.

[8] Significance of added variables was based on the t-statistics shown for individual variables and the Wald F-statistics for groups of variables.

Table 4: Coefficients of variables for NIM -large banks

Independent Variables		**Coefficients**	**t Stat**		**Coefficients**	**t Stat**		**Coefficients**	**t Stat**	
	Intercept	-0.0473	-5.9292	***	-0.0592	-8.7026	***	-0.0733	-8.4537	***
Bank Risk Related Variables										
Interest Rate Risk	Irisk	0.0302	5.3089	***	0.0274	5.5308	***	0.0295	6.9262	***
Liquidity Risk	Lrisk	0.0311	3.9828	***	0.0462	5.0424	***	0.0538	6.5548	***
Capitalization Risk	CAPrisk	0.1312	4.8693	***	0.1168	3.8417	***	0.1214	4.3883	***
Credit Risk	CRrisk1	0.1422	5.1619	***	0.1049	3.7627	***	0.1331	5.0053	***
	CRrisk2	0.0518	2.5927	**	0.0787	1.9731	**	0.0322	2.3507	**
Market Related Variables										
Market	Mkt1				0.0175	1.2937		0.0173	1.4659	
	Mkt2				0.0171	4.1801	***	0.0142	4.0528	***
Diversification	Dvr				0.3276	1.9598	**	0.1845	2.1239	**
Macroeconomic/Locational Variable										
Bank Size	Size2									
	Size4							-0.0028	-0.7266	
National Income	INC							0.0000	3.7603	***
Bank Location	Kansas City							0.0035	0.5124	
	Chicago							0.0003	0.0702	
Atlanta	New York							0.0005	0.0732	
(Control)	Dallas							0.0063	0.6615	
	San Francisco							-0.0008	-0.1259	
	RSquared	0.7714			0.8732			0.9141		

With regards to specific variables, for small banks (Table 3), in the risk related category, the interest rate risk (IRisk), liquidity risk (LRisk), capitalization risk (CapRisk) and credit risk (CRisk1, CRisk2) variables is each significant in at least one of the models and each has its expect sign. For the interest rate risk variable (Net Interest Income/Total Income), the coefficient is 0.035, which suggest that NIM (Net Interest Income/Equity) is likely to increase by 0.035 units for a one unit increase in the IRisk variable. This result agrees with the results of Angbazo (1997), Demirguc-Kunt and Huizunga (1999), Hawtrey and Liang (2008), and Saunders and Schumacer (2000) and suggests, in general, that NIM is likely to increase with an increase in interest rate risk.

The liquidity risk variable (Total Deposit/Total Asset), has a coefficient is 0.019, which suggest that NIM is likely to increase by that number of units for a one unit increase in LRisk. This result predicts that NIM is likely to increase with an increase in liquidity risk as was the case in the results of Angbazo (1997) and Demirguc-Kunt and Huizunga (1999).

With regards to the capitalization risk variable (Equity/Total Asset), the coefficient is 0.04 indicating that NIM is likely to increase by this value for a one unit increase in CapRisk. As in Demirguc-Kunt and Huizunga (1999) and Athanasoglou et al.(2008), this result supports the notion that NIM is likely to increase with increases in the capitalization risk.

The credit risk variables, CRisk1, measured as Loan Loss Allowance/Total Deposit, has a coefficient of 0.05 and CRisk2 (Loan Loss Allowance/Loan), 0.9, suggesting that NIM is likely to increase by 0.05 and 0.9 units for a one unit increase in the respective variable.

Similar results were obtained by Angbazo (1997), Demirguc-Kunt and Huizunga (1999), Hawtrey and Liang (2008) and Chirwa and Mlachila (2004). These results suggest, in general, that NIM is likely to increase with increases in credit risk.

