RISK BALANCING IN THE BANKING SECTOR

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Risk Balancing in the Banking Sector

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ABSTRACT

Policies to help banks reduce risks could have a null effect or completely opposite effect because firms exhibit a preferred risk level. The objective of this study is to evaluate the effects of risk balancing in the banking sector of the Northern Great Plains region of the USA. A panel model will be used to evaluate the effects of both business risk and financial risk of over 870 banks in the region. The Global Financial Crisis and bank policies will be taken into account. The banks will be separated into three separate population sectors to analyze the effects of different sectors.

Results indicate that the risk balancing hypothesis holds true in the banking sector. This is important to both bank managers and policy makers in efficient policy design. Policies to help reduce risk could have the unintended effect when policy makers fail to account for risk balancing hypothesis.

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CHAPTER I. INTRODUCTION

1.1. Introduction

Was the banking sector affected but the Global Financial Crisis of 2007 – 2009? If so, what were the effects? Did the banking sector address the Global Financial Crisis by reallocating their portfolio to balance the risk due the business and financial aspect of their business? Does the risk balancing hypothesis hold for the banking sector? This is an important issue especially to bank managers and policy makers. To analyze if banks reallocate their portfolio to balance risk, the risk balancing hypothesis will be tested to see if it holds true for the banking sector.

The risk balancing hypothesis suggest that banks, other businesses, and individuals have an equilibrium level of total risk they are comfortable with. Total risk is comprised of both business risk and financial risk. "Business risk is defined to be the risk inherent in the firm, independent of the way it is financed" (Gabriel and Baker 1980). Exogenous risks to the firm makeup business risk; such as customer loss risk and operating risks. While financial risk is the risk associated with leasing and borrowing, such as default on loans, or the added variability in cash flows. Risk balancing refers to the act of altering one of the types of risk opposite of the other to maintain the equilibrium level of total risk. An example is with a decrease in business risk, financial risk would increase, consequently remaining at equilibrium.
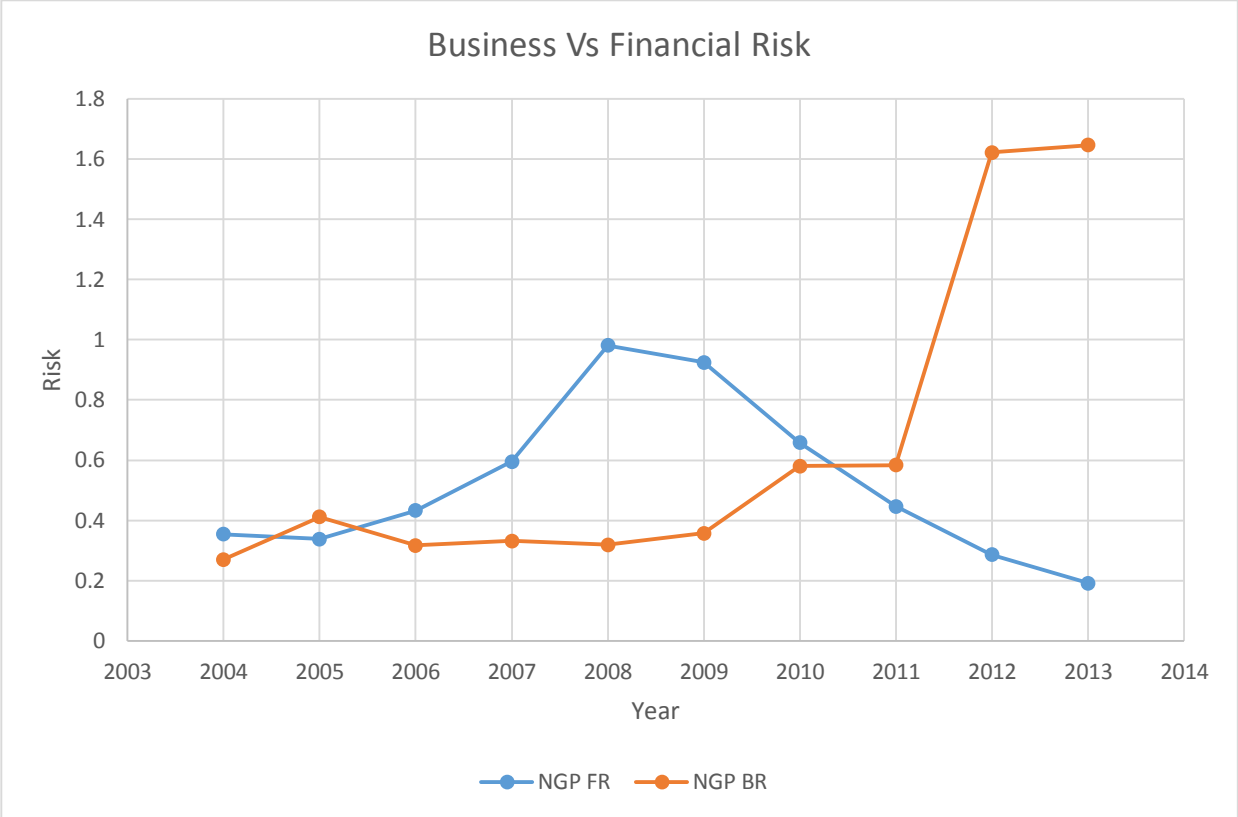
Figure 1.1. Business versus Financial Risk

As can be seen above, there is evidence that the risk balancing hypothesis could exist in the banking. From 2005 to 2008 financial risk is increasing, while business risk is decreasing. Again, from 2008 to 2013 financial risk is decreasing, but during the same time period business risk is increasing. Observations from the banking sector suggest that the risk balancing hypothesis could be present, and need to look further into this area of study. Traditionally, time series data has been used to analyze the risk balancing hypothesis. To the best of our knowledge, this is the first study using a panel model to analyze the risk balancing hypothesis in the banking sector.

This issue is of importance especially, as aforementioned, to policy makers and bank managers. Policy makers need to be aware of risk balancing to properly construct policies so that the policies have the intended effect. If a policy is set into place to mitigate risk, it may decrease one type of risk, but increase another type of risk, therefore not decreasing total risk at all. Bank

managers also need to be aware of risk balancing in the banking sector to determine if reallocating their portfolio to manage their risk is beneficial to them. If one bank reallocates their portfolio in a risk balancing manner, and outperforms a bank that does not. The underperforming bank needs to be aware of risk balancing and implement the strategy, if beneficial. Understanding risk taking behavior could greatly impact the performance if the banking sector.

The financial sector has always played an important role in society, from grain loans to farmers in Babylonia to more modern loans for people to buy a house or car. Why does the financial sector, banks in this case, make these loans? There are risks associated with lending money to someone else; most obvious is the risk of default, in which the borrower does not pay the loan back. The banks make money off interest to cover the banks opportunity cost of the money. Investigating what triggers banks to take on more risk and how they manage their risk will be addressed in this study. Does the saying of 'more risk, more reward' apply to banks in this setting? What happens when banks take on more risk than they can handle?

1.1.1. The Risk Balancing Hypothesis

My research topic is on the risk balancing hypothesis. Banks, other businesses, and individuals have an equilibrium level of total risk they are comfortable with undertaking or tolerating. Total risk is comprised of both business risk and financial risk. Risk balancing refers to the act of altering one of the types of risk opposite of the other to maintain the equilibrium level of total risk. An example is with a decrease in business risk, financial risk should increase. Different policies and regulations may alter the risk levels. Previous research has looked at the agriculture aspect of risk balancing. We will apply the risk balancing hypothesis to the banking sector to examine the impact of federal assistance to mitigate the Global Financial Crisis of 2007 – 2009.

1.1.2. Policy Effectiveness

During the Global Financial Crisis different policies were put into place to help stabilize the economy. It is extremely important to look into how policies set in place to stabilize the economy and mitigate risk may actually have no effect in reducing risk or the opposite effect in increasing total risk. Governments and policymakers need to be careful on how they make policies set to mitigate risk, so that they actually do reduce risk, and not have no effect or actually increase risk.

What lead to, or what are the causes of the Global Financial Crisis? There are multiple factors. The housing price bubble, mortgage backed securities, the "Too Big to Fail" mentality. One of the reasons though are banks risk management, or lack thereof. The purpose of this thesis is to look into how banks manage and mitigate their risk, before, during, and after the Global Financial Crisis.

1.1.3. Banking Sector

The banking sector is the cornerstone of our economy. Banks play an essential role in our economy and society. Providing millions of jobs in the United States as well as access to capital for families to buy a home or a car and allowing businesses to expand their operations and invest. Businesses and farms need to be able to borrow money to grow crops or buy inventory, invest in new technology, and expand their operation and output. A strong and confident banking industry is necessary for economic growth and independence.

From small town community banks that help fund and promote their community to large commercial banks that help fund our manufacturing and major businesses, we as a society could not live without banks. Banks play a fundamental role in our society. By lending money to help our economy expand and develop, banks take on risk; this risk may include default on loans or

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being late on payments. Managing these risks is the key to success in the banking sector. The risk balancing hypothesis suggests that businesses and banks have an equilibrium level of total risk. Total risk is comprised of both business risk and financial risk. Business risk and financial risk have an inverse relationship, hence the risk balancing. If financial risk increases business risk will decrease to maintain the equilibrium level.

