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Bank Efficiency Ratios - Can They Be Used To Reliably Predict Future Bank Performance?

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BANK EFFICIENCY RATIOS - CAN THEY BE USED TO RELIABLY PREDICT FUTURE BANK PERFORMANCE?

by

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This thesis, submitted by Michael Loebach in partial fulfillment of the requirements for the Degree of Master of Science in Applied Economics from the University of North Dakota has been read by the Faculty Advisory Committee under whom the work has been done and is hereby approved.

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Michael Loebach
April 2, 2015

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ABSTRACT

The aim of this study is to assess the predictive ability of the bank efficiency ratio. The popular press, analysts and investors (individuals, institutions and other bank's looking for M&A targets) often use the bank efficiency ratio as a current measure of how efficiently a bank earns a dollar of profit for each dollar of expenditure. Implied in the usage of the ratio is that a bank that is performing well today will continue to perform better than peers in the future. To assess the predictive ability of the ratio, I grouped banks into quintiles of profit performance and used an ordered logit model with independent variables based on past literature on the determinants of bank profitability to predict the future relative performance of the bank. The efficiency ratio is found to be directionally correct in that a bank with a better relative efficiency ratio today tended to be a higher relative performer in the future. However, the efficiency ratio is not found to be the best indicator of future bank profitability. A bank's current ROA is found to be the most useful indicator in predicting the future relative performance of a bank.

CHAPTER I

INTRODUCTION

Measuring productivity in the financial sector can be a difficult task. In an attempt to capture a bank's relative productivity, the banking industry has developed something called the "efficiency ratio". At its most basic level, a bank's efficiency ratio is measured as the ratio of non-interest expense to revenue (that is revenue from net interest income and non-interest income). The ratio measures how much revenue is generated per the bank's non-interest related expense. A high ratio indicates a less efficient bank and a low ratio indicates a more efficient bank. The popular press often describes the ratio as an easy way to assess the profitability of a bank. The implicit assumption of the popular press, market analysts and bankers that use the ratio is that the ratio is not only a good indicator of a profitable bank, but is also an indicator of a banks future profitability relative to its peers. For example, if a bank has an efficiency ratio that is substantially below its peers, then that would also indicate the bank will be more profitable than its peers in the future.

In my experience, the ratio is also informally used by investment banks and commercial banks engaging in M&A activity to determine the future profitability of a bank. Banks looking to expand and consolidate operations would target other banks with high efficiency ratios on the thought that they would have ample cost cutting opportunities. Bank holding companies looking to expand in new markets but still maintain the standalone charter would target low efficiency ratio banks on the thought that

it is representative of continued profitability in the future. Understanding the predictive capabilities of a bank's efficiency ratio therefore can have a significant impact on industry M&A activity as well as bank strategic plans to improve profitability. The intention of this study is to assess the ability of efficiency ratios to predict future bank performance relative to other banks.

The determinants of a bank's efficiency ratio are varied. The three basic components are non-interest expense, net interest income and non-interest income. A bank's net interest income is affected by credit spreads, the yield curve structure, competitive pressures, leverage and the macro market cycle to name a few. Non-interest expense is primarily composed of wages and salaries, and non-interest income can be composed of product fees, overdraft charges, mortgage banking, capital markets and derivative market making. The greatest variability between banks is in their non-interest income. Larger banks tend to have more varied non-interest income sources, while smaller banks tend to focus more on traditional banking of taking deposits and making loans (contributors to net interest income) (Jaceqitz and Kupiec, 2012).

Efficiency ratios are commonly used by banks in self-assessments, peer comparisons and as evaluation tools in mergers and acquisitions. Efficiency ratios can be used by shareholders to determine if a bank is "well run" (a low relative efficiency ratio translates into a "well run" bank), it can be used in performance based compensation packages for management and employees, it can be used as a screening tool in M&A work by purchasing banks, and as supportive evidence for a premium/discount price for a bank that is being sold. The assumption in each of the uses is that the efficiency ratio has some sort of predictive capability with respect to a bank's future profitability (relative to peers).

It is assumed that a bank that has a low relative efficiency ratio is profitable, and will remain profitable into the future (Jenkins (2014), Brown (2015)).

My own prior belief is that a bank's efficiency ratio is not a good predictor of a bank's future profitability. The ratio makes no correction for the level of risk that a bank takes on to achieve its level of profitability. One simple way for a bank to improve its efficiency ratio is to increase its leverage. By doing this a bank can increase its net interest income which will improve the efficiency ratio, but the bank also potentially increased its credit, liquidity and interest rate risk which is not reflected in the ratio. Additionally, all of the numbers used to calculate the ratio comes from past data that reflect past market conditions. There is little forward looking information in the ratio making its ability to predict future earnings somewhat suspect.

CHAPTER II

LITERATURE REVIEW

Past studies of the efficiency ratio

Academic literature on the efficiency ratio itself is quite limited. Most academic studies that focus on bank efficiency as a topic tend to estimate efficient frontiers based on cost or profit functions using Data Envelope Analysis. Further complicating the study of bank efficiency is the difficulty defining inputs and outputs. For instance, is a deposit an input to the bank product process or is it an output. As pointed out by Wheelock and Wilson (1995), should outputs be measured by the number of deposit accounts, transactions processed or the dollar amount of loans or deposits or all of the above? Bank activities have also varied over time due to changes in the regulatory and technological environment. For instance, common services provided today that were not offered 20 years ago are the ability to check one's deposit and loan accounts online and even pay bills online. Being as a bank's output could be defined in a number of different ways and that definition can change over time, it is not surprising that studies have found varying results when estimating economies of scale. Older empirical studies that used data from the 1980s only found economies of scale existing at small banks. Mester (2010) in a review of the literature found that more recent studies that used data from the 1990s and 2000s and more modern methods for modeling bank operations and risk preferences find significant economies of scale. These studies though were not focused the bank efficiency

ratio, but on estimating efficient frontiers and determining if economies of scale were present.

There are a few studies that have focused on the efficiency ratio itself though. Jaceqitz and Kupiec (2012) studied efficiency ratios at community banks and non-community banks over the period 1984 to 2011 for the FDIC. The authors broadly defined community banks as banks with assets less than $1 billion. Over that period of time, there has been a divergence between community bank and non-community bank efficiency ratios with community banks typically showing higher efficiency ratios than non-community banks (see Figure 1). During the period of study there were significant bank consolidations resulting in increased asset concentration in a few institutions leading one to potentially believe that non-community banks performed better due to the greater economies of scale achieved through the larger asset bases. The researchers found though that after controlling for the increased asset concentration, the efficiency ratio performance among the largest non-community banks was not affected by the increase in assets.

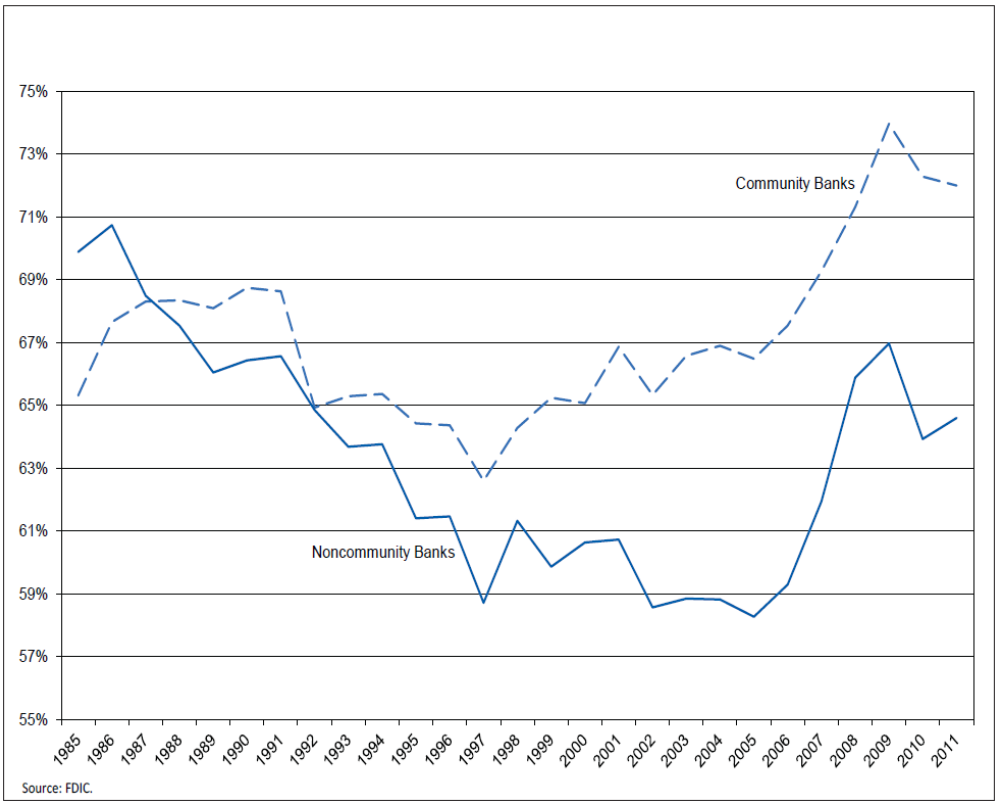

Figure 1: Median Efficiency Ratio at Community Banks and Other Depository Institutions

The authors attribute the divergence in efficiency ratios between community and non-community banks to differences in interest spread, non-interest income and a lack of productivity gains at community banks relative to non-community banks. Community banks experienced a decline in spread between the yields on loans and the costs of deposits relative to non-community banks (Jaceqitz and Kupiec, 2012). The decline is due largely to a convergence of cost of funds. The authors noted that historically, community banks enjoyed a cost of funds lower by as much as 100 basis points relative to non-community banks. Today though, community banks have a cost of funds slightly higher than non-community banks. Community banks also experienced a decline in non-interest income to non-interest expense over this period of time while non-community banks non-

interest income to non-interest expense remained fairly constant. Lastly, community banks also experienced lower productivity growth (as measured by assets per employee) compared to non-community banks.

Researchers Forester and Shaffer (2005) investigated the relationship between absolute size, relative size and pre-tax return on assets and efficiency ratios in Latin America. When the authors controlled for absolute size and relative size, they found that larger banks tended to exhibit lower efficiency ratios.

Past studies on the determinants of bank profitability

While the literature on efficiency ratios themselves may be lacking, there is a significant amount of academic literature on the determinants of bank profitability. Determinants of profitability are usually grouped into two categories, internal determinants and external determinants. The internal determinants are bank specific determinants of profitability, while external determinants are industry specific and macroeconomic determinants.