With regards to large banks (Table 4), the corresponding coefficients for IRisk, LRisk, CapRisk1 and CRisk2 are 0.03, 0.05, 0.13 and 0.07, all positive as in

small banks. The coefficients for CapRisk1 and CRisk1 were greater for large banks than in small banks, suggesting that NIM in large banks is more responsive to changes in these variables than in small banks.

In the market related variables category, for small banks (Table 3), each variable was also significant in at least one model and each had its expected sign. Of the market variables, the coefficient for Mkt1 (Net Loans/Total Asset) is 0.02 and that for Mkt2 (Net Loan/Total Deposit) is 0.007 implying that NIM is likely to increase by these amounts for a one unit increase in the corresponding variable. In general these results indicate that NIM is likely to increase as the rate of loan creation increases.

For the diversification variable, Dvr, calculated as Non-Interest Income/Total Income, the coefficient is 0.04 indicating that NIM is likely to increase by this value for each unit increase in Dvr. This result matches those of Demirguc -Kunt & Huizinga (1999) and Afanasieff (2002), and supports the notion that there is a positive correlation between interest income and noninterest income. This is quite possibly, as proposed by DeYoung and Rice (2004), the result of an increase in fee-based noninterest income from traditional banking activities rather than from other nontraditional banking activities, such as investment, insurance, etc., in small banks. In the large bank category (Table 4), of the market variables, only Mkt2 is significant, with a coefficient (0.017) that is smaller than that in small banks. The diversification variable (Dvr), has a coefficient is 0.3, which is less than that in that for small banks, suggesting that small banks are more responsive to non-interest income than large banks.

Of the bank size variables, in neither the small bank group nor the large bank group was there any significant difference in NIM between any of the Size variables and the control. In terms of the macro-economic/location related variables, for small banks (Table 3), only the macroeconomic variable (GDP/ Capita) was significant and it had its expected positive sign. The coefficient for the variables was, however, very small. For large bank (Table 4), similar results were obtained. Of the bank location variables, none was significant, suggesting that there was no significant difference between NIM in either small or large banks in any location compared with the control, the Atlantic Region.

6. CONCLUSION

The U.S. banking industry has experienced significant structural change over the past decade.

Understanding how the relationships between the net interest margin (NIM) and both internal and external factors change with each structural change can provide useful information into how to improve the NIM after each change. Overall, results indicate that in both large and small banks, the bank risk variables (interest rate risk, liquidity risk, capitalization risk and credit risk) appear to explain most of the variation in the net interest margin (52% vs 77%), followed by the market related variables (lending rate and the diversification variable). Bank location, or banking region, appears to matter very little in determining the NIM.

Specific results indicate that in both large and small banks:

a) NIM had a positive correlation with the interest rate risk variable (IRisk, Net Interest Income/ Total Income).
b) NIM had a positive correlation with the liquidity risk variable (LRisk, Total Deposit/ Total Asset).
c) NIM risk had a positive correlation with the capitalization risk variable (CapRisk, Equity/ Total Asset).
d) NIM risk had a positive correlation with the credit risk variable (CRisk1, Loan loss allowance/ Total deposit; CRisk2, Loan loss allowance/ Total Loan).
e) NIM had a positive correlation with the Market competition variables (Mkt1, Net loan/Total Deposit) and the diversification variable (Dvr, Non-Interest Income/Total Income).
f) NIM had a positive correlation with the measure of macroeconomic condition (INC, GDP/ Capita).

The correlation coefficient for each variable, except for interest rate risk, the market variable (lending rate) and the diversification variables, appeared to be stronger in favor of large banks compared with small banks suggesting that, at the industry level, strategies aimed at improving liquidity rate risk, capitalization risk and credit risk could have a stronger impact on the NIM in large banks compared with small banks. Strategies to improve interest rate risk, lending rate and portfolio diversification in small banks are likely to have a greater impact on NIM in small banks than in large banks.

The overall coefficient of determination (R-squared) was lower in small banks compared with large banks (about 70% vs 91 %), suggesting that additional factors need to be considered in order to more fully explain the NIM in small banks.

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