Bank managers, policymakers, and governments all need to understand the effect of risk balancing occurring in the banking sector. Previous research about the risk balancing hypothesis suggests that business risk and financial risk are inversely related. Business risk is defined a few different ways; Gabriel and Baker suggest that "Business risk is defined to be the risk inherent in the firm, independent of the way it is financed. …. Generally it is reflected in the variability of net operating income or net cash flows" (Gabriel and Baker 1980). Whereas Collins (1985) describes "The variance of the return on assets or the rate of return on assets is commonly called business risk. … Business risk measures the risk exogenous to the firm." Gabriel and Baker alternatively describe financial risk as "the added variability of the net cash flows of the owners' equity that results from the fixed financial obligation associated with debt financing and cash leasing. … Financial risk encompasses the risk of cash insolvency." "A decline in business risk will lead to the acceptance if greater financial risk, reducing the effects of the diminished business risk on total risk" (Gabriel and Baker). In short financial risk is the risk associated with leasing and borrowing and business risk is all other risk inherent in the firm.

1.2. Objectives

Objective 1:

Understand how banks adjust their financial risk in response to changes in business risk, commonly known as the risk balancing hypothesis.

This forms the primary objective of the thesis. Specifically, test the risk balancing hypothesis in the banking sector using bank level data. Develop an appropriate measure of both business and financial risk. Use simple descriptive statistics to test the correlation between business and financial risk for different population sectors of banks.

Objective 2:

Develop a panel data framework to analyze if the risk balancing hypothesis is different for metropolitan, micropolitan, and rural banks.

Panel model analysis provides a more detailed analysis and offers more efficient coefficients. This is important to evaluate if one-size-fits-all policies are appropriate for metropolitan, micropolitan, and rural banks. Special care was taken to categorize the banks based on their zip code.

Objective 3:

Assess the effectiveness of polices to mitigate the Global Financial Crisis of 2007 – 2009.

This will be addressed by the use of a dummy variable for year in the data set to determine if the Global Financial Crisis had a lasting impact on banks. This will be useful to address how policies have had an impact on risk levels for banks. Analyze if the bailout policies increased or reduced total risk.

Objective 4:

Analyze the importance of value at risk in explaining the risk balancing hypothesis.

This will be addressed by the statistical significance of the value at risk variable in the model. This will show how effective the value at risk index is at capturing the risk balancing hypothesis in the banking industry.

1.3. Model

Due to the availability of individual bank data through time, a panel model will be used to determine the relationship between business and financial risk in the banking sector. The panel model accounts for potential variation across banks and through time. The panel model will examine the statistical relationship between financial risk, an endogenous variable and a set of exogenous variables. The exogenous variables include business risk along with value at risk, return on equity, return on assets, and cost of debt.

1.3.1. Data

The model used in this research will determine different interaction of both business risk and financial risk. This research will look at a five state region in the United States, the Northern Great Plains. The states included are Minnesota, Montana, Nebraska, North Dakota, and South Dakota. This is the region where I have been born and raised as well as attended school and pursued my education. Therefore, I decided to focus on this area for my study. These five states have common production practices. Agriculture is very important economic activity in all five states. Banking risks are similar between these five states as well. If all fifty states were included in the research, too much variability would be in the model to determine what causes business risk and financial risk to adjust.

The time period of the data is spanning ten years covering both before, during, and after the Global Financial Crisis. The years included are from 2001 to 2013. The banks in the data set will be sorted by zip code and converted to which county the bank resides in. County codes will be used to determine the type of community or area that the banks are in. These county codes are from the Census Bureau. Either metropolitan (urban), micropolitan (suburban) or rural; based on

a database of counties and population. The different regions will be analyzed and compared to each other to conclude if there are differences in the regions risk behavior.

1.4. Organization of Paper

The remaining portion of this paper will include a literature review of past research, alternative methods, and will discuss the Global Financial Crisis in detail in Chapter two. Chapter three will contain the methodology of both theoretical and empirical model being used in the analysis. The data being used will be addressed in greater detail in Chapter four. Chapter five will encompass the empirical results and findings of my analysis. Chapter six will hold the conclusion and final remarks regarding the risk balancing hypothesis in the banking sector.

CHAPTER II. LITERATURE REVIEW

2.1. Evolution of the Risk Balancing Hypothesis

My research topic is on the risk balancing hypothesis. Banks have an equilibrium level of total risk they are comfortable with tolerating. Total risk is comprised of both business risk and financial risk. Risk balancing refers to the act of altering one of the types of risk opposite of the other to maintain the equilibrium level of total risk. Different policies and regulations may alter the risk levels. Previous research has looked at the agriculture aspect of risk balancing.

The first paper written in the topic area of balancing risk in agriculture was written by Stephen C. Gabriel and C. B. Baker and was titled "Concepts of Business and Financial Risk" in 1980. They defined business risk to be the risk inherent in the firm, independent of the way the firm is financed. The identified two external sources of business risk, market risk and output risk. The first is the market, with price variability in both the input and output costs and also the risk of output quality. The second is the nature of the environment with which this is in; agriculture production has risk, with risk in yield and production. Weather is a factor in agriculture production that may be difficult to manage that has consequences to yield and quality. Financial risk is defined as the added variability of cash flows that results from fixed financial obligations with debt serviceability and also includes the risk of cash insolvency (Gabriel and Baker 1980).

For the model, it is assumed that both firm survival and profit maximization are the goals. Risk balancing refers to the adjustment in the components of total risk. There are mamy of different equations in the article leading to the final analysis done in the paper; they each build on one another. Linear regression was used in order to determine the coefficients. The data was aggregate income, net income, total assets, interest payments, total liabilities, and farmland price data from the USDA for the time period 1949 through 1976. The variables included are coefficient

of variation, interest rate divided by debt, return on assets, and percent change in land price. The results from this research found, that in the aggregate, farmers make financial adjustments which results in a decrease in financial risk in a response to an increase in business risk and vice versa. Due to the fact that this is the result from the aggregate and it may be that certain farmers or certain types of farmers may behave differently.

The conceptual framework about the risk balancing hypothesis is best understood by the decomposition of total risk, the sum of business risk and financial risk. Following Gabriel and Baker (1980) the total risk, TR can be written as:

$$
\begin{aligned}
TR &= \frac{\sigma}{NIBIT - i} \\
&= \frac{\sigma}{NIBIT} \, x \, \frac{NIBIT}{NIBIT - i} \\
&= \frac{\sigma}{NIBIT} + \frac{\sigma}{NIBIT} \, x \, \frac{i}{NIBIT - i} \\
&\equiv BR + BR \, x \, FD \\
&\equiv BR + FR \leq \beta
\end{aligned}
\tag{2.1}
$$

Where NIBIT is the net operating income before interest and taxes, σ is the standard deviation of NIBIT, and i is the interest payments. BR, FD, and FR represents business risk, financing decision, and financial risk respectively. β is the maximum amount of total risk that a firm can tolerate given firm's level of risk aversion. Equation (2.1) implies that the total risk, TR, consists of business risk, BR, which is equivalent to $\frac{\sigma}{NIBIT}$, and that financial risk, FR which is equivalent to $\frac{\sigma}{NIBIT} \, x \, \frac{i}{NIBIT-i}$ and that the total risk TR is bounded by some constant, β. An exogenous shock of business risk that disrupts Equation (2.1) can be mitigated through strategic adjustments in financing decision, FD which is equivalent to $\frac{i}{NIBIT-i}$ in order to restore the original equilibrium condition of Equation (1). Suppose there is no slack in Equation (1). In response to a rise in business risk, firm may reduce its financing decision to restore the original equilibrium

condition: $TR = \beta$, which may lead to a fall in financial risk. However, if there is a slack in Equation (1) due to firm's demographic attributes, such as low degree of risk aversion and risk management strategy of individual firms, a rise in business risk may not necessarily lead to a fall in finance decision. In this case, it is possible that financial risk may increase in response to increase in business risk.

Robert A. Collins proposes an alternative model from Gabriel and Baker. Collins's assumptions in his model are

1. The proprietor's objective is maximization of expected utility of rate of return on equity,

2. The utility function of wealth is negative exponential,

3. Normal distribution for rate of return for assets, and

4. Taxes are ignored.

He defines business risk as the variance of the return on assets. Collins used a more theoretical approach to the empirical model that Gabriel and Baker started (Collins 1985). Collins found equations that also build on each other and concluded that a decrease in business risk should lead to an increase in financial risk, holding other factors constant. This is supporting of what was first published by Gabriel and Baker. A decrease in business risk should produce an increase in financial risk, *ceteris paribus.*

Collins (1985) provides a theoretical explanation of the risk balancing hypothesis using the DuPont identity. Return on equity equals the profit margin multiplied by the total assets turnover ratio multiplied by the equity multiplier.

$$ROE = PM \ x \ TAT \ x \ EM \tag{2.2}$$

It also states the rate of return on equity equals the rate of return on assets time the equity multiplier:

$$\frac{r_p}{E} \equiv \frac{r_p}{A}\frac{A}{E} \qquad (2.3)$$

Where r_p the net expected return to the portfolio, E is the total equity, and A is the total assets.