Common variables used as internal determinants are size, capital, risk management and expense management. Size is included to account for existing economies or diseconomies of scale. Smirlock (1985) and Pasiouras and Kosmidou (2007) find a positive and significant relationship between size and profitability. However, several researchers (Micco, Panizza, & Yanez, 2007) find that the coefficient for bank size (when explaining return on average assets) is always positive, but not statistically significant. Athanasoglou et al., (2008) find the effect of size to be not important in explaining bank profitability.

Two risks that banks pay keen attention too are credit risk and liquidity risk. A bank's risk management can be partially captured by a bank's liquidity, capital and credit ratios. A high level of liquidity, capital and provisions to loans may suggest a bank that is operating overly cautious and ignoring potentially profitable investment opportunities. The literature on the topic is split as to the effects of liquidity and credit risk. Rhoades (1985) finds a positive relationship between risk and profit. Bourke (1989) finds that both capital and liquidity ratios have a positive relationship with profits. However, Molyneux and Thornton (1992) found a negative and significant relationship between the level of liquidity and profitability and a positive relationship between capital levels and profitability. Athanasoglou et al., (2008) find credit risk to be negative and significant in explaining bank profitability. Athanasoglou et al., (2008) also found capital levels to be positive and highly significant. More recent studies appear to converge in that higher capital levels are associated with higher profit levels and higher credit risk is associated with lower profits. The impact of liquidity risk appears to be the most ambiguous. Given the differences in data sets, time periods investigated and countries it is not surprising. One possible explanation for the differences in findings regarding liquidity levels and profitability may be the different elasticity's of demand for loans in the different markets. Banks that are highly liquid may be willing to set lower loan rates than banks tighter on liquidity. Liquidity risk, credit risk and capital levels repeatedly appear in the literature and are often found to be statistically significant. This would suggest that an analysis of bank profitability should include these variables in some form.

Bank expenses are also considered an important determinant of profits. It is often used as a proxy for the efficiency of bank management and is stated as the ratio of a

bank's expenses to assets. In certain regards, this determinant is closely related to the bank efficiency ratio in that the efficiency ratio is a measure of expense per dollar of profit. Both ratios are trying to get at a common measure of the cost efficiency of a bank's management. Molyneux and Thornton (1992) and Bourke (1989) find a positive and significant relationship between lower expense ratios and profitability. Some researchers (Athanasoglou, Brissimis &Delis, 2008) find a negative statistically significant relationship between overhead costs and profitability.

External determinants of bank profitability can be further classified into macroeconomic variables and industry specific variables. Industry specific variables include ownership status, industry size and market concentration. Macroeconomic variables generally include inflation, interest rates and cyclical output.

Many studies of the determinants of bank profitability look at the impact of ownership status of a bank, namely privately owned versus state owned. This variable is less important for a study of banks in the United States though because there are few state owned banks.

Market structure, or industry concentration, is included in studies of bank profitability because of the structure-conduct-performance theory. The structure-conduct-performance model hypothesizes that market concentration fosters collusion among firms in the market and thus they earn monopoly profits. A related theory is relative-market power hypothesis, which asserts that only firms with large market shares and well-differentiated products are able to exercise market power. In contrast to the market power theories, there are two efficiency explanations of the positive relationship between profits

and concentration or market share. The first is the X-efficiency theory where firms with superior management have lower costs and therefore higher profits. The second is the efficient-structure hypothesis where some firms produce at more efficient scales and thus have lower unit costs and higher unit profits. In both efficiency theories, firms are assumed to gain larger market shares due to being more competitive. The larger market shares would thus appear to support the market power theories, but the correlation would be spurious. Smirlock (1985) found that after controlling for market share, concentration of the industry was not significant in explaining profitability. Likewise, Athanasoglou et al., (2008) found that industry concentration was not significant in explaining bank profitability. However, Bourke (1989) and Molyneux and Thornton (1992) find evidence of a positive and statistically significant relationship between concentration and bank profitability. According to Berger (1995), the differences in results of various market structure studies can be attributed to the inclusion or lack of inclusion of X-efficiency variables. Many researchers regress profitability on concentration and market share and find similar results, but interpret them differently. An analysis of the impact of market structure on bank profitability should therefore not only include a concentration or market share variable, but also an efficiency variable in an attempt to rule out a spurious correlation. For the purposes of this study, I will be including the efficiency ratio and operating expenses to assets.

Inflation is generally considered an important determinant of bank profitability. Perry (1992) stated that the effect of inflation on a bank's profitability depends on the extent that inflation expectations are fully anticipated. An inflation rate fully anticipated by a bank implies the bank can adjust internal interest rates in order to increase revenues

faster than costs and thus earn higher profits. Bourke (1989), Molyneux and Thornton (1992) and Athanasoglou et al., (2008) find a positive and statistically significant relationships between inflation and long term interest rates and bank profitability.

The final external determinant commonly found in more recent literature is the extent to which bank profits are impacted by cyclical fluctuations in the macro economy. A worsening economy can lead to higher credit losses which reduce bank profitability. Bank profits may also be pro-cyclical in that when the economy is expanding (contracting), demand for bank loans increase (decrease) as well. Demirguc-Kent and Huizinga (2000) found a positive correlation between bank profits and the business cycle using the annual growth rate of GDP and GNP per capita as a proxy for the business cycle. Bikker and Hu (2002) found a positive correlation using various macroeconomic variables such as GDP, the unemployment rate and an interest rate differential. Athanasoglou et al., (2008) used the difference between real GDP and its segmented trend to estimate cyclical output and found it to be positively related to bank profits and statistically significant. Further, the authors found the business cycle impacts to be asymmetric in that positive output gaps resulted in higher earnings and negative output gaps to be of less significance.

Discussion of bank efficiency ratio as a variable

The general definition of the bank efficiency ratio is non-interest expense divided by the sum of net interest income and non-interest income. The definition usually excludes bad debt write offs. The rationale for excluding debt write offs is that such expense reflects the quality of credit decisions from previous periods and thus does not reflect current performance of the bank. However, banks with a higher level of current impaired assets would be expected to have higher expense as they work to deal with the

problem assets. Additionally, by focusing on non-interest cost the ratio should be less volatile than if interest costs were included (in the denominator). Net interest income can be affected by the general level of interest rates.

To assess the usefulness of the bank efficiency ratio though, it should be compared to other measures of bank costs. A common ratio used for this purpose is operating costs to average total assets. While operating costs to average total assets can be criticized on some of the same grounds as the bank efficiency ratio, it does offer a different perspective.

The ratio of operating costs to average total assets is heavily influenced by a bank's business mix. A bank that relies heavily on wholesale funding versus a bank that focuses on retail lending will most likely have lower operating costs. Likewise, a bank that typically maintains a larger securities portfolio will have a lower cost to assets ratio than a bank that focuses on a retail book of lending. An investment bank that focuses on deal making would be expected to have a relatively high ratio of costs to assets. The cost ratio can thus be more indicative of a bank's business mix rather than a detailed look at its costs.

CHAPTER III

VARIABLE SELECTION

This section describes both the dependent and independent variables used in my study. The discussion of independent variables includes both internal and external determinants of bank profitability. Table 1 lists each variable with a brief description and the expected sign.

Dependent variable

For the dependent variable in this study, I created a quintile ranking of bank performance based on a common measure of bank profitability, return on assets (ROA). The ROA is measured as net income divided by assets. The denominator in the ratio is often expressed as an average of total assets over a specified period of time. In the case of my study, I will be using the annual averages. In past studies, return on equity is also often used, however it is considered to be a slightly inferior measure as it influenced by financial leverage and does not make a correction for it; minimum equity is also often determined by financial regulations. Therefore ROA is considered the key variable for evaluation. Each bank was given a rank for each year of 1, 2, 3, 4 or 5 with a 1 being the top quintile of performers and a 5 representing the bottom quintile performers.

Independent variables

Bank profits show a tendency to persist over time, reflecting market impediments to competition, informational opacity and/or sensitivity to regional/macroeconomic shocks

(Berger et al., 2000). Due to the tendency for profits to persist over time, I include the current year's ROAA for each bank in the model.

Bank size is often considered an important determinant of bank profitability. Athanasoglou et al., (2008) point out that while the effect of growing size has been generally shown to increase profitability, extremely large banks could begin to show diseconomies of scale due to large bureaucratic managements or other reasons. Following Athanasoglou et al., (2008), I include bank assets (logarithm) and their square in an attempt to determine if there is a non-linear relationship between size and profitability. I expect the sign on assets to be negative, and the sign on the square of assets to be positive.

For capital I will use equity divided by total assets. A higher ratio indicates a more capitalized bank and a lower ratio indicates a bank with less capital. A higher capitalized bank is considered safer, and thus more likely to be less profitable (the capital is not being fully utilized). However, since a lower risk bank should be considered to have a higher creditworthiness, it should be able to reduce its funding costs. An advantage of the inclusion of the equity to assets ratio in the profitability function is that it incorporates a measure of leverage into the function. A bank's ROA and ROE is heavily influenced by the degree of leverage in its balance sheet, and thus any comparison of bank profitability should include some correction for it. Since these two effects of a higher capital ratio (or lower leverage) are opposite of each other, the impact of capital levels on profitability is indeterminate.

To proxy for credit risk I will use the loan loss provision to gross loans ratio. Theory would suggest that a higher level of loan loss provision would indicate a higher

level of credit risk and thus lower profitability. I expect the sign on the credit risk coefficient to be positive.

To proxy liquidity risk I will use the liquidity ratio, which is defined as the sum of cash and balances due, securities, Fed Funds sold and trading account assets less pledged securities divided by total liabilities. In theory, a bank that maintains lower liquidity is at greater risk of a liquidity crisis which would lower profitability. However, a bank may also be too cautious in its liquidity management and therefore gives up earnings potential by having too short of assets. Since the liquidity ratio has two opposing implications, I am unsure what the sign on the coefficient will be.

The total cost of a bank (net of interest expense) can be separated into operating expense and other expenses (taxes, depreciation, etc.). Only operating expenses can be directly attributed to bank management. The ratio of operating expenses to assets is expected to have a positive sign as higher expenses imply the bank will be less profitable.

To view the effects of concentration on bank profitability I will use the concentration ratio. The concentration ratio for each bank is measured by the proportion of a bank's assets divided by the total amount of commercial bank assets. According to the structure-conduct performance hypothesis, banks in highly concentrated markets tend to collude and therefore earn monopoly profits as they tend to charge higher rates on loans and pay lower rates on deposits. On the other hand, bank concentration may be a result of superior management and thus garnering a larger market share in which case the coefficient for concentration would be insignificant economically and statistically. The overall implication for the sign on the concentration coefficient is indeterminate.