On another note, another identity, A = D + E where D is the total debt can be written as:

$$\frac{A}{A} = \frac{D}{A} + \frac{E}{A}$$

Or

$$\frac{A}{E} = \frac{1}{1-\delta} \qquad (2.4)$$

Where $\delta = \frac{D}{A}$. Substituting Equation (2.4) into Equation (2.3), we have:

$$\frac{r_p}{E} = \frac{r_p}{A}\frac{1}{1-\delta} \qquad (2.5)$$

With an interest rate of i associated with the total debt D, the effect of the total debt on the rate of return on the total assets is $-\frac{iD}{E}$ or $-i\delta$. With an anticipated rate of increase if m associated with the total assets A, the effect of the asset inflation on the expected rate of return on assets is $\frac{mA}{A}$ or m. Incorporating these components, $-i\delta$ and m, Equation (2.5) becomes:

$$R_E = \left(\frac{r_p}{A} + m - i\delta\right)\frac{1}{1-\delta}, \qquad (2.6)$$

In which R_E is the net rate of return to equity. Let $R_A = \frac{r_p}{A} + m$. Then, Equation (2.6) becomes:

$$R_E = (R_A - i\delta)\frac{1}{1-\delta}. \qquad (2.7)$$

Notice that R_A represents a gross anticipated rate of return to the total assets A. Regarding R_A as a random variable with the mean $\overline{R_A}$ and variance σ_E^2, the expected value of the net rate of return

to equity, $\overline{R_E}$ can be written as:

$$\overline{R_E} = (\overline{R_A} - i\delta)\frac{1}{1-\delta} \tag{2.8}$$

Also, the variance of the net rate of return to equity, σ_E^2 can be written as:

$$\sigma_E^2 = \sigma_A^2 \left(\frac{1}{1-\delta}\right)^2 \tag{2.9}$$

In the mid-1990's, Barry M. Purdy, Michael R. Langemeier, and Allen M. Featherstone did research in the risk balancing field. Their research focused on Kansas farms, and hypothesized that the mean financial performance of the Kansas farms was dependent on various factors such as: risk, age of the farmer, percentage of acres owned, financial efficiency, leverage, specialization, and farm size. In this study to measure farm size the total acres operated is used, however it is not a perfect way to measure farm size as land type and quality may distort the data slightly (Purdy Langemeier & Featherstone 1997).

They derived different equations to calculate the mean return on equity for each farm and variance of return on equity for each farm. Data from 320 farms over the years of 1985 to 1994 was used in the study. Their results find that age of farmer, percent of acres owned, financial efficiency, and leverage were negatively correlated to financial performance while farm size was positively correlated. Specialization in swine, dairy, or crop production increased financial performance while specialization in beef production reduced financial performance. Farmers with both crop and livestock enterprises had less variation in the financial performance.

Douglas Allen and Dean Lueck (1998) did research on the trade-off between moral incentives and gains from specialization. They looked at over 1,000 farms in British Columbia and Louisiana and addressed the question of why family farms do not grow into larger factory style corporations. As larger corporations were more profitable, but there were more family farms than

corporate farms. Nature is random and also seasonal and the relationship between these may cause some moral hazard; nature may also reduce the gain one would receive from specialization. Their conclusion discovered that seasonality and randomness limits the benefits of specialization and that family farms are the optimal choice of farm style or set up, but if farms are successful in mitigating the seasonal and randomness risk, the farm would grow toward a more factory processes and corporate ownership (Allen & Lueck 1998).

Cesar Escalante and Peter Barry did a study about Illinois grain farmers and their correlation between business and financial risk. Their study tests how much of an impact demographic information and business growth strategies has on risk balancing. The study had two different time periods, one in the 1980s and one in the 1990s. The 1980s had a more liquidity constrained environment with higher interest rates which resulted in risk balancing plans with specialization and revenue increasing strategies. The 1990s brought a different approach as crop diversification and crop insurance plans were used to reduce risk (Escalante & Barry 2003). In this study the importance of firm demographic attributes as determinants of the correlation coefficient between the business and financial risk is shown. Their study uses panel data methodology to overcome the problems of omitted variables and unobservable heterogeneity among individual firms. A panel model enables them to control for firm's unobservable demographic attributes. To the best of our knowledge, this is the first study to apply a panel data methodology to testing the risk balancing hypothesis.

There are studies questioning whether previous research and papers have been too narrow to discover the true behavioral patterns, stating that the previous models have been too general and not specific enough for each type of operation. Farms that have failed need to be researched more

to determine what went wrong and what was ignored by the farmer that allowed the failure to occur (Just & Pope 2003).

The relationship between investor protection and corporate risk-taking of firms should be considered when looking into the risk balancing hypothesis. 39 countries' worth of manufacturing companies are used from 1992 to 2002 to analyze this relationship. The results determine that there is a positive relationship between risk taking and growth of firms. This means that if firms take on more risk, those firms will grow at a faster rate than the firms that do not. "Better investor protection lowers the expected level of private benefits causing insiders to be less risk averse" (John, Litov, & Yeung 2008). Stronger investment protections is associated with less corporate risk taking (John, Litov, & Yeung 2008).

"This example shows that the effect of changes in business risk on the variance of ROE may be negative or positive, and thus risk-reducing farm policies may not necessarily lead to more risk for farmer" (Cheng & Gloy 2008). Optimal debt level and consumption in farms with two sources of uncertainty; return on assets and interest rates. Different risk reducing policies has effects on a farms financial decisions and business decisions. As discovered previously, farm policies that help lead to a reduction in business risk may lead to an increase in financial leverage, total risk and expected returns (Cheng & Gloy 2008). These results are inconsistent with other research done.

The effects of the supply of risk management information and instruments available to the farmer and productivity are also relevant to look at. The amount of risk management information available to the farmer has an impact on productivity. According to Cornaggia, crop yield was increased with the availability of risk management tools. The impacts of additional supply of risk management were greater in areas with more banks, or access to more finance. This study

compared how much access or supply to risk management tools had on risk balancing (Cornaggia 2013).

The amount of federal crop insurance from 1990 to 2011 has risen dramatically. This has to do in part with the reform acts of 1994 and 2000 which increased subsidies to the crop insurance substantially (Glauber 2013). Also, disaster assistance it is not seen as a substitute to crop insurance but as a supplement. The program is relatively efficient and has transferred the benefits to the producers. Crop insurance used to be very complicated and there were different types that only covered certain farmers, certain types of farmers, or area of farmers. Now it is more generalized for more people. In the 1980s, crop insurance programs were criticized for low participation; about 25 percent of eligible acres were enrolled. In 2011, over 265 million acres were insured (Glauber 2013).

There may also be a harm associated with crop insurance which is that the premiums are highly subsidized by taxpayers. "The harm associated with subsidized crop insurance arises from the distortion brought about by what amounts to significant budgetary transfers from taxpayers to farms and private crop insurance companies" (Goodwin & Smith 2013). So much so that US federal crop insurance is the most costly form of intervention in agriculture markets. Removing all risk from the economy is a concern, as this would reduce innovation and growth (Goodwin & Smith 2013).

The relationship between executive board composition of members for banks and risk taking is also relevant to the risk balancing hypothesis. "We raise the question of how the composition of a banks' executive team affects risk taking" (Berger, Kick, & Schaeck 2014). The composition of board members included gender, age, education, and other attributes. To test the how board members of banks affect risk taking behavior several hypotheses are developed.

Hypothesis 1: Age Hypothesis: Portfolio risk decreases in board age.

Hypothesis 2: Gender Hypothesis: A higher representation of female executives reduces portfolio risk.

Hypothesis3: Education Hypothesis: A higher representation of better educated executives reduces portfolio risk.

The data is from 1994 to 2010 of German banks. A difference-in-difference estimation process was used to test the hypothesis 1, 2, and 3. The first hypothesis is confirmed through the results. The results for the second hypothesis are not statistically significant, suggesting that gender does not play a large role in risk taking behavior for banks. Female executives can affect bank management decisions to some extent; however almost all banks executive boards have a majority or males on the board, marginalizing the females' impact. The level of Ph.D. degrees were used to measure the education hypothesis. The presence of Ph.D. degrees reduces the risk in the banks' portfolio (Berger, Kick, & Schaeck 2014).

How the confidence and overconfidence of managers' leads to a firm taking on more risk is explained in a paper entitled *Managerial Overconfidence and Corporate Risk Management,* published in the *Journal of Banking & Finance*. The authors test the managerial overconfidence hypothesis by looking into 92 gold mining firms in North America and their quarterly reported hedge ratios from 1989 to 1999. The managerial overconfidence hypothesis is "managers credit themselves for successes while blaming outside factor for failures, cause managerial overconfidence to increase following successes but not commensurately decrease following failures" (Adam, Fernando, & Golubena 2015).   The results of their study found evidence to support the managerial overconfidence hypothesis. Financial success of past speculative decisions leads to managers becoming confident, eventually leading to the same managers to increase their

levels of speculation. However, losses do not reduce managers' level of confidence as they blame them on bad luck. This scenario is in a way similar to the risk balancing hypothesis, when mangers feel confident due to past transactions, they take on more risk, but when the risk leads to poor outcomes, managers divert the blame elsewhere.

Banking crises are quite costly and there is a large effort put forth to avoid them. The study using a daily banking sector indices to see the effect of different countries on other countries. 54 countries' banking data is used in the study where the Capital Asset Pricing Model (CAPM) framework is used. The results show that the Global Financial Crisis originated in the United States and then spread to other countries, through the global banking system where systemic risk is evident. "Banking sectors across the world were disturbed by the crisis and were not immune to contagion effects" (Dungey and Gajurel 2015). One of policy makers' goals is to avoid a banking crisis. They do this by setting domestic polices to set capital requirements of banks and to set leverage limits. However, international banks are out of domestic policy makers' control, therefore leading to a limit in the capabilities of policy makers. This is relevant to the risk balancing hypothesis by confirming that polices may not have any effect or no the intended effect that the policy was set in place to take control of in the first place.

2.2. Alternative Methods

In 2001 James H Stock and Mark W Watson wrote a paper entitled *Vector Autoregressions*. James H. Stock is the Roy E. Larsen Professor of Political Economy, John F. Kennedy School of Government, Harvard University, Cambridge, Massachusetts. While, Mark W. Watson is Professor of Economics and Public Affairs, Department of Economics and Woodrow Wilson School of Public and International Affairs, Princeton, New Jersey. This paper discusses the four things that macro-econometricians can do: describe data, make forecasts, quantify the structure of

the macro-economy, or advise policy makers. Vector auto-regressions (VARs) is the used in the paper. "A univariate autoregression is a single-equation, single-variable linear model in which the current value of a variable is explained by its own lagged values" (Stock and Watson 2001). VAR is an actual simple framework initial thought to "capture rich dynamics" in time series data with easy to interpret results.

Stock and Watson checked the accuracy and effectiveness of VAR on the four issues mentioned earlier. There are three varieties of VARs: reduced form, recursive, and structural. The data being used is macroeconomic data of unemployment rate, Federal Funds rate, and the inflation rate. Data description is tested using VAR. VAR results are widely accepted and used for showing co-movements in data, but VAR results may give misleading results if variables are highly persistent. VAR is not perfect for data description with another limitation being VAR may not determine if nonlinearities, heteroscedasticity, and drifts or breaks. To test the validity of VAR for the use in forecasting reduced form VAR is used. Inflation rate forecasts were for the average value of inflation, while for Federal Funds rate and unemployment were made for the final quarter of the period. VAR has better results with forecasting.

VAR is then used to test its accuracy in structural inference. The estimated effects of monetary policy on the unemployment and inflation rate depend on the Fed. VAR had a difficult time determining what caused what in this situation. Policy analysis was used to test VAR accuracy in detecting the policy's effectiveness. Again, VAR has difficulty in explaining causation and effectiveness in this type of situation. To sum up the results on how well VAR works at addressing these types of issues, "it depends."

"In data description and forecasting, VARs have proven to be powerful and reliable

tools that are now, rightly, in everyday use. Structural inference and policy analysis

are, however, inherently more difficult because they require differentiating between correlation and causation; this is the "identification problem" in the jargon of econometrics. This problem cannot be solved by a purely statistical tool, even a powerful one like a VAR. Rather, economic theory or institutional knowledge is required to solve the identification (causation versus correlation) problem" (Stock and Watson 2001).

2.3. Global Financial Crisis

The Global Financial Crisis that started in 2007 brought several challenges, especially to the financial sector. On February 27, 2007 the Federal Home Loan Mortgage Corporation (Freddie Mac) announced that the most risky subprime mortgage will no longer be bought. In April, New Century Financial Corporation, one of the leading subprime mortgage lenders, filed for Chapter 11 bankruptcy. Throughout 2007 Standard and Poor's and Moody's Investment Services downgraded bonds and securities. On February 13, 2008 President George W Bush signed the Economic Stimulus Act of 2008. JP Morgan Chase & Co. acquired Bear Stearns in March of 2008. In September 2008 Bank of America purchased Merrill Lynch & Co and Lehman Brothers Holding Incorporated filed for Chapter 11 Bankruptcy. On October 3, 2008 President George W Bush signed into law the Emergency Economic Stabilization Act of 2008, which established the $700 billion Troubled Asset Relief Program (TARP). PNC Financial Service Group Inc. purchased National City Corporation in October 2008 to create the fifth largest bank in the US.

2.3.1. Capital Purchase Program

During the financial crisis, the US Treasury stepped into the economy to help banks stay afloat. "The Capital Purchase Program (CPP) was launched to stabilize the financial system by providing capital to viable financial institutions of all sizes throughout the nation. Without a viable

banking system, lending to businesses and consumers could have frozen and the financial crisis might have spiraled further out of control" (Capital Purchase Program). Under CPP the US Treasury purchased preferred stock of banks; in total the US Treasury helped 707 financial institutions in 48 states. The banks that received the capital via preferred stock had to repay the treasury and taxpayers have already recovered more than the amount invested through this program. Over $228.5 Billion was spent on the Capital Purchase Program. Starting in October of 2008 with $125 Billion spent to purchase preferred stock of banks. The program's final investment was in December 2009. The banks that took the capital injection from the Treasury had to repurchase their stocks from the Treasury at market value. One of the reasons for this program is to hinder hostile takeover of United States banks from foreign investors. The program was partially in place to keep the American banks under American ownership and control.

On February 17, 2009 President Obama signed the American Recovery and Reinvestment Act of 2009 which cut taxes and increased certain government spending to help stimulate the economy. Insurance coverage of the FDIC increased from $100,000 to $250,000 per depositor, initially temporarily, but stayed long-term in May 2009. In July 2010 the Dodd-Frank Wall Street Reform and Consumer Protection Act was set to promote stability in the financial industry.

2.3.2. Economic Conditions

According to *Essentials of Investments,* "The Dow Jones Industrial Average (DJIA) of 30 large, "blue-chip" corporations has been computed since 1896. Its long history probably accounts for its preeminence in the public mind" (Bodie Kane & Marcus 2013). The DJIA uses a price weighted average approach to its calculation; which means that the percentage change in the DJIA

measures the return on a portfolio that invests one share in each of the 30 stocks in the index. One

would see large drop in the index during the financial crisis.
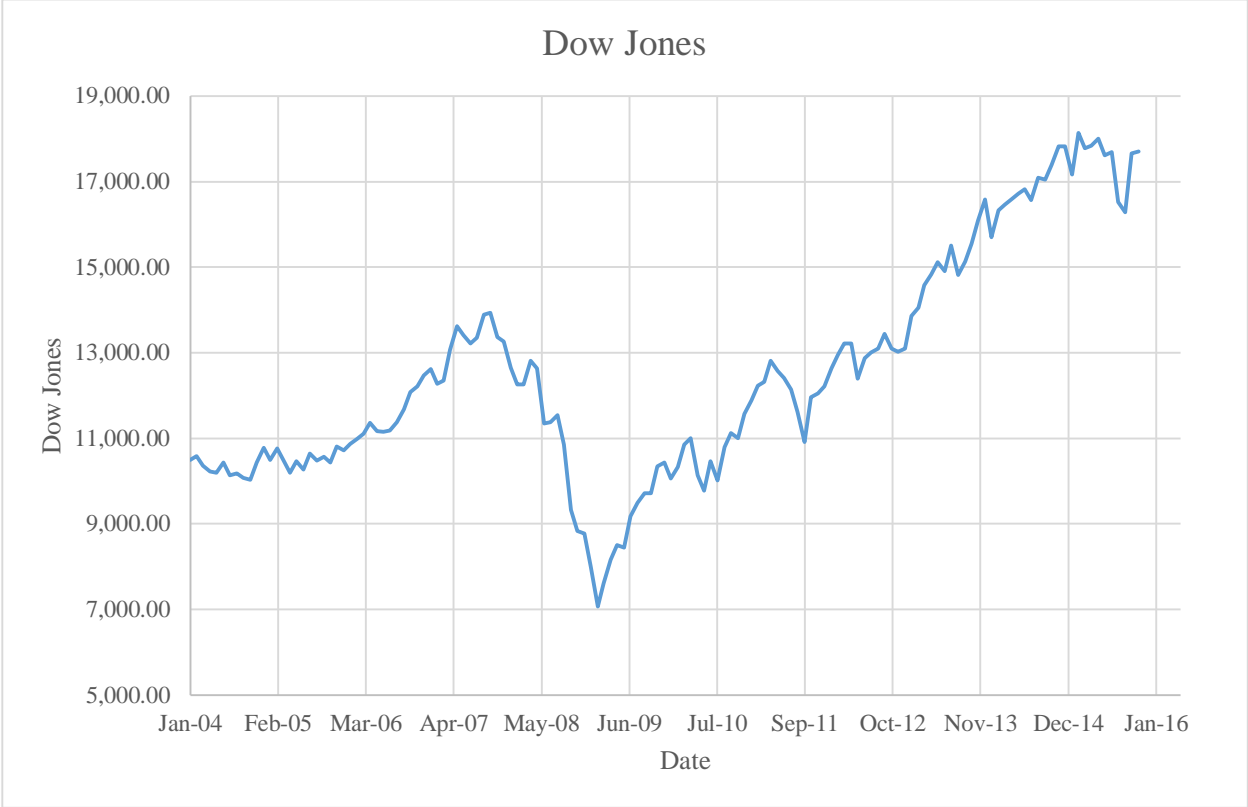
Figure 2.1. Dow Jones Industrial Average