To proxy the business cycle, I will use nominal regional GDP growth rates except for banks with $100 billion or more in assets. For banks with $100 billion in assets I will use national GDP growth rates since most of these banks have more of a national footprint. Since a declining economy can increase credit losses for banks, and demand for loans is potentially positively correlated with the business cycle, I would expect the sign on the business cycle coefficient to be negative.

An additional macroeconomic variable that I will include in my analysis is the term structure of interest rates. One of the ways that banks earn a profit is by providing what is called maturity transformation. That is they aggregate short term deposits and then lend that out in longer term loans. A large proportion of the interest spread they earn is from the difference in yields on say 5 year rates versus 3 month rates. To capture the term structure of interest rates, I will use regional Federal Home Loan Bank rate curves. Many commercial banks use FHLB advances to supplement their funding base as well as using the regional curves for pricing loans. To account for the term structure of interest rates I will use spreads between the 5 year FHLB bullet advance rates and the 3 month FHLB bullet advance rates. A larger spread would result in increased profitability, thus the expected sign is negative.

Table 1: Definitions, notation and the expected effect of the explanatory variables on future performance.

Variable	Measure	Notation	Expected Sign
Dependent Variable			
Relative Future Performance	Quintile Rank based on next year's ROAA	ROARank	
Independent Variables			
Bank Specific			
Profitability	Net profits over average total assets (in %)	ROAA	Negative
Capital	Equity over total assets (in %)	Equity/Assets	?
Credit Risk	Loan loss provisions over total loans (in %)	Loan Loss Reserve/Gross Loans	Positive
LiquidityRisk	Sum of cash and balances due, securities, Fed Funds sold and trading account assets less pledged securities divided by total liabilities (in %)	Liquidity Ratio	?
Operating Expenses Management	Operating expenses divided by assets (in %)	Non-Interest Expense/Assets	Positive
Efficiency	Operating Expenses divided by the sum of net interest income and non interest income (in %)	Efficiency Ratio	Positive
Bank size	Natural log of assets	Ln Assets	Negative
	Square of natural log of Assets	Ln Asset^2	Positive
Industry specific			
Market Concentration	Bank assets divided by total commercial bank assets (in %)	Concentration Ratio	?
Macroeconomic			
Term Structure of Interest Rates	Five year regional FHLB advance bullet rate less 3 month FHLB advance bullet rate (in %)	Term Structure	Negative
GDP Growth Rate	Regional nominal GDP growth rate (in %)	GDP Growth Rate	Negative

Overall, I expect the profitability variable to be the most important determinant of a bank's future profitability. I expect the sign and statistical significance to be time period specific in that the signs may change depending on the time period under review. I expect operating expenses and the efficiency ratio to have similar results in all models and I expect the bank size variables to be consistent in sign and significance across all models. While I'm not sure what the sign for the concentration ratio will be, based on past literature I expect it will not be statistically significant since I've included several efficiency measures. I expect the sign and statistical significance of the term structure of interest rates and GDP growth rates to be consistent across all models.

CHAPTER IV

DATA ANALYSIS

The bank specific data for this analysis came from Call Reports. Banks that are members of the FDIC are required to file quarterly reports with the FDIC that cover a wide range of data points about the bank in order to help the FDIC better identify problem banks. The Call Reports are publicly available and were accessed through SNL. Annualized data from 2005 through 2013 were used. Since this analysis looks at bank performance in 2006, 2007, 2009, 2010, 2012 and 2013 using the previous year's data, full data sets for years 2005 to 2012 were collected, but only ROAA was collected for 2013. Appendix A contains all of the correlation tables for the data, as well as general descriptive statistics.

Below is a discussion of the descriptive statistics and correlation tables. The discussion starts out describing events that took place in the US economy over the period of study and how the various independent variables at the banks changed over time. The discussion then goes into a correlation analysis over time of each of the independent variables with the dependent variable, next year's ROAA rank.

From 2005 to 2013 the US economy experienced a very severe recession brought on by the bursting of a credit fueled housing bubble. As the source of the credit, banks were at the center of the housing bubble and experienced immense stress with the result being that many banks failed and many other troubled banks were merged into healthier

banks. The severity of the stress experienced by banks is evident in the descriptive statistics of the industry in Table 2. Reflecting the level of consolidation, average bank assets approximately doubled in size over the period of review, as did the largest bank in the data set. Bank return on assets were volatile over the period starting at 1.14% in 2005 and falling to .03% in 2009 and then rebounding to .83% in 2012. As further evidence of the volatility in the market, when returns on assets fell to their lowest levels, the standard deviations of those returns were at their highest.

Table 2: Summary Statistics table showing mean values for each variable for each year

	2005	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
ROAA	1.14	1.10	0.94	0.33	0.03	0.35	0.62	0.83
Equity/Assets	10.74	11.08	11.34	10.91	10.63	10.59	10.97	11.00
Loan Loss Reserve/Gross Loans	1.42	1.39	1.37	1.54	1.83	1.95	1.94	1.86
Liquidity Ratio	24.93	23.84	22.69	21.97	25.75	27.47	30.13	31.98
Non-Interest Expense/Assets	3.30	3.35	3.37	3.41	3.40	3.32	3.25	3.19
Efficiency Ratio	64.44	65.82	68.40	73.83	77.40	74.63	72.98	71.63
Ln Assets	11.80	11.86	11.90	11.97	12.01	12.04	12.09	12.16
Ln Asset^2	140.91	142.35	143.44	145.04	146.03	146.57	147.86	149.56
Concentration Ratio	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02
Term Structure	1.29	0.20	0.19	2.23	3.79	3.51	3.31	2.24
GDP Growth Rate	2.97	2.41	1.31	-0.52	-2.78	2.49	1.77	2.61
ROA Rank	2.99	2.99	3.00	2.99	2.99	2.99	2.99	2.99

Table 3: Summary Statistics table showing standard deviation values for each variable for each year

	2005	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
ROAA	1.11	1.29	1.29	1.93	1.98	1.69	1.36	1.17
Equity/Assets	4.86	5.02	5.07	4.63	4.59	4.50	4.21	4.11
Loan Loss Reserve/Gross Loans	1.26	1.25	1.47	1.54	1.77	1.40	1.40	1.55
Liquidity Ratio	30.47	23.07	18.75	17.84	86.92	22.50	19.48	26.65
Non-Interest Expense/Assets	2.86	3.51	4.31	4.71	4.28	4.24	3.69	1.88
Efficiency Ratio	24.26	20.82	23.00	30.72	31.82	28.55	25.40	22.83
Ln Assets	1.32	1.33	1.32	1.32	1.31	1.30	1.31	1.33
Ln Asset^2	33.37	33.86	33.70	33.92	33.82	33.66	34.22	34.83
Concentration Ratio	0.25	0.27	0.29	0.30	0.29	0.30	0.31	0.31
Term Structure	0.09	0.13	0.12	0.21	0.14	0.09	0.08	0.07
GDP Growth Rate	1.24	1.58	1.22	1.13	1.13	0.66	0.96	1.29
ROA Rank	1.41	1.41	1.41	1.42	1.42	1.42	1.41	1.42

Other variables that showed volatility over the time period of analysis were the Liquidity Ratio, Loan Loss Reserve to Gross Loans and the Efficiency Ratio. The volatility in the Liquidity Ratio shows up in the standard deviation of the ratio over time. In 2009 the standard deviation ballooned out to 87%. In 2008 and 2009, financial markets experienced a liquidity crunch with many financial institutions trying to become as liquid as possible by selling longer assets and purchasing shorter assets. The variability in their success to become more liquid is reflected in the large standard deviation.

In addition to the liquidity crunch, banks also realized significant levels of credit write offs from loans that had gone bad. This can be seen in the average Loan Loss Reserve to Gross Loans over the time period. The ratio started at 1.42% in 2005 and gradually increased over the time period peaking at 1.95% in 2010. The ratio increased by about 37% over that time period.

The evidence of reduced bank income from increased liquidity and credit write offs is not only apparent in the reduced ROA ratios, but also the Efficiency Ratio. The average efficiency ratio started at 64.44% in 2005 and trended up until 2009 peaking at 77.40% before starting to trend back down to 71.63% in 2012.

Not all of the ratios were volatile over the period though. The average equity to assets remained relatively flat over the time period at approximately 11%. The average noninterest expense to assets in 2005 was 3.30% and gradually increased peaking in 2008 at 3.41% before starting to gradually decline to 3.19% in 2012. The standard deviation in noninterest expense to assets did show some volatility in that it started in 2005 at 2.86%, increased to 4.71% in 2008 and then declined to 1.88% in 2012.

Below is Table 4 which pulls out the results for each of the year ahead correlations for the ROA ranking and the other variables. For the purposes of reading this table, a negative correlation would result in a lower rank with a ranking of one being the top 20% of performers and a five being the bottom 20% of performers. Table 5 shows the correlation results for each of the variables with the Efficiency Ratio for each of the years under study.