Figure 2.2. S&P 500

According to the *Essentials of Investments,* "The Standard & Poor's Composite 500 (S&P 500) stock index represents an improvement over the Dow Jones average in two ways. First, it is a more broadly based index of 500 firms. Second, it is a market value-weighted index" (Bodie Kane & Marcus 2013). The S&P 500 is calculated by the total market value of 500 firms in the index. "The rate of return of the index equals the rate of return that would be earned by an investor holding a portfolio of all 500 firms in the index in proportion to their market value" (Bodie Kane & Marcus 2013). It is considered one of the best proxies for the overall economy. This figure of the S&P 500 shows the significance of the financial crisis in terms of the overall economic performance. Similarly to the Dow Jones, one can see the significant decline in 2007 during the start of the Global Financial Crisis. The Global Financial Crisis was not a small decline in the economy, rather it was a colossal issue and people and businesses were hurt.
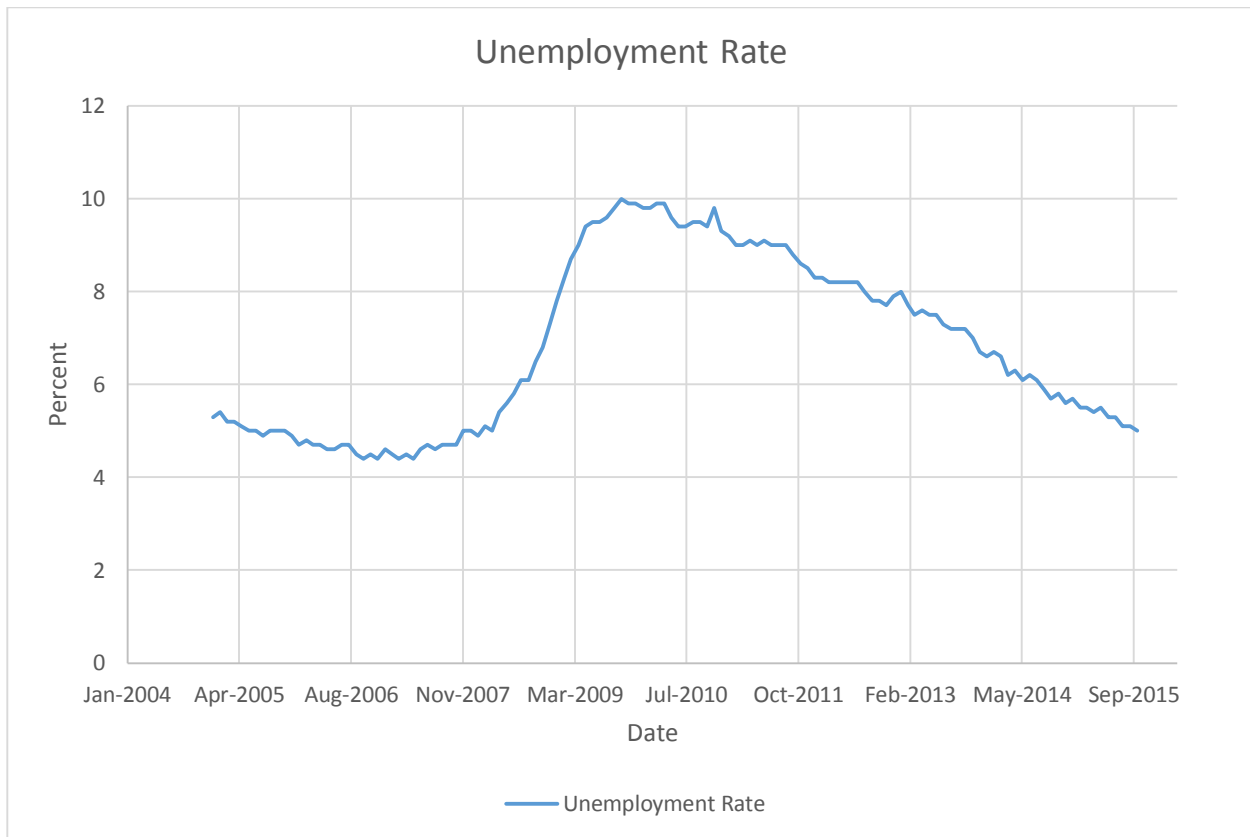
Figure 2.3. United States Unemployment Rate

This figure shows the unemployment rate of the United States of America from 2005 to 2015. The data is from the Bureau of Labor Statistics. From the ending of 2007 the unemployment rate started to increase; 4.6% in August 2007. The rate kept climbing through 2008 and into 2009 climaxing in October of 2009 at 10.0%, the highest rate in decades. The unemployment rate has been slowly decreasing. Still 9.0% in September 2011. It has improved though as the rate was 5.0 percent in October 2015; half the rate of six years prior.

2.3.3. Federal Reserve

The Federal Reserve can maintain the interest rate of the United States through the Federal Fuds Rate. The Federal Reserve has multiple tools in their toolbox to change the interest rate.
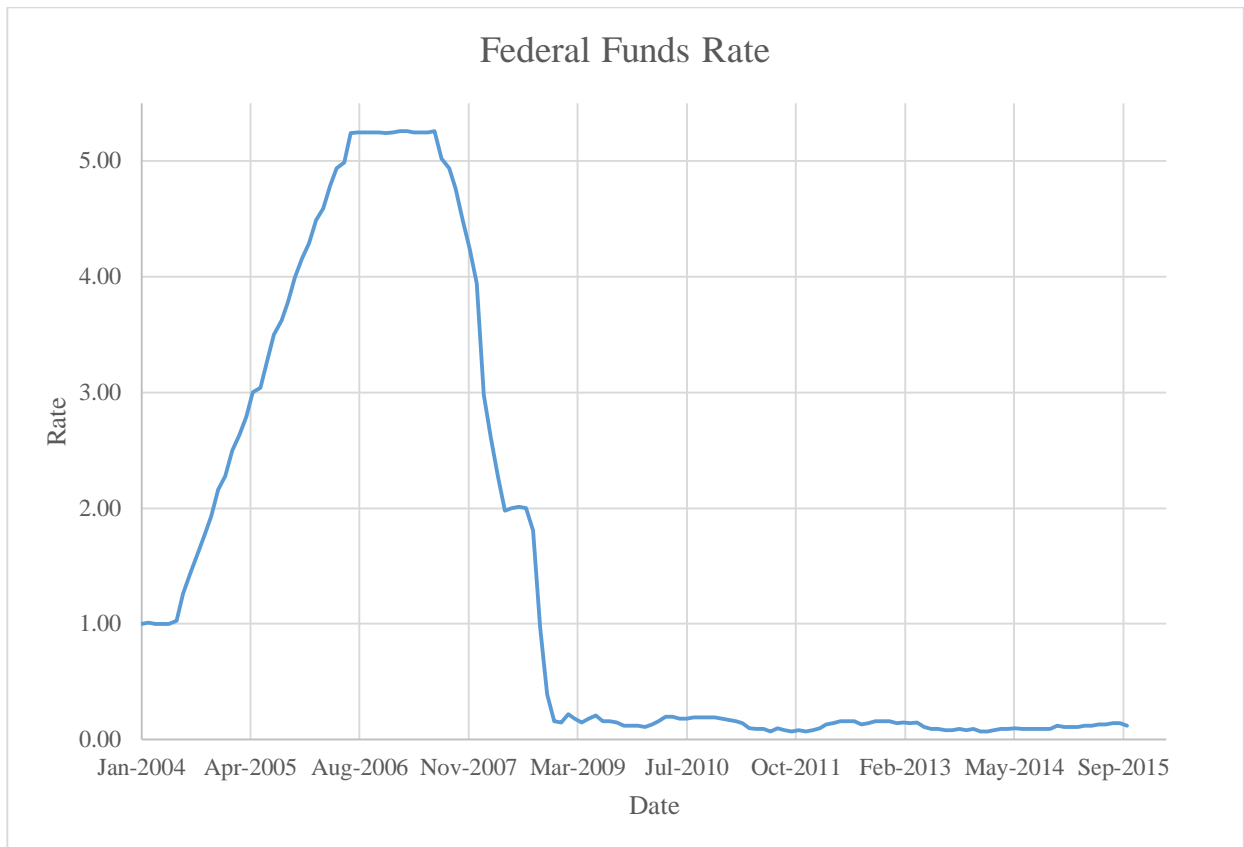
Figure 2.4. Federal Funds Rate

The federal funds rate is displayed in this figure, the data is from the Federal Reserve Bank of Saint Louis from their Federal Reserve Economic Data (FRED). According to the Federal Reserve

"The federal funds rate is the interest rate at which depository institutions trade federal funds (balances held at Federal Reserve Banks) with each other overnight. When a depository institution has surplus balances in its reserve account, it lends to other banks in need of larger balances. In simpler terms, a bank with excess cash, which is often referred to as liquidity, will lend to another bank that needs to quickly raise liquidity. (1) The rate that the borrowing institution pays to the lending institution is determined between the two banks; the weighted average rate for all of these types of negotiations is called the effective federal funds rate.

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(2) The effective federal funds rate is essentially determined by the market but is influenced by the Federal Reserve through open market operations to reach the federal funds rate target" (Effective Federal Funds Rate).

It is evident in the figure that the Federal Reserve lowered the interest rate during the financial crisis to help stimulate spending and growth; people are more willing to take out loans and buy things when the opportunity cost of their money is low, with low interest rates leading to low interest payments on loans. A decrease in interest rate, leads to consumer spending more, this is a simple example of risk balancing that the Federal Reserve implements. The Federal Reserve has kept interest rates near zero percent through 2015. Through all the turmoil and hostility of the financial crisis, business were reluctant to hire and as a result the unemployment rate rose significantly.

2.4. Review

The papers in general shared the idea that, a decrease in financial risk will result in an increase in business risk. How much of an impact that the change in business risk had on financial risk varied among the different articles. In the agricultural sector, specialization in different crops and livestock operations may help reduce risk. And different studies were done in different areas of the United States which gave similar results but had varying coefficients. Also, the coefficients for the impact of the change in one type of the risk to the other, financial to business, has slightly varied across time as well. VAR has been shown to have limited effect in structural inference and policy analysis. It has been shown that there are multiple reason for firms to take on more risk; the old saying of more risk leads to more return and the managerial overconfidence hypothesis. Policy makers do not have the best track record for polices set into place being 100% worthwhile or that they even work as intended. There are different reason for policies not working as designed;

one being forces outside of the policy makers' control taking control of the situation at hand, while another is that policy makers are not educated enough about the problem or situation and making policies that have side effects not thought of beforehand.

As can be seen the Global Financial Crisis had a colossal and lasting effect on the world's financial sector. During this time period financial risks of banks increased with larger risks of defaults from borrowers. This paper will determine if the increase in financial risk lead to a decrease in business risk during the same time span. Also, the policies made during that time period were meant to lower total risk; this study will analyze if the policies set into place only lowered one type of risk while raising another type of risk. To ensure that another financial crisis will not happen, we need to understand the risk balancing hypothesis and its effects on the banking sector. This will lead to better policies and bank mangers focusing efforts on keeping banks from making costly mistakes.

CHAPTER III. METHODOLOGY

3.1. Theoretical Analysis

The theoretical framework of the risk balancing hypothesis will be explained in full. Some of the framework was discussed lightly in the literature review, but will be discussed in greater detail here about what is applicable to my study and not others' research.

3.1.1. Theoretical Framework

Collins (1985) provides a theoretical explanation of the risk balancing hypothesis using the DuPont identity. Return on equity equals the profit margin multiplied by the total assets turnover ratio multiplied by the equity multiplier.

$$ROE = PM \ x \ TAT \ x \ EM \tag{3.1}$$

It also states the rate of return on equity equals the rate of return on assets time the equity multiplier:

$$\frac{r_p}{E} \equiv \frac{r_p}{A}\frac{A}{E} \tag{3.2}$$

In which r_p the net expected return to the portfolio, E is the total equity, and A is the total assets. From the DuPont Identity a balanced sheet must be balanced, A = D + E where D is the total debt, weighing by A yields:

$$\frac{A}{A} = \frac{D}{A} + \frac{E}{A}$$

Or

$$\frac{A}{E} = \frac{1}{1-\delta} \tag{3.3}$$

In which $\delta = \frac{D}{A}$. Substituting Equation (3.3) into Equation (3.2), we have:

$$\frac{r_p}{E} = \frac{r_p}{A}\frac{1}{1-\delta} \tag{3.4}$$

With an interest rate of i associated with the total debt D, the effect of the total debt on the rate of return on the total assets is $-\frac{iD}{E}$ or $-i\delta$. With an anticipated rate of increase if m associated with

the total assets A, the effect of the asset inflation on the expected rate of return on assets is $\frac{mA}{A}$ or

m. Incorporating these two components, $-i\delta$ and m, Equation (3.4) becomes:

$$R_E = \left(\frac{rp}{A} + m - i\delta\right)\frac{1}{1-\delta}, \tag{3.5}$$

In which R_E is the net rate of return to equity. Let $R_A = \frac{rp}{A} + m$. Then, Equation (3.5) becomes:

$$R_E = (R_A - i\delta)\frac{1}{1-\delta}. \tag{3.6}$$

Notice that R_A represents a gross anticipated rate of return to the total assets A. Regarding R_A as

a random variable with the mean $\overline{R_A}$ and variance σ_E^2, the expected value of the net rate of return

to equity, $\overline{R_E}$ can be written as:

$$\overline{R_E} = (\overline{R_A} - i\delta)\frac{1}{1-\delta} \tag{3.7}$$

Also, the variance of the net rate of return to equity, σ_E^2 can be written as:

$$\sigma_E^2 = \sigma_A^2 \left(\frac{1}{1-\delta}\right)^2 \tag{3.8}$$

Following Freund (1956), we consider the following firms' expected utility maximization

problem.

$$\max_{\delta}(C.E.) = \overline{R_E} - \frac{\rho}{2}\sigma_E^2,$$

Which is equivalent to:

$$\max_{\delta}(C.E) = (\overline{R_A} - i\delta)\frac{1}{1-\delta} - \frac{\rho}{2}\sigma_A^2\left(\frac{1}{1-\delta}\right)^2, \tag{3.9}$$

Where ρ is the firm's risk aversion parameter. Freund (1956) shows the expected utility

maximization solution δ^* can be obtained by solving the problem above. Collins' model suggests

that the degree of financial risk depends not only in business risk, but also the return on equity, the

interest rate, and the risk aversion parameter. The first order condition implies that the firm's optimal leverage position is:

$$\delta^* = 1 - \frac{\rho \sigma_A^2}{R_A - i}. \tag{3.10}$$

The second order condition requires $-\frac{\rho}{2} \sigma_A^2 < 0$, which is met if the firm is risk averse. Finally, we differentiate Equation (3.10) with respect to the business risk σ_A^2. It follows that:

$$\frac{\partial \delta^*}{\partial \sigma_A^2} = -\frac{\rho}{R_A - i}, \tag{3.11}$$

Which is negative as long as ρ and $\overline{R_A} - i$ are positive. Thus, the Collins (1985) theoretical model concludes that the risk balancing hypothesis holds as long as the firm's risk aversion parameter is positive and the interest rate of the total debt does not exceed the rate of return to the total assets. The result suggest that in order to test the risk balancing hypothesis, it is critically important to take into account the interest rate of total debt the rate of return to the total assets which are observable, and the firm's behavior towards risk which is unobservable. The existing literature fails to control for such unobservable individual effects. In order to overcome this problem, a panel model will be used, which allows to control for the unobservable individual effects.

3.2. Empirical Analysis

The methodology for this research will take the framework from previous research on risk balancing in the agricultural sector and apply it to the banking sector. Previous studies about the risk balancing hypothesis have suggested that business risk and financial risk have an inverse relationship. This study will look at bank data and determine what affects their business and financial risk and how business and financial risk affect each other. A panel model will be used to analyze the data. Panel modeling provides more efficient results. Here, the panel model be discussed in detail.

3.2.1. Panel Data Setting

We consider the following general linear equation for panel data setting.

$$FR_{j,t} = x'_{j,t}\beta + z'_j\gamma + \xi_j + \varepsilon_{j,t} \tag{3.12}$$

Where j=1,…J (cross-section unit) and t=1,…T (time-series unit). The basic assumptions about

Equation (3.12) are:

(i) $x_{j,t}$ is k x 1vector of time-varying repressors

(ii) z_j is g x 1 vector of time invariants (overall intercept included)

(iii) ξ_j vary over j but constant over time (individual effects)

(iv) $d_j \equiv \left(x'_{j,1}, \dots, x'_{j,T}, z'_j, \xi_j\right)'$is uncorrelated with $\varepsilon_{j,t}$ for all j and t

(v) $\varepsilon_j \equiv \left(\varepsilon_{j,1}, \dots, \varepsilon_{\varepsilon j,T}\right)'$are cross-sectionally independent and $\mathrm{E}\left(\varepsilon_j \middle| d_j\right) = 0_{Tx1}$ and

$Var\left(\varepsilon_j \middle| d_j\right) = \sigma_\epsilon^2 \, I_T$.

All of these assumptions must hold regardless of fixed effects model and random effects model.

In matrix notation, Equation (3.12) can be written as:

$$y_j = X_j\beta + 1_T z'_j\gamma + u_j; \ u_j = 1_T\xi_j + \varepsilon_j, \tag{3.13}$$

Where $y_i = \begin{pmatrix} y_{j,1} \\ \vdots \\ y_{j,T} \end{pmatrix}$, $X_j = \begin{pmatrix} x'_{j,1} \\ \vdots \\ x'_{j,T} \end{pmatrix}$, 1_T is T × 1 vector of ones, and $\varepsilon_j = \begin{pmatrix} \varepsilon_{j,1} \\ \vdots \\ \varepsilon_{j,T} \end{pmatrix}$.