Table 4: Summary Correlation table showing next year's ROA Rank with current year's variable

	ROAA	*Equity/ Assets*	*Loan Loss Reserve/ Gross Loans*	*Liquidity Ratio*	*Non-Interest Expense/ Assets*	*Efficiency Ratio*	*Ln Assets*	*Ln Asset*^{2}	*Concentration Ratio*	*Term Structure*	*GDP Growth Rate*
ROA Rank 2006	-0.50	-0.04	-0.02	0.04	0.01	0.38	-0.16	-0.15	-0.01	-0.08	-0.13
ROA Rank 2007	-0.49	-0.02	-0.04	0.00	0.02	0.50	-0.08	-0.07	0.01	-0.04	-0.15
ROA Rank 2008	-0.48	0.04	0.01	-0.11	0.04	0.44	0.07	0.08	0.02	0.01	-0.13
ROA Rank 2009	-0.55	-0.04	0.13	-0.19	0.05	0.47	0.10	0.10	0.01	-0.01	-0.13
ROA Rank 2010	-0.59	-0.16	0.19	-0.01	0.03	0.52	0.03	0.03	0.00	0.08	-0.12
ROA Rank 2011	-0.58	-0.17	0.26	-0.05	0.03	0.54	-0.04	-0.04	-0.01	-0.04	-0.14
ROA Rank 2012	-0.58	-0.18	0.19	0.01	0.03	0.56	-0.12	-0.11	-0.01	0.01	-0.19
ROA Rank 2013	-0.54	-0.15	0.08	0.08	0.10	0.57	-0.16	-0.15	-0.02	0.09	-0.11

Table 5: Summary Correlation table showing each variable's correlation with the current year Efficiency Ratio

	ROAA	*Equity/ Assets*	*Loan Loss Reserve/ Gross Loans*	*Liquidity Ratio*	*Non-Interest Expense/ Assets*	*Ln Assets*	*Ln Asset*^{2}	*Concentration Ratio*	*Term Structure*	*GDP Growth Rate*	*ROA Rank*
Efficiency Ratio 2005	-0.44	0.13	0.04	0.14	0.23	-0.22	-0.21	-0.02	0.03	0.00	0.38
Efficiency Ratio 2006	-0.61	0.15	0.03	0.10	0.26	-0.29	-0.27	-0.02	0.01	0.00	0.50
Efficiency Ratio 2007	-0.69	0.19	0.02	0.08	0.21	-0.26	-0.25	-0.02	0.03	-0.01	0.44
Efficiency Ratio 2008	-0.65	0.18	0.08	0.02	0.19	-0.21	-0.20	-0.02	-0.09	-0.05	0.47
Efficiency Ratio 2009	-0.67	-0.07	0.16	-0.01	0.14	-0.18	-0.18	-0.03	0.09	-0.01	0.52
Efficiency Ratio 2010	-0.71	-0.15	0.29	0.01	0.14	-0.18	-0.18	-0.03	-0.10	-0.16	0.54
Efficiency Ratio 2011	-0.72	-0.22	0.27	-0.03	0.16	-0.18	-0.17	-0.02	-0.07	-0.10	0.56
Efficiency Ratio 2012	-0.64	-0.20	0.19	0.02	0.31	-0.21	-0.20	-0.02	0.10	-0.01	0.57

Over the period of review, the previous year's ROA was mildly correlated with the next years rank. A higher ROA was thus associated with a better rank the next year.

Equity to assets was only slightly correlated with the subsequent year's rank. A higher Equity to Assets ratio was usually associated with a slightly better ROA. The opposite was only true in 2007 when a higher level of equity was slightly positively correlated with worse performance in 2008. Interestingly, the correlation between equity levels and next year's performance was close to zero from 2005 through 2008, but then the correlation increased to about -.16 for the remaining years. The increased correlation and the negative sign indicate that higher levels of equity were associated with better subsequent performance in the latter years of the study. This could be due to increased credit problems in the latter years and banks with higher levels of capital were better able to deal with those problems resulting in better performance.

The correlation between subsequent year rank and Loan Loss Reserves to Gross loans was close to zero between 2005 and 2007 but then increased to around .20 between 2009 and 2011. This can be interpreted as meaning that banks with higher levels of reserves were associated with a worse subsequent year performance. This outcome makes sense in the context of the housing bubble that had burst several years before and the high levels of losses banks were incurring.

The correlation results for the Liquidity ratio are quite interesting. The correlation between the Liquidity Ratio and return rank is at best weak. What is interesting though is that the correlation for 2009 was negative, while for most other years it was positive. Generally a bank that is more liquid is less profitable because it achieves the liquidity by holding shorter assets with little to no credit risk. Banks get paid to take on certain risks, and if a bank is avoiding those risks in order to be liquid, then it will earn less money. Thus a positive correlation between the Liquidity ratio and subsequent year's performance

makes sense. As mentioned previously, there was a major liquidity crunch in the United States in 2008 and 2009, which is reflected in the negative correlations for the middle years of the study. Banks that were more liquid in 2008 had better relative performance in 2009. The benefit though was only temporary as the correlation for 2010 was approximately zero.

The correlation between the Efficiency ratio and rank are mildly positively correlated through the time period. The correlation can be interpreted as banks with higher efficiency ratios (which are not good) are mildly correlated with worse relative performance. Interestingly, the related variable Non Interest Expense/Assets had a correlation that was positive and close to zero for all of the study. The higher correlation between the Efficiency ratio and next year's ROA rank and the almost zero correlation between Non Interest Expense/Assets suggests that next year's performance is driven more by the income component of the Efficiency ratio as opposed the expense component.

The correlation of the log of assets and the square of the log of assets with rank went from being slightly negative, to slightly positive during the crisis years and then slightly negative in 2012 and 2013. This means that large banks were associated with better returns at the beginning of the period, then were associated with worse returns during the crisis and after the crisis were again associated with better returns.

The correlation between the concentration ratio and subsequent performance is close to zero. Interestingly though, the sign on the ratio is similar to the signs found on the log of assets and the square of the log of assets, indicating that large banks with larger market shares are slightly correlated with better performance in the beginning of the period under review and the end of the period.

Of the macro variables, GDP Growth Rate consistently showed a mildly negative correlation with next year's performance. The correlation of Term Structure of interest rates with next year's performance was less clear. The correlation was close to zero and bounced from being a positive to a negative correlation. Being as these two variables would impact banks in seemingly similar ways, I am not surprised that they do not have a strong correlation with a bank's relative performance in subsequent years.

To sum the data description, over the period of study the US economy experienced a severe recession. Most of the independent variables saw significant changes during the recession; profitability dropped, average asset size and concentration levels increased. Capital levels were fairly constant over the period, but loan loss provisions increased over the period and liquidity ratios spiked up during the recession. The efficiency ratio and the non-interest expense ratio both got worse over the time period. The correlation analysis of the various independent variables with next year's ROA rank supported some of my prior beliefs about the relationship between the variables. The signs of ROAA, loan loss reserve to gross loans, non-interest expense to assets, efficiency ratio and the GDP growth rate were as I expected. The correlation between equity to assets and next year's ROA rank has a negative sign indicating that banks with higher levels of capital tend to perform better. This is in line with past research on the relationship between bank profitability and capital levels. The signs on the liquidity ratio, bank size, concentration and term structure of interest rates were both positive and negative over the period of study. The variability of the sign for the liquidity and concentration ratios is not entirely un-expected as past research is mixed as to the effect of the two variables on profitability. The bank size and term structure of interest rate signs are not as I expected though.

CHAPTER V

ECONOMETRIC METHOD

The multivariate statistical technique I used for this paper is the ordered logit model. Logistic regression models are used for estimating the probability of group membership of an independent variable by making a logistic transformation of a linear combination of dependent variables. I used an ordered logit model due to the dependent variable being a bank's relative quartile performance compared to all other commercial banks which is discrete and ordinal. In an ordered logit model, the dependent variable *y* represents ordered observations or in other words a ranking variable. In this case, the relative performance rank for each bank. The dependent variable is modeled by a latent variable *y** that has a linear relation with the vector of explanatory variable x_i as follows:

$$y^*_i = x'_i \boldsymbol{\beta} + \mu_i$$

Where μ_i is independently and identically distributed. The actual y_i is fitted from y^*_i where:

$$y_i = j \text{ if } \kappa_{j-1} < y^*_i \leq \kappa_j$$

The probability that observation i will select alternative j is:

$$p_{ij} = p(y_i = j) - p(\kappa_{j-1} < y^*_i \leq \kappa_j) = F(\kappa_j - x'_i \boldsymbol{\beta}) - F(\kappa_{j-1} - x'_i \boldsymbol{\beta})$$

For the ordered logit, F is the logistic cumulative distribution function $F(z) = e^Z/(1+e^Z)$. The sign of the parameters shows whether the latent variable *y** increases with the regressor.

As stated previously, the models were designed using common variables in the determinants of bank profitability literature. To test the ability of the efficiency ratio to predict future bank performance, three models for each of the years 2005, 2008 and 2011 were ran. The models were calibrated using data from 2005, 2008 and 2011 to predict the performance ranking of the banks in 2006, 2009 and 2012. The models were then tested with out-of-sample data from 2006, 2009 and 2012 to predict the performance rank in 2007, 2010 and 2013. Of the three types of models ran for each year, the first model contained all of the independent variables listed in Table 1 except for Non-Interest Expense, the second model included all of the variables except for the Efficiency Ratio, and the last model included both the Efficiency Ratio and Non-Interest Expense. For naming purposes, each model was named with a combination of the year of the data the model was calibrated with and the first letter of which variable was being reviewed. For instance, the model 2005E refers to the model that used 2005 data and had all of the independent variables listed in Table 1 except for the Non-Interest Expense variable, thus it was a review of the Efficiency variable. The model 2005NIE contained all of the independent variables in Table 1 except for the Efficiency Ratio and the model 2005B contained all of the independent variables including the Efficiency Ratio and Non-Interest Expense.

CHAPTER VI

MODEL RESULTS

Table 6 presents the empirical results of the estimation of the models for years 2005, 2008 and 2011. Table 7 shows the marginal effects of each variable. The marginal effect is the change in probability for a one unit change in the variable. Table 8 presents the in-sample and out-of-sample prediction performance for each of the models and years. The out-of-sample predictions were the outcomes for 2007, 2010 and 2013.

Overall model performance can be judged in two ways. The first is the Pseudo R^2 value for each model. The Pseudo R^2 value is a measure of the closeness of fit. A higher value indicates the model is a closer fit to the data. In comparing the three model types across all years, the rank of performance is consistent in that the model with both the efficiency ratio and non-interest expense to average assets had the highest Pseudo R^2 value, and the model with just the efficiency ratio had the next highest Pseudo R^2 value. The consistency of the results suggests that the inclusion of the efficiency ratio does improve the predictive ability of the models. The difference in the closeness of fit between all of the models is quite small though indicating that the improvement from including the efficiency ratio is only slight. A second measure of overall model performance is a rank performance for in-sample and out-of-sample data predictions.

Table 6: Ordinal Logistic Output

	2005E	2005NIE	2005B	2008E	2008NIE	2008B	2011E	2011NIE	2011B
ROAA	-2.248	-2.686	-1.964	-1.463	-1.717	-1.411	-2.255	-2.872	-2.084
	(39.12)**	(50.87)**	(33.22)**	(31.25)**	(46.46)**	(30.25)**	(31.50)**	(46.92)**	(28.43)**
Equity/Assets	-0.028	-0.045	-0.013	-0.009	-0.007	-0.006	-0.018	-0.032	-0.01
	(3.76)**	(6.12)**	-1.66	-1.2	-0.98	-0.84	-1.94	(3.55)**	-1.13
Loan Loss Reserve/Gross Loans	-0.092	-0.073	-0.073	0.146	0.109	0.182	-0.059	-0.08	-0.03
	(4.05)**	(2.84)**	(3.20)**	(4.36)**	(3.23)**	(5.32)**	(1.96)*	(2.67)**	-0.98
Liquidity Ratio	0.002	0.001	-0.003	-0.015	-0.016	-0.016	0.017	0.016	0.013
	-1.34	-0.77	(2.57)*	(8.93)**	(9.39)**	(9.51)**	(9.95)**	(9.59)**	(7.54)**
Efficiency Ratio	0.046		0.097	0.016		0.023	0.039		0.057
	(18.12)**		(25.79)**	(7.49)**		(9.56)**	(14.11)**		(16.46)**
Non-Interest Expense/Assets		-0.024	-0.705		-0.051	-0.135		0.022	-0.294
		-1.02	(18.92)**		(2.45)*	(6.11)**		-0.87	(8.61)**
Ln Assets	-0.046	-0.673	-0.147	-0.207	-0.436	-0.304	-0.94	-1.345	-0.917
	-0.23	(3.30)**	-0.72	-1.01	(2.11)*	-1.47	(4.28)**	(6.19)**	(4.17)**
Ln Assets^2	0.003	0.022	0.008	0.013	0.02	0.017	0.035	0.048	0.035
	-0.32	(2.77)**	-0.97	-1.64	(2.40)*	(2.14)*	(4.13)**	(5.67)**	(4.10)**
Concentration Ratio	-0.011	-0.021	-0.064	-0.155	-0.153	-0.182	-0.217	-0.237	-0.226
	-0.11	-0.21	-0.65	-1.82	-1.8	(2.12)*	(2.39)*	(2.61)**	(2.49)*
Term Structure	-0.766	0.108	-0.39	0.14	-0.054	0.102	1.823	1.493	1.647
	-1.85	-0.26	-0.95	-1.23	-0.48	-0.9	(5.53)**	(4.54)**	(4.97)**
GDP Growth Rate	-0.185	-0.204	-0.138	-0.101	-0.094	-0.091	-0.229	-0.198	-0.224
	(6.55)**	(7.26)**	(4.84)**	(4.89)**	(4.55)**	(4.39)**	(8.26)**	(7.18)**	(8.06)**
cut1_cons	-3.947	-11.079	-2.466	-2.138	-5.91	-2.663	-1.759	-9.069	-1.575
	(2.86)**	(8.28)**	-1.78	-1.5	(4.23)**	-1.86	-0.92	(4.88)**	-0.82
cut2_cons	-2.301	-9.45	-0.767	-0.695	-4.475	-1.217	-0.083	-7.401	0.115
	-1.67	(7.07)**	-0.55	-0.49	(3.20)**	-0.85	-0.04	(3.98)**	-0.06
cut3_cons	-1.004	-8.22	0.594	0.61	-3.18	0.095	1.403	-5.956	1.617
	-0.73	(6.15)**	-0.43	-0.43	(2.28)*	-0.07	-0.73	(3.21)**	-0.84
cut4_cons	0.437	-6.87	2.1	2.313	-1.48	1.808	3.295	-4.133	3.529
	-0.32	(5.15)**	-1.52	-1.62	-1.06	-1.26	-1.72	(2.23)*	-1.84
* p<0.05; ** p<0.01									
N	7021	7021	7021	6808	6808	6808	6080	6080	6080
LR chi2(12)	4982.38	4607.78	5345.55	4926.94	4876.61	4969.71	5429.79	5228.69	5512.28
Prob > chi2	0	0	0	0	0	0	0	0	0
Pseudo R2	0.2205	0.2039	0.2366	0.2248	0.2225	0.2268	0.2774	0.2672	0.2817

Table 7: Ordinal Logistic Output - Marginal Effects

	2005E	2005NIE	2005B	2008E	2008NIE	2008B	2011E	2011NIE	2011B
ROAA	0.204	0.252	0.180	0.144	0.169	0.138	0.219	0.277	0.201
Equity/Assets	0.003	0.004	0.001	0.001	0.001	0.001	0.002	0.003	0.001
Loan Loss Reserve/Gross Loans	0.008	0.007	0.007	0.014	0.011	0.018	0.006	0.008	0.003
Liquidity Ratio	0.000	0.000	0.000	0.001	0.002	0.002	0.002	0.002	0.001
Efficiency Ratio	0.004		0.009	0.002		0.002	0.004		0.006
Non-Interest Expense/Assets		0.002	0.065		0.005	0.013		0.002	0.028
Ln Assets	0.004	0.063	0.013	0.020	0.043	0.030	0.091	0.130	0.089
Ln Assets^2	0.000	0.002	0.001	0.001	0.002	0.002	0.003	0.005	0.003
Concentration Ratio	0.001	0.002	0.006	0.015	0.015	0.018	0.021	0.023	0.022
Term Structure	0.069	0.010	0.036	0.014	0.005	0.010	0.177	0.144	0.159
GDP Growth Rate	0.017	0.019	0.013	0.010	0.009	0.009	0.022	0.019	0.022

Table 8: Summary table of In-Sample and Out-of-Sample Model Prediction Results

	2005E In-Sample	2005 Out-of-Sample	2008 In-Sample	2008 Out-of-sample	2011 In-Sample	2011 Out-of-Sample
B	52.06%	42.51%	51.60%	47.11%	57.38%	27.05%
E	48.74%	36.01%	51.20%	45.68%	57.35%	25.73%
NIE	46.09%	46.71%	51.78%	50.97%	57.96%	26.48%

Table 8 presents each model's performance at correctly predicting a banks ROA rank for the in-sample data and out-of-sample data. For the in-sample data, most of the models were able to correctly predict a banks actual ROA rank in about 50% of the instances. The out-of-sample performance was a bit more varied with correct predictions ranging from a low of 25% to a high of 50%. The 2011 out-of-sample prediction performance dropped markedly from all of the other years. The sharp drop is due in large part to the changes in ROAA and term spread between 2011 and 2012. The typical bank ROAA improved significantly between 2011 and 2012 which resulted in the model predicting much better performance for the out-of-sample data. The 2011 models also showed an increase in the size of the term structure coefficient compared to previous years. The 2011 models all showed a relationship where a higher regional term spread was associated with a worse ROA rank. In 2012, term spreads shrank which similar to the change in ROAA resulted in the models predicting better performance for the out-of-sample data. This highlights a limitation of the model in that while the data was segmented into quintiles of performance, the model out-put is not segmented into quintiles of performance. In essence, the model is predicting future ROA rank relative to this year's ROA rank. Banks as a whole had much better performance numbers in 2012 than they had in 2011, thus the models all predicted the banks to be top quartile banks relative to the previous year's performance which is impossible.

Due to the similarity of performance by each of the models, it is difficult to assess which model did the best. The NIE model generally had the best prediction performance, and the E model had the worst performance. The difference in performance is slight though. The conclusion that can be drawn from the performance tables is that the efficiency ratio and non-interest expense to assets ratios appear to be inter-changeable in the models and thus do not explicitly support or reject the hypothesis that efficiency ratios are can be used to predict future bank performance.

Turning to analysis of the specific variables in the models, the efficiency ratio consistently has a positive sign and is statistically significant at the 1% level across all models and time periods. The outcome is what was expected and indicates that a bank with a higher efficiency ratio will have worse relative performance in the next period. This is consistent with how many market participants use the ratio and supports the hypothesis that the ratio can be used to predict future bank performance.

Interestingly, the non-interest expense ratio does not maintain the same sign across all models and all years. It is statistically significant at the 5% level across most of the years. In the NIE models, the sign on the non-interest expense to average assets coefficient is positive indicating that banks with higher levels of non-interest expense generally have a worse relative performance in the following year. This is as expected. However, when both the efficiency ratio and the non-interest expense ratios are included in the model, the sign on the non-interest expense coefficient is negative meaning that higher non-interest expense results in a better ROA rank which is counter intuitive. Both measures are attempts at measuring the cost efficiency of a bank. The opposing signs of the coefficients when they are both included can be interpreted similarly to the inclusion

of the natural log of assets and its square to determine if there is a non-linear relationship. The results suggest there is a non-linear relationship between ROA rank and measures of cost efficiency. Higher costs are typically associated with a worse rank, but at a certain level a bank that has a higher relative cost has a better relative rank. This could be due to banks that temporarily incur high costs due to say a restructuring or a recent merger, but the changes they made may result in the bank being more profitable relative to peers in the future. This finding suggests caution in broadly applying the notion that higher costs result automatically in lower profitability.

Turning to ROAA, the variable consistently has a negative sign, is economically meaningful and is statistically significant across all models in all time periods. This is consistent with expectations and past research. This implies that the most meaningful and consistent predictor of future performance of a bank is its current levels of profitability.

The equity to assets variable has a negative sign in all of the models. The variable is only statistically significant in the 2005 E and NIE model and the 2011NIE model. The economic impact of the variable is relatively small. The finding is in line with past research; however it is not what I expected. As a measure of leverage in a bank, I expected better future returns to be correlated to lower levels of equity. The negative sign on the coefficients indicate that banks with higher levels of equity do perform relatively better than banks with lower levels of equity.

The loan loss reserve to gross loans ratio had a negative sign in the 2005 and 2011 models, but had a positive sign in the 2008 models. The coefficient was statistically significant in all of the models at the 5% level except for the 2011E and 2011B models.

As a measure of credit risk, the negative sign can be interpreted to mean that banks with higher levels of reserves in 2005 and 2011 had better future ROA ranks and the positive sign in 2008 can be interpreted as meaning banks with higher reserves had a worse future ROA rank. In theory, banks book reserves when they have a reasonable expectation of credit losses. The positive sign in 2008 therefore makes sense in that banks that were expecting losses due to the deflating housing bubble were booking reserves and probably recognized those losses in 2009 and 2010. The negative sign in 2005 and 2011 could be an indicator of the level of accounting discretion banks have, and how they may use accounting rules to smooth earnings. By this I mean that banks could book excess reserves during periods of relatively low credit losses and ample earnings, only to reverse those reserves during periods when earnings are running below expectations thus smoothing earnings over time.

The liquidity ratio has a positive sign for the 2005 E and NIE models as well as all of the models in 2011. For the 2005B and 2008 models it had a negative sign. Except for the 2005 models, the variable is statistically significant at the 1% level. Economically, the coefficient had a relatively small impact. The sign change on the variable is interesting given what happened in the economy in 2008 and 2009. As stated before, the US economy was in the midst of a housing bubble collapse. One of the consequences was a liquidity crisis at the banks. The positive sign on the coefficient in 2005 and 2011 suggests that banks that maintain higher levels of liquidity performed worse than those that maintained less liquidity. In 2008 and 2009 though, banks wither higher levels of liquidity did better. The results seem to fit the economic headlines, but this variable along

with the loan loss reserve ratio demonstrate the changing nature of what variables are important to assessing future performance.