The mean-operator P_T and deviation-from-mean Q_T is defined as follows.

$$P_T = T^{-1}1_T 1'_T = \begin{pmatrix} \frac{1}{T} & \frac{1}{T} & \cdots & \frac{1}{T} \\ \frac{1}{T} & \frac{1}{T} & & \vdots \\ \vdots & & \ddots & \frac{1}{T} \\ \frac{1}{T} & \cdots & \frac{1}{T} & \frac{1}{T} \end{pmatrix}, \tag{3.14}$$

And

$$Q_T = I_T - P_T = \begin{pmatrix} \frac{T-1}{T} & -\frac{1}{T} & \cdots & -\frac{1}{T} \\ -\frac{1}{T} & \frac{T-1}{T} & & \vdots \\ \vdots & & \ddots & -\frac{1}{T} \\ -\frac{1}{T} & \cdots & -\frac{1}{T} & \frac{T-1}{T} \end{pmatrix}. \tag{3.15}$$

Notice that: P_T and Q_T are idempotent matrices, $P_T y_j = \begin{pmatrix} \bar{y}_j \\ \vdots \\ \bar{y}_j \end{pmatrix}, Q_T y_j = \begin{pmatrix} y_{j,1} - \bar{y}_j \\ \vdots \\ y_{i,T} - \bar{y}_j \end{pmatrix}$,

$P_T Q_T = 0_{T \times T}, P_T 1_T = 1_T$, and $Q_T 1_T = 0_{T \times 1}$, where $\bar{y}_j = \frac{1}{t} \sum_t y_{j,t}$. Furthermore, define V, P_V,

and Q_V by:

$$V = I_J \otimes I_T = \begin{pmatrix} I_T & 0_T & \cdots & 0_T \\ 0_T & I_T & & \vdots \\ \vdots & & \ddots & 0_T \\ 0_T & \cdots & 0_T & I_T \end{pmatrix}_{JT \times J}, \tag{3.16}$$

$$\begin{aligned} P_V &= V(V'V)^{-1}V'' \\ &= I_J \otimes P_T, \end{aligned} \tag{3.17}$$

And

$$\begin{aligned} Q_V &= I_{JT} - P_V \\ &= I_J \otimes Q_T, \end{aligned} \tag{3.18}$$

In which $\otimes$ is a Kronecker product. By stacking X_j, z_j, and u_j, Equation (3.13) can be written as:

$$y = X\beta + VZ\gamma + u; \quad u = V\xi + \varepsilon, \tag{3.19}$$

Where $y = \begin{pmatrix} y_{1,1} \\ \vdots \\ y_{1,T} \\ \cdots \\ \vdots \\ y_{J,1} \\ \vdots \\ y_{J,T} \end{pmatrix}, X = \begin{pmatrix} x'_{1,1} \\ \vdots \\ x'_{1,T} \\ \cdots \\ \vdots \\ x'_{J,1} \\ \vdots \\ x'_{J,T} \end{pmatrix} X, \epsilon = \begin{pmatrix} \epsilon_{1,1} \\ \vdots \\ \epsilon_{1,T} \\ \cdots \\ \vdots \\ \epsilon_{J,1} \\ \vdots \\ \epsilon_{J,T} \end{pmatrix}, VZ = \begin{pmatrix} 1_T z'_1 \\ \vdots \\ 1_T z'_j \end{pmatrix}$ and $V\xi = \begin{pmatrix} 1_T \xi_1 \\ \vdots \\ 1_T \xi_J \end{pmatrix}.$

Notice that: P_V and Q_V are idempotent matrices, $P_V y = \begin{pmatrix} \bar{y}_1 \\ \vdots \\ \bar{y}_1 \\ \cdots \\ \vdots \\ \bar{y}_J \\ \vdots \\ \bar{y}_J \end{pmatrix}, Q_V y = \begin{pmatrix} y_{1,1}-\bar{y}_1 \\ \vdots \\ y_{1,T}-\bar{y}_1 \\ \cdots \\ \vdots \\ y_{J,1}-\bar{y}_J \\ \vdots \\ y_{J,T}-\bar{y}_J \end{pmatrix}'$

$P_V Q_V = 0_{JT \times JT}$, and $Q_V V = 0_{JT \times J}$.

3.2.2. Radom Effects Model

If ξ_j are random and not correlated with any other regressors, i.e. $E(\xi_j | x_{j,1}, \dots, x_{j,T}, z_j) = 0$ and $Var(\xi_j | x_{j,1}, \dots, x_{j,T}, z_j) = \sigma_\xi^2$ for all j, Equation (3.19) is called random effects model and can be estimated by GLS. Equation (3.19) can be written as:

$$y_i = X\beta + VZ\gamma + u$$
$$= H\delta + u \tag{3.20}$$

Where $H = (X, V Z)$ and $\delta = (\beta, \gamma)'$. Notice that it is necessary to do GLS to estimate δ efficiently in random effects model because $Var(u|H) = \sigma_\epsilon^2 \Omega \neq \sigma_\epsilon^2 I_{NT}$, where $\Omega = \theta^{-2} P_V + Q_V$ and $= \sqrt{\frac{\sigma_\epsilon^2}{T\sigma_\xi^2 + \sigma_\epsilon^2}}$. The GLS estimator of δ is $\hat{\delta}_{GLS} = (H'\Omega^{-1}H)^{-1} H'\Omega^{-1}y$ and θ which is included in Ω can be estimated as follows. We first calculate $\hat{s}_B^2 = \frac{\hat{v}'\hat{v}}{N-k-g}$ where $\hat{v} = P_V \hat{u}$ and $\hat{u}$ is the residual vector obtained by doing OLS on Equation (3.19). Then, the estimator of θ can be

obtained by $\widehat{\theta} = \sqrt{\frac{\widehat{s_W^2}}{\widehat{s_B^2}}}$. The variance of $\hat{\delta}_{GLS}$ is $Var(\hat{\delta}_{GLS}|H) = \sigma_\epsilon^2(H'\Omega^{-1}H) = \sigma_\epsilon^2(H'G_VH +$

$\theta^2 H'P_VH)^{-1}$ and it can be estimated by $\hat{s}_W^2(H'Q_VH + \hat{\theta}^2 H'P_VH)^{-1}$.

3.2.3. Fixed Effects Model

On the other hand, if ξ_j are random variables which are correlated with all the regressors, Equation (3.19) is called fixed effects model and can be estimated by within estimation. To this end, Equation (3.19) is multiplied by Q_V as follows.

$$
\begin{aligned}
Q_V y &= Q_V X\beta + Q_V VZ\gamma + Q_V u \\
&= Q_V X\beta + Q_V \epsilon.
\end{aligned} \tag{3.21}
$$

The within estimator of β can be obtained by doing OLS on Equation (3.20) i.e. $\hat{\delta}_W = (X'^{Q_V}X)^{-1}X'^{Q_V}y$. The variance of $\hat{\delta}_W$ is $Var(\hat{\delta}_W|X) = \sigma_\epsilon^2(X'Q_VX)^{-1}$ and σ_ϵ^2 can be estimated by $\hat{s}_W^2 = \frac{\hat{\epsilon}'Q_V\hat{\epsilon}}{N(T-1)-k}$.

According to Clark and Lizer in their 2014 journal article about the fixed and random effects model, they suggest that if the number of cross section identifiers, banks in this case, are more than the time series unit, years, in this study; then a fixed effects model is the appropriate model to use. This study looks at ten years of banking data across hundreds of banks. A fixed effects model is therefore justified.

3.3. Variables

The data consists of different measures and numbers from banks across a five state region in the United States these include; Minnesota, Montana, Nebraska, North Dakota, and South Dakota, over the time span of 2001 through 2013. The measures include total assets, total

liabilities, interest expense, net income, total taxes and other variables. The data can and will be then used to calculate different equations for business risk and financial risk.

3.3.1. Variable Explanation

Due to the availability of individual bank data through time, a panel model will be used to determine the relationship between business and financial risk in the banking sector. The panel model accounts for potential variation across banks and through time. The panel model will examine the statistical relationship between financial risk, an endogenous variable, and a set of exogenous variables. Research previously done with the agricultural sector, has used similar models to analyze the risk balancing hypothesis. Previous models have held one variable constant while altering the other. Thus, assuming an independent and dependent variable; using data along time to determine how one variable affects the other. Preceding research has found the relationship to be that the financial risk is the dependent variable and the business risk is the independent variable. The panel model equation will relate financial risk and business risk within a year over multiple years. The exogenous variables include business risk along with value at risk, as well as return on equity, return on assets, and cost of debt. The means used in the analysis are calculated by a four year moving average. This is used for coefficient of variation and standard deviation. This is why the analysis is only ten years. Years 2001, 2002, and 2003 do not have the mandatory three years previous to incorporate a four year moving average.

The banks will also be organized to see how both types of risk will change for different population areas, such as rural, micropolitan (suburban), and metropolitan (urban). Time will be incorporated into the model as well, to determine how the risk of banks has changed over time and also how financial and business risk has evolved both before and after the Global Financial Crisis of 2007 – 2009.