The natural log of assets coefficient has a negative sign across all models and years, and the natural log of assets squared has a positive sign across all models and years. Both are statistically significant in the 2011 models, the 2005 and 2008 NIE models and the natural log assets squared is statistically significant in the 2008B model. The negative sign on the natural log of assets implies that larger banks tend to have better relative performance, but beyond a certain size the outperformance declines. The results suggest that the relationship between size and performance is non-linear.

The Concentration ratio has a negative sign across all models and years and is only statistically significant at the 5% level in a few of the models. The negative sign indicates that the larger market share a bank has, the better its future relative performance. The economic impact of the variable is quite small though.

The sign on the term structure of interest rates fluctuates across the models and is only statistically significant in 2011. The fluctuating sign makes the interpretation of the variable quite difficult, indicating that it may not have been that important of a variable except for in 2011.

The GDP coefficient had a negative sign across all models and years and was also statistically significant in all models. The negative signed indicated that if a bank operated in a region that had higher GDP growth in a year, it typically outperformed other banks in the following year.

To sum the model results, the models do not provide evidence to reject the hypothesis that the efficiency ratio can be used to predict future bank performance. The evidence to use the ratio is weak though in that the measures of fit and out-of-sample prediction performance were not that much greater for models that included the ratio compared to the model that excluded it. The ROAA variable appears to be a more useful indicator of a banks future performance.

CHAPTER VII

CONCLUSION

In this paper, I specified an empirical framework to predict future bank relative performance using bank specific, industry specific and macroeconomic determinants of profitability commonly accepted to in the literature of U.S. commercial banks. In particular, my goal was to investigate the efficiency ratio to determine if it is a useful indicator of future bank performance. A novel feature of my paper is the use of an Ordered Logit model to predict future performance.

I found that the efficiency ratio can be used to predict a bank's future performance, and that the typical way the ratio is analyzed by market participants is correct. Typically a bank with a higher efficiency ratio will perform worse relative to the other banks in the following year. I also found that focusing exclusively on the expenses portion of the efficiency ratio can be miss-leading. When both the efficiency ratio and the non-interest expense to average assets ratios were included in the models, the sign on the efficiency ratio was positive indicating higher ratios were associated with worse performance, and the sign on the non-interest expense ratio was negative indicating that a higher ratio was associated with better future performance. The implication is that banks that are performance laggards might do better to focus on enhancing revenue as opposed to trying to cut costs.

The findings of my paper also show that while the efficiency ratio can be used to predict the future performance of a bank, it is not the best indicator. The best indicator appears to be a bank's current return on average assets. This ratio had the largest economic impact in each of the models, maintained a consistent sign in all of the models, and was statistically significant at the 1% level in all of the models.

Overall, these empirical results do not reject the hypothesis that the efficiency ratio is a useful indicator of a bank's future performance even when controlling for other variables such as leverage, credit and liquidity risk, operational expenses, size, market share, the term structure of interest rates and growth in GDP. Banks however would be advised that when implementing strategies to improve their efficiency ratio they should not exclusively focus on expense reduction. Revenue enhancement, even if that means more expenses, appears to be at least equally if not more important.

APPENDICES

Appendix A
Additional Data Tables

Table 9: Correlation table using data from all years

Data from 2005 to 2012	*ROAA*	*Equity/ Assets*	*Loan Loss Reserve/ Gross Loans*	*Liquidity Ratio*	*Non-Interest Expense/ Assets*	*Efficiency Ratio*	*Ln Assets*	*Ln Asset²*	*Concentration Ratio*	*Term Structure*	*GDP Growth Rate*	*ROA Rank*
ROAA	1.00											
Equity/Assets	0.14	1.00										
Loan Loss Reserve/Gross Loans	-0.21	0.10	1.00									
Liquidity Ratio	0.03	0.35	0.14	1.00								
Non-Interest Expense/Assets	0.08	0.24	0.06	0.06	1.00							
Efficiency Ratio	-0.66	0.01	0.15	0.03	0.19	1.00						
Ln Assets	0.03	-0.15	0.02	-0.14	-0.05	-0.20	1.00					
Ln Asset^2	0.03	-0.13	0.03	-0.13	-0.04	-0.19	0.99	1.00				
Concentration Ratio	0.00	-0.01	0.02	0.01	0.00	-0.02	0.26	0.32	1.00			
Term Structure	-0.20	-0.04	0.15	0.05	0.00	0.14	0.07	0.06	0.00	1.00		
GDP Growth Rate	0.20	0.02	-0.02	0.05	0.01	-0.11	-0.03	-0.03	-0.01	-0.34	1.00	
ROA Rank	-0.51	-0.08	0.10	-0.01	0.04	0.48	-0.04	-0.04	0.00	0.00	-0.07	1.00

Table10: Correlation table with 2005 data

Data from 2005	*ROAA*	*Equity/ Assets*	*Loan Loss Reserve/ Gross Loans*	*Liquidity Ratio*	*Non-Interest Expense/ Assets*	*Efficiency Ratio*	*Ln Assets*	*Ln Asset²*	*Concentration Ratio*	*Term Structure*	*GDP Growth Rate*	*ROA Rank*
ROAA	1.00											
Equity/Assets	0.01	1.00										
Loan Loss Reserve/Gross Loans	0.01	0.21	1.00									
Liquidity Ratio	-0.09	0.48	0.14	1.00								
Non-Interest Expense/Assets	0.08	0.29	0.21	0.10	1.00							
Efficiency Ratio	-0.44	0.13	0.04	0.14	0.23	1.00						
Ln Assets	0.15	-0.17	-0.10	-0.19	-0.06	-0.22	1.00					
Ln Asset^2	0.14	-0.15	-0.09	-0.17	-0.06	-0.21	0.99	1.00				
Concentration Ratio	0.01	-0.01	-0.01	0.00	0.00	-0.02	0.27	0.32	1.00			
Term Structure	-0.02	-0.01	0.01	0.05	0.05	0.03	0.16	0.15	0.00	1.00		
GDP Growth Rate	0.00	0.03	0.04	0.03	0.06	0.00	0.16	0.15	0.00	0.74	1.00	
ROA Rank	-0.50	-0.04	-0.02	0.04	0.01	0.38	-0.16	-0.15	-0.01	-0.08	-0.13	1.00

Table 11: Correlation table with 2006 data

Data from 2006	*ROAA*	*Equity/ Assets*	*Loan Loss Reserve/ Gross Loans*	*Liquidity Ratio*	*Non-Interest Expense/ Assets*	*Efficiency Ratio*	*Ln Assets*	*Ln Asset*^{2}	*Concentration Ratio*	*Term Structure*	*GDP Growth Rate*	*ROA Rank*
ROAA	1.00											
Equity/Assets	-0.01	1.00										
Loan Loss Reserve/Gross Loans	0.01	0.26	1.00									
Liquidity Ratio	-0.01	0.49	0.46	1.00								
Non-Interest Expense/Assets	0.08	0.27	0.08	0.08	1.00							
Efficiency Ratio	-0.61	0.15	0.03	0.10	0.26	1.00						
Ln Assets	0.13	-0.18	-0.11	-0.23	-0.06	-0.29	1.00					
Ln Asset^2	0.13	-0.16	-0.10	-0.21	-0.05	-0.27	0.99	1.00				
Concentration Ratio	0.01	-0.01	-0.01	0.01	0.00	-0.02	0.26	0.32	1.00			
Term Structure	0.02	0.00	0.00	0.06	0.03	0.01	0.16	0.15	0.00	1.00		
GDP Growth Rate	0.07	0.01	0.01	0.11	0.06	0.00	0.06	0.06	-0.01	0.71	1.00	
ROA Rank	-0.49	-0.02	-0.04	0.00	0.02	0.50	-0.08	-0.07	0.01	-0.04	-0.15	1.00

Table 12: Correlation table with 2007 data

Data from 2007	*ROAA*	*Equity/ Assets*	*Loan Loss Reserve/ Gross Loans*	*Liquidity Ratio*	*Non-Interest Expense/ Assets*	*Efficiency Ratio*	*Ln Assets*	*Ln Asset*^{2}	*Concentration Ratio*	*Term Structure*	*GDP Growth Rate*	*ROA Rank*
ROAA	1.00											
Equity/Assets	0.00	1.00										
Loan Loss Reserve/Gross Loans	-0.01	0.09	1.00									
Liquidity Ratio	0.05	0.44	0.15	1.00								
Non-Interest Expense/Assets	0.16	0.25	0.05	0.11	1.00							
Efficiency Ratio	-0.69	0.19	0.02	0.08	0.21	1.00						
Ln Assets	0.11	-0.19	-0.05	-0.30	-0.06	-0.26	1.00					
Ln Asset^2	0.10	-0.17	-0.04	-0.28	-0.05	-0.25	0.99	1.00				
Concentration Ratio	0.00	-0.01	0.00	0.01	0.00	-0.02	0.25	0.31	1.00			
Term Structure	-0.01	0.00	0.00	0.04	0.01	0.03	0.11	0.10	0.00	1.00		
GDP Growth Rate	0.10	0.03	0.04	0.13	0.06	-0.01	-0.05	-0.05	-0.02	0.14	1.00	
ROA Rank	-0.48	0.04	0.01	-0.11	0.04	0.44	0.07	0.08	0.02	0.01	-0.13	1.00

Table 13: Correlation table with 2008 data

Data from 2008	*ROAA*	*Equity/ Assets*	*Loan Loss Reserve/ Gross Loans*	*Liquidity Ratio*	*Non-Interest Expense/ Assets*	*Efficiency Ratio*	*Ln Assets*	*Ln Asset*^{2}	*Concentration Ratio*	*Term Structure*	*GDP Growth Rate*	*ROA Rank*
ROAA	1.00											
Equity/Assets	0.02	1.00										
Loan Loss Reserve/Gross Loans	-0.20	0.03	1.00									
Liquidity Ratio	0.12	0.45	0.09	1.00								
Non-Interest Expense/Assets	0.05	0.26	0.03	0.11	1.00							
Efficiency Ratio	-0.65	0.18	0.08	0.02	0.19	1.00						
Ln Assets	-0.03	-0.22	0.04	-0.32	-0.04	-0.21	1.00					
Ln Asset^2	-0.03	-0.20	0.05	-0.30	-0.04	-0.20	0.99	1.00				
Concentration Ratio	0.00	-0.02	0.02	0.02	0.00	-0.02	0.25	0.30	1.00			
Term Structure	0.02	0.01	0.02	-0.04	0.00	-0.09	-0.08	-0.07	0.00	1.00		
GDP Growth Rate	0.07	0.03	0.05	0.07	0.04	-0.05	-0.14	-0.13	-0.02	0.13	1.00	
ROA Rank	-0.55	-0.04	0.13	-0.19	0.05	0.47	0.10	0.10	0.01	-0.01	-0.13	1.00

Table 14: Correlation table with 2009 data

Data from 2009	*ROAA*	*Equity/ Assets*	*Loan Loss Reserve/ Gross Loans*	*Liquidity Ratio*	*Non-Interest Expense/ Assets*	*Efficiency Ratio*	*Ln Assets*	*Ln Asset*^{2}	*Concentration Ratio*	*Term Structure*	*GDP Growth Rate*	*ROA Rank*
ROAA	1.00											
Equity/Assets	0.23	1.00										
Loan Loss Reserve/Gross Loans	-0.32	0.04	1.00									
Liquidity Ratio	0.01	0.34	0.12	1.00								
Non-Interest Expense/Assets	0.08	0.24	0.03	0.05	1.00							
Efficiency Ratio	-0.67	-0.07	0.16	-0.01	0.14	1.00						
Ln Assets	-0.06	-0.15	0.11	-0.07	-0.04	-0.18	1.00					
Ln Asset^2	-0.06	-0.13	0.12	-0.06	-0.04	-0.18	0.99	1.00				
Concentration Ratio	0.00	0.00	0.04	0.00	0.00	-0.03	0.26	0.32	1.00			
Term Structure	-0.09	0.05	0.05	0.01	0.04	0.09	0.25	0.24	0.01	1.00		
GDP Growth Rate	0.08	0.03	-0.01	0.00	0.03	-0.01	-0.04	-0.03	-0.01	0.38	1.00	
ROA Rank	-0.59	-0.16	0.19	-0.01	0.03	0.52	0.03	0.03	0.00	0.08	-0.12	1.00

Table 15: Correlation table with 2010 data

Data from 2010	*ROAA*	*Equity/ Assets*	*Loan Loss Reserve/ Gross Loans*	*Liquidity Ratio*	*Non-Interest Expense/ Assets*	*Efficiency Ratio*	*Ln Assets*	*Ln Asset*^{2}	*Concentration Ratio*	*Term Structure*	*GDP Growth Rate*	*ROA Rank*
ROAA	1.00											
Equity/Assets	0.28	1.00										
Loan Loss Reserve/Gross Loans	-0.42	0.06	1.00									
Liquidity Ratio	0.10	0.55	0.17	1.00								
Non-Interest Expense/Assets	0.07	0.22	0.04	0.12	1.00							
Efficiency Ratio	-0.71	-0.15	0.29	0.01	0.14	1.00						
Ln Assets	0.00	-0.10	0.11	-0.24	-0.04	-0.18	1.00					
Ln Asset^2	0.00	-0.08	0.12	-0.22	-0.04	-0.18	0.99	1.00				
Concentration Ratio	0.01	0.00	0.04	0.01	0.00	-0.03	0.27	0.33	1.00			
Term Structure	0.09	0.00	-0.12	-0.04	-0.02	-0.10	0.05	0.05	0.02	1.00		
GDP Growth Rate	0.15	-0.04	-0.15	0.00	-0.05	-0.16	-0.21	-0.20	0.00	0.50	1.00	
ROA Rank	-0.58	-0.17	0.26	-0.05	0.03	0.54	-0.04	-0.04	-0.01	-0.04	-0.14	1.00

Table 16: Correlation table with 2011 data

Data from 2011	*ROAA*	*Equity/ Assets*	*Loan Loss Reserve/ Gross Loans*	*Liquidity Ratio*	*Non-Interest Expense/ Assets*	*Efficiency Ratio*	*Ln Assets*	*Ln Asset*^{2}	*Concentration Ratio*	*Term Structure*	*GDP Growth Rate*	*ROA Rank*
ROAA	1.00											
Equity/Assets	0.37	1.00										
Loan Loss Reserve/Gross Loans	-0.30	0.06	1.00									
Liquidity Ratio	0.16	0.49	0.16	1.00								
Non-Interest Expense/Assets	0.09	0.17	0.05	0.06	1.00							
Efficiency Ratio	-0.72	-0.22	0.27	-0.03	0.16	1.00						
Ln Assets	0.05	-0.07	0.05	-0.26	-0.04	-0.18	1.00					
Ln Asset^2	0.05	-0.06	0.05	-0.24	-0.03	-0.17	0.99	1.00				
Concentration Ratio	0.01	0.00	0.03	0.01	0.00	-0.02	0.27	0.33	1.00			
Term Structure	0.04	0.02	-0.09	-0.05	-0.01	-0.07	0.07	0.07	0.02	1.00		
GDP Growth Rate	0.16	0.02	-0.07	0.15	0.00	-0.10	-0.16	-0.15	-0.02	-0.11	1.00	
ROA Rank	-0.58	-0.18	0.19	0.01	0.03	0.56	-0.12	-0.11	-0.01	0.01	-0.19	1.00

Table 17: Correlation table with 2012 data

Data from 2012	*ROAA*	*Equity/ Assets*	*Loan Loss Reserve/ Gross Loans*	*Liquidity Ratio*	*Non-Interest Expense/ Assets*	*Efficiency Ratio*	*Ln Assets*	*Ln Asset*^{2}	*Concentration Ratio*	*Term Structure*	*GDP Growth Rate*	*ROA Rank*
ROAA	1.00											
Equity/Assets	0.33	1.00										
Loan Loss Reserve/Gross Loans	-0.12	0.13	1.00									
Liquidity Ratio	0.09	0.49	0.12	1.00								
Non-Interest Expense/Assets	0.08	0.22	0.13	0.09	1.00							
Efficiency Ratio	-0.64	-0.20	0.19	0.02	0.31	1.00						
Ln Assets	0.11	-0.05	0.01	-0.21	-0.06	-0.21	1.00					
Ln Asset^2	0.10	-0.04	0.01	-0.19	-0.05	-0.20	0.99	1.00				
Concentration Ratio	0.01	0.00	0.01	0.01	0.00	-0.02	0.28	0.34	1.00			
Term Structure	-0.07	0.01	0.00	-0.03	0.07	0.10	0.20	0.18	0.00	1.00		
GDP Growth Rate	0.08	-0.01	-0.03	0.10	0.03	-0.01	-0.06	-0.06	-0.02	0.23	1.00	
ROA Rank	-0.54	-0.15	0.08	0.08	0.10	0.57	-0.16	-0.15	-0.02	0.09	-0.11	1.00

Table 18: Summary Statistics table with data from all the years

Variable	Obs	Mean	Std. Dev.	Min	Max
ROAA	52397	0.67	1.56	-32.00	30.84
Equity/Assets	52397	10.91	4.66	-9.06	98.79
Loan Loss Reserve/Gross Loans	52397	1.65	1.48	0.00	100.00
Liquidity Ratio	52397	25.91	37.74	-2.05	6891.06
Non-Interest Expense/Assets	52397	3.33	3.80	0.01	302.48
Efficiency Ratio	52397	71.01	26.54	-1250.00	348.46
Ln Assets	52397	11.97	1.32	7.74	21.36
Ln Asset^2	52397	145.07	34.01	59.84	456.40
Concentration Ratio	52397	0.02	0.29	0.00	15.64
Term Structure	52397	2.05	1.35	0.07	4.22
GDP Growth Rate	52397	1.27	2.20	-4.80	5.80
ROA Rank	52397	2.99	1.41	1.00	5.00

Table 19: Summary Statistics with data from 2005

Variable	Obs	Mean	Std. Dev.	Min	Max
ROAA	7021	1.14	1.11	-15.00	26.00
Equity/Assets	7021	10.74	4.86	1.67	93.81
Loan Loss Reserve/Gross Loans	7021	1.42	1.26	0.00	57.14
Liquidity Ratio	7021	24.93	30.47	0.23	1566.90
Non-Interest Expense/Assets	7021	3.30	2.86	0.18	147.37
Efficiency Ratio	7021	64.44	24.26	-1250.00	314.15
Ln Assets	7021	11.80	1.32	7.74	20.80
Ln Asset^2	7021	140.91	33.37	59.84	432.74
Concentration Ratio	7021	0.01	0.25	0.00	12.54
Term Structure	7021	1.29	0.09	1.20	1.39
GDP Growth Rate	7021	2.97	1.24	1.30	4.90
ROA Rank	7021	2.99	1.41	1.00	5.00

Table 20: Summary Statistics with data from 2006

Variable	Obs	Mean	Std. Dev.	Min	Max
ROAA	6907	1.10	1.29	-32.00	29.00
Equity/Assets	6907	11.08	5.02	-0.15	94.25
Loan Loss Reserve/Gross Loans	6907	1.39	1.25	0.00	57.12
Liquidity Ratio	6907	23.84	23.07	0.00	1076.26
Non-Interest Expense/Assets	6907	3.35	3.51	0.04	163.51
Efficiency Ratio	6907	65.82	20.82	-250.00	310.19
Ln Assets	6907	11.86	1.33	7.79	20.90
Ln Asset^2	6907	142.35	33.86	60.75	436.91
Concentration Ratio	6907	0.01	0.27	0.00	12.36
Term Structure	6907	0.20	0.13	0.07	0.36
GDP Growth Rate	6907	2.41	1.58	0.90	5.70
ROA Rank	6907	2.99	1.41	1.00	5.00

Table 21: Summary Statistics with data from 2007

Variable	Obs	Mean	Std. Dev.	Min	Max
ROAA	6812	0.94	1.29	-17.53	26.16
Equity/Assets	6812	11.34	5.07	2.25	93.84
Loan Loss Reserve/Gross Loans	6812	1.37	1.47	0.00	100.00
Liquidity Ratio	6812	22.69	18.75	0.02	525.21
Non-Interest Expense/Assets	6812	3.37	4.31	0.03	231.39
Efficiency Ratio	6812	68.40	23.00	-250.00	339.62
Ln Assets	6812	11.90	1.32	7.91	21.00
Ln Asset^2	6812	143.44	33.70	62.59	441.00
Concentration Ratio	6812	0.01	0.29	0.00	13.15
Term Structure	6812	0.19	0.12	0.09	0.34
GDP Growth Rate	6812	1.31	1.22	0.10	3.60
ROA Rank	6812	3.00	1.41	1.00	5.00

Table 22: Summary Statistics with data from 2008

Variable	Obs	Mean	Std. Dev.	Min	Max
ROAA	6808	0.33	1.93	-23.73	29.29
Equity/Assets	6808	10.91	4.63	-4.57	95.17
Loan Loss Reserve/Gross Loans	6808	1.54	1.54	0.00	100.00
Liquidity Ratio	6808	21.97	17.84	-2.05	363.82
Non-Interest Expense/Assets	6808	3.41	4.71	0.04	302.48
Efficiency Ratio	6808	73.83	30.72	-102.53	345.63
Ln Assets	6808	11.97	1.32	8.03	21.28
Ln Asset^2	6808	145.04	33.92	64.44	452.87
Concentration Ratio	6808	0.01	0.30	0.00	15.64
Term Structure	6808	2.23	0.21	1.96	2.42
GDP Growth Rate	6808	-0.52	1.13	-2.40	0.90
ROA Rank	6808	2.99	1.42	1.00	5.00

Table 23: Summary Statistics with data from 2009

Variable	Obs	Mean	Std. Dev.	Min	Max
ROAA	6574	0.03	1.98	-24.52	29.69
Equity/Assets	6574	10.63	4.59	-5.32	98.79
Loan Loss Reserve/Gross Loans	6574	1.83	1.77	0.00	100.00
Liquidity Ratio	6574	25.75	86.92	0.25	6891.06
Non-Interest Expense/Assets	6574	3.40	4.28	0.01	300.70
Efficiency Ratio	6574	77.40	31.82	-82.79	345.72
Ln Assets	6574	12.01	1.31	8.08	21.21
Ln Asset^2	6574	146.03	33.82	65.33	449.88
Concentration Ratio	6574	0.02	0.29	0.00	14.54
Term Structure	6574	3.79	0.14	3.71	4.22
GDP Growth Rate	6574	-2.78	1.13	-4.80	-0.80
ROA Rank	6574	2.99	1.42	1.00	5.00

Table 24: Summary Statistics with data from 2010

Variable	Obs	Mean	Std. Dev.	Min	Max
ROAA	6318	0.35	1.69	-25.14	23.97
Equity/Assets	6318	10.59	4.50	-9.06	95.32
Loan Loss Reserve/Gross Loans	6318	1.95	1.40	0.00	49.84
Liquidity Ratio	6318	27.47	22.50	0.08	977.88
Non-Interest Expense/Assets	6318	3.32	4.24	0.13	294.51
Efficiency Ratio	6318	74.63	28.55	1.70	348.46
Ln Assets	6318	12.04	1.30	8.11	21.21
Ln Asset^2	6318	146.57	33.66	65.74	449.98
Concentration Ratio	6318	0.02	0.30	0.00	13.95
Term Structure	6318	3.51	0.09	3.39	3.76
GDP Growth Rate	6318	2.49	0.66	1.30	3.30
ROA Rank	6318	2.99	1.42	1.00	5.00

Table 25: Summary Statistics with data from 2011

Variable	Obs	Mean	Std. Dev.	Min	Max
ROAA	6080	0.62	1.36	-12.82	27.19
Equity/Assets	6080	10.97	4.21	-3.63	93.97
Loan Loss Reserve/Gross Loans	6080	1.94	1.40	0.00	60.34
Liquidity Ratio	6080	30.13	19.48	0.08	449.61
Non-Interest Expense/Assets	6080	3.25	3.69	0.25	258.64
Efficiency Ratio	6080	72.98	25.40	1.72	343.92
Ln Assets	6080	12.09	1.31	8.29	21.32
Ln Asset^2	6080	147.86	34.22	68.80	454.44
Concentration Ratio	6080	0.02	0.31	0.00	14.46
Term Structure	6080	3.31	0.08	3.24	3.53
GDP Growth Rate	6080	1.77	0.96	0.60	3.70
ROA Rank	6080	2.99	1.41	1.00	5.00

Table 26: Summary Statistics with data from 2012

Variable	Obs	Mean	Std. Dev.	Min	Max
ROAA	5877	0.83	1.17	-18.49	30.84
Equity/Assets	5877	11.00	4.11	0.04	94.30
Loan Loss Reserve/Gross Loans	5877	1.86	1.55	0.00	85.71
Liquidity Ratio	5877	31.98	26.65	1.60	1414.14
Non-Interest Expense/Assets	5877	3.19	1.88	0.19	57.37
Efficiency Ratio	5877	71.63	22.83	-105.18	343.97
Ln Assets	5877	12.16	1.33	8.17	21.36
Ln Asset^2	5877	149.56	34.83	66.75	456.40
Concentration Ratio	5877	0.02	0.31	0.00	14.26
Term Structure	5877	2.24	0.07	2.18	2.35
GDP Growth Rate	5877	2.61	1.29	1.60	5.80
ROA Rank	5877	2.99	1.42	1.00	5.00

APPENDIX B
In-Sample and Out-of-Sample Prediction Matrices

Table 27: In-Sample and Out-of-Sample Prediction tables for 2005 Models

In Sample Prediction Matrix for model 2005B

		Actual				
		1	2	3	4	5
Predicted	1	**1115**	159	104	36	15
	2	335	**363**	540	117	24
	3	59	197	**836**	297	65
	4	22	51	522	**627**	141
	5	33	35	170	446	**712**

Correctly Predicted 52.03%

Out of Sample Prediction Matrix for model 2005B

		Actual				
		1	2	3	4	5
Predicted	1	**834**	374	83	83	17
	2	212	**189**	550	379	53
	3	50	51	**388**	758	164
	4	24	29	180	**605**	527
	5	46	41	100	250	**920**

Correctly Predicted 42.51%

In Sample Prediction Matrix for model 2005E

		Actual				
		1	2	3	4	5
Predicted	1	**1135**	101	116	56	21
	2	388	**245**	557	167	22
	3	58	182	**824**	333	57
	4	24	58	576	**577**	128
	5	32	33	225	465	**641**

Correctly Predicted 48.74%

Out of Sample Prediction Matrix for model 2005E

		Actual				
		1	2	3	4	5
Predicted	1	**608**	578	41	111	53
	2	111	**246**	174	647	205
	3	28	58	**111**	723	491
	4	16	28	46	**475**	800
	5	28	41	29	212	**1047**

Correctly Predicted 36.01%

In Sample Prediction Matrix for model 2005NIE

		Actual				
		1	2	3	4	5
Predicted	1	**1195**	18	146	51	19
	2	423	**39**	669	228	20
	3	77	49	**866**	413	49
	4	26	33	673	**525**	106
	5	36	15	396	338	**611**

Correctly Predicted 46.09%

Out of Sample Prediction Matrix for model 2005NIE

		Actual				
		1	2	3	4	5
Predicted	1	**1186**	40	91	61	13
	2	357	**129**	599	286	12
	3	83	107	**741**	444	36
	4	43	76	638	**444**	164
	5	65	49	303	214	**726**

Correctly Predicted 46.71%

Table 28: In-Sample and Out-of-Sample Prediction tables for 2008 Models

In Sample Prediction Matrix for model 2008B

Predicted \ Actual	1	2	3	4	5
1	**956**	331	57	26	13
2	235	**693**	346	51	29
3	74	377	**587**	267	62
4	44	154	401	**498**	253
5	18	48	155	354	**779**

Correctly Predicted 51.60%

Out of Sample Prediction Matrix for model 2008B

Predicted \ Actual	1	2	3	4	5
1	**540**	518	175	49	53
2	74	**407**	591	194	52
3	15	119	**483**	541	138
4	7	41	199	**669**	395
5	7	16	60	233	**998**

Correctly Predicted 47.11%

In Sample Prediction Matrix for model 2008E

Predicted \ Actual	1	2	3	4	5
1	**953**	333	54	29	14
2	244	**672**	359	50	29
3	80	377	**585**	261	64
4	41	155	405	**502**	247
5	17	50	152	361	**774**

Correctly Predicted 51.20%

Out of Sample Prediction Matrix for model 2008E

Predicted \ Actual	1	2	3	4	5
1	**502**	512	207	60	54
2	62	**369**	604	227	56
3	11	94	**449**	597	145
4	6	30	188	**671**	416
5	7	13	52	230	**1012**

Correctly Predicted 45.68%

In Sample Prediction Matrix for model 2008NIE

Predicted \ Actual	1	2	3	4	5
1	**934**	355	53	27	14
2	236	**697**	333	61	27
3	70	378	**604**	247	68
4	40	147	409	**512**	242
5	17	47	136	376	**778**

Correctly Predicted 51.78%

Out of Sample Prediction Matrix for model 2008NIE

Predicted \ Actual	1	2	3	4	5
1	**694**	418	120	52	51
2	125	**534**	478	132	49
3	26	207	**556**	387	120
4	10	67	290	**600**	344
5	10	25	66	246	**967**

Correctly Predicted 50.97%

Table 29: In-Sample and Out-of-Sample Prediction tables for 2011 Models

In Sample Prediction Matrix for model 2011B

Predicted \ Actual	1	2	3	4	5
1	**840**	260	59	40	24
2	179	**698**	246	72	25
3	38	333	**571**	224	56
4	18	69	314	**633**	180
5	16	16	60	362	**747**

Correctly Predicted 57.38%

Out of Sample Prediction Matrix for model 2011B

Predicted \ Actual	1	2	3	4	5
1	**1108**	42	18	12	11
2	1047	**85**	13	8	7
3	784	342	**44**	12	16
4	273	585	217	**50**	31
5	95	208	297	269	**303**

Correctly Predicted 27.05%

In Sample Prediction Matrix for model 2011E

Predicted \ Actual	1	2	3	4	5
1	**846**	244	68	37	28
2	188	**680**	251	78	23
3	38	327	**586**	212	59
4	18	71	321	**630**	174
5	14	16	59	367	**745**

Correctly Predicted 57.35%

Out of Sample Prediction Matrix for model 2011E

Predicted \ Actual	1	2	3	4	5
1	**1114**	39	16	11	11
2	1072	**62**	14	6	6
3	894	250	**28**	10	16
4	381	566	146	**35**	28
5	113	272	295	219	**273**

Correctly Predicted 25.73%

2012 5877 5877

In Sample Prediction Matrix for model 2011NIE

Predicted \ Actual	1	2	3	4	5
1	**856**	244	59	37	27
2	162	**721**	242	69	26
3	37	303	**589**	231	62
4	18	66	316	**648**	166
5	14	15	69	393	**710**

Correctly Predicted 57.96%

Out of Sample Prediction Matrix for model 2011NIE

Predicted \ Actual	1	2	3	4	5
1	**1112**	39	20	8	12
2	1037	**90**	19	7	7
3	740	393	**38**	10	17
4	247	662	170	**43**	34
5	106	255	309	229	**273**

Correctly Predicted 26.48%

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