Table 3.1. Variable Description

Variable Name	Variable Description	Variable Measure
Financial Risk	Is the added variability of the net cash flows of the owners' equity that results from the fixed financial obligation associated with debt financing and cash leasing. The risk associated with borrowing and leasing.	$$FR = \frac{\sigma}{NIBIT} \times \frac{i}{NIBIT - i}$$ Where i is the interest payments. NIBIT is the net operating income before interest and taxes. σ is the standard deviation of NIBIT.
Business Risk	Is the risk inherent in the firm, independent of the way it is financed. Others risks associated with the firm. Will measure the change from the mean.	$$Coefficient\ of\ Variation = \frac{\sigma_A}{\bar{\Gamma}_A}$$ $$\sigma_A = \frac{\sqrt{\Sigma(x_i - \bar{x})^2}}{(N - 1)}$$ $$\bar{\Gamma}_A = average\ ROE$$
Cost of Debt	The interest payments divided by total liabilities is cost of debt. A measure of cost of capital.	$$COD = \frac{i}{Total\ Liabilities}$$ Where i is the interest payments
Return on Assets	This shows the net income generated for a firms' assets. It gives an idea to how efficient management is using its assets to generate earnings.	$$ROA = \frac{Net\ Income}{Total\ Assets}$$

Table 3.1. Variable Description (continued)

Variable Name	Variable Description	Variable Measure
Return on Equity	Measures a firms' profitability in comparison to the money shareholders have invested. The profits generated for the equity of a firm.	$ROE = \dfrac{Net\ Income}{Total\ Equity}$
Value at Risk	A measure of risk. This measures shows with 95% confidence the percent of return on equity that can be lost in a given year.	$VaR = \overline{ROE} + (-1.645 \times \sigma_{ROE})$
Dummy	A dummy variable for year, for before or after the Global Financial Crisis. 0 if before or during the crisis and 1 if after the crisis	2004 - 2008 = 0 2009 - 2013 = 1
BR-Dummy	Interaction Term for business risk	BR-Dum = BR x Dummy
VaR-Dummy	Interaction term for value at risk	VaR-Dum = VaR x Dummy

Table 3.2. Variable Summary

Variable Name	Expected Sign from Literature	Mean	Standard Deviation
Financial Risk	Dependent	0.485986639	1.350750824
Business Risk	-	0.927706969	3.297215726
Cost of Debt	+	1.382716578	2.229902398
Return on Assets	-	1.190971548	1.034999124
Return on Equity	-	11.16521999	6.13277937
Value at Risk	+/-	6.274895767	7.046515197
Dummy	-	0.46985447	0.49909042
Business Risk-Dummy	-	0.750861713	3.292764779
Value at Risk-Dummy	+/-	2.20485333	5.359577976

3.3.2. Expanded DuPont Analysis

The justification for the variables included in the analysis are because of the expanded DuPont Analysis.

$$ROE = PM \ x \ TAT \ x \ EM$$

Or

$$ROE = ROA \ x \ EM$$

The equity multiplier is a measure of financial leverage. A function of business risk, financial risk, cost of debt, and the value at risk measure, and year-dummy variable.

$$Equity \ Multiplier = f(c, FR, COD, BR_{Dummy}, VaR_{Dummy})$$

When examining this function through panel least squares model for the Northern Great Plains region this is the result in the table below.

Table 3.3. Equity Multiplier as a Function

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10.04345	0.13968	71.90444	0.00000
Financial Risk	-0.02311	0.01723	-1.34107	0.18000
COD	-0.15787	0.09467	-1.66755	0.09550
VaR-Dummy	-0.00302	0.00722	-0.41744	0.67640
BR-Dummy	0.00053	0.00011	4.71960	0.00000

The R-squared value in this model is 0.7821. Which is quite high, meaning that 78.21 percent of the variation in the equity multiplier can be explained by the model. Financial risk and the year dummy are statistically insignificant. While the constant, cost of debt, business risk, and value at risk are significant. This function capture almost 80% of the variation in the financial leverage. The model used in this study uses these same variables, meaning that the model captures almost 80 percent of the variation in financial leverage.

By substituting the above function of equity multiplier into the DuPont analysis one gets:

$$ROE = PM \ x \ TAT \ x \ f\left(c, FR, COD, BR_{Dummy}, VaR_{Dummy}\right)$$

Or

$$ROE = ROA \ x \ f\left(c, FR, COD, BR_{Dummy}, VaR_{Dummy}\right)$$

By moving around the variable the following equation can be equated:

$$FR = f\left(c, ROA, COD, BR_{Dummy}, ROE, VaR_{Dummy}\right)$$

Which results in:

$$FR = f\left(c, BR_{Dummy}, COD, ROA, ROE, VaR_{Dummy}\right)$$

This is the function for the analysis that will be used to calculate the relationship between business and financial risk in the banking sector.

3.4. Objectives

Objective 1:

Understand how banks adjust their financial risk in response to changes in business risk, commonly known as the risk balancing hypothesis.

This forms the primary objective of the thesis. Specifically, test the risk balancing hypothesis in the banking sector using bank level data. Develop an appropriate measure of both business and financial risk. Use simple descriptive statistics to test the correlation between business and financial risk for different population sectors of banks.

Objective 2:

Develop a panel data framework to analyze if the risk balancing hypothesis is different for metropolitan, micropolitan, and rural banks.

Panel model analysis provides a more detailed analysis and offers more efficient coefficients. This is important to evaluate if one-size-fits-all policies are appropriate for

metropolitan, micropolitan, and rural banks. Special care was taken to categorize the banks based on their zip code.

Objective 3:

Assess the effectiveness of polices to mitigate the Global Financial Crisis of 2007 – 2009.

The effectiveness will be addressed by an interaction term of Value at Risk – Dummy and Business risk – Dummy interaction variables. That will capture the effect of the policy on both business risk and Value at Risk, determine if the Global Financial Crisis had a lasting impact on banks. The impactfulness of policies on risk levels of banks will be addressed by the interaction terms. Analyze if the bailout policies increased or reduced total risk.

Objective 4:

Analyze the importance of value at risk in explaining the risk balancing hypothesis.

This will be addressed by the statistical significance of the value at risk variable in the model. This will show how effective the value at risk index is at capturing the risk balancing hypothesis in the banking industry.

3.4.1. Hypotheses

Hypotheses will be constructed to examine the objectives. Theses hypotheses will be described in the table below.

Table 3.4. Hypotheses Description

Hypothesis	Description	Measure
1	Financial risk and business risk are inversely related.	Coefficient on Business Risk
2	Different population sectors will have different risk taking behavior.	Compare coefficients across different population sector
3	Policies to reduce risk will affect different population sectors differently, in the same industry.	Assess the dummy variable coefficient and its significance
4	The Value at Risk index will be statistically significant in measuring the risk balancing hypothesis.	The p-value on the VaR variable

Hypothesis one will determine how firms adjust business risk to financial risk, or vice versa. This would suggest that if business risk decreases then financial risk would increase. Calculating the rate of change or impact will be important as well. This will be derived from the data and model to see how the two types of risks will vary.

Hypothesis two will determine if different population sectors of the Northern Great Plains have different risk taking behavior. The rural areas may be more risk adverse compared with the metropolitan. These will be tested by arranging the data to different population sectors.

Hypothesis three will analyze the Global Financial Crisis of 2007 – 2009 had an impact on the banking industry. The crisis led to a large recession in the United States and the world. Before 2007 banks may have been less risk adverse and more willing to take on risk and their financial risk may have been higher. After the Global Financial Crisis lessons may have been learned and banks would become more risk adverse. Policies were set into place to reduce risk, we will analyze if they worked. This will be examined by the model and will the dummy variable.

Hypothesis four will help understand if Value at Risk is an important index when looking at the risk balancing hypothesis. Value at Risk states with 95% confidence the percent of return on equity that can be lost within a year. It will analyzed through its statistical significance to measure the risk balancing hypothesis.

CHAPTER IV. DATA

4.1. Data

The data used in this analysis is from the Uniform Bank Performance Report. According to the Federal Financial Institutions Examination Council's (FFIEC) website, "The Uniform Bank Performance Report (UBPR) is an analytical tool created for bank supervisory, examination, and management purposes. In a concise format, it shows the impact of management decisions and economic conditions on a bank's performance and balance-sheet composition. The performance and composition data contained in the report can be used as an aid in evaluating the adequacy of earnings, liquidity, capital, asset, and liability management, and growth management. Bankers and examiners alike can use this report to further their understanding of a bank's financial condition, and through such understanding, perform their duties more effectively" (FFIEC UBPR Home Page).

4.1.1. Panel Data

According to *Econometric Models and Economic Forecasts,* panel data is one that includes a sample of individuals (banks) over a period of time. "As a result it may include numerous observations in each individual in the sample. A panel data set can be useful because it allows the researcher to sort out economic effects that cannot be distinguished with the use of either cross-section or time-series data alone" (Pindyck and Rubinfeld 1998). That is exactly the case in this analysis. Data in the Uniform Bank Performance Report are listed from 2001 until 2013, totaling 13 years. The data set contains the information on 8,857 banks in the United States of America, with each bank reporting quarterly and having 602 different ratios or data points associated with it, from accumulated other comprehensive income to undivided profits – capital reserves, it is a large data set. A four year moving average will be used to help calculate the variable in the model.

Due to this fact, years 2001, 2002, and 2003, each without three years previous, will not have their own data reported. Years 2004 through 2013 will be used in the analysis due to this.

4.2. Northern Great Plains

For sake of this study not the entire nation will be looked at but merely a five state region. The region being studied is the Northern Great Plains region that consists of Minnesota, Montana, Nebraska, North Dakota, and South Dakota, the highlighted states in the map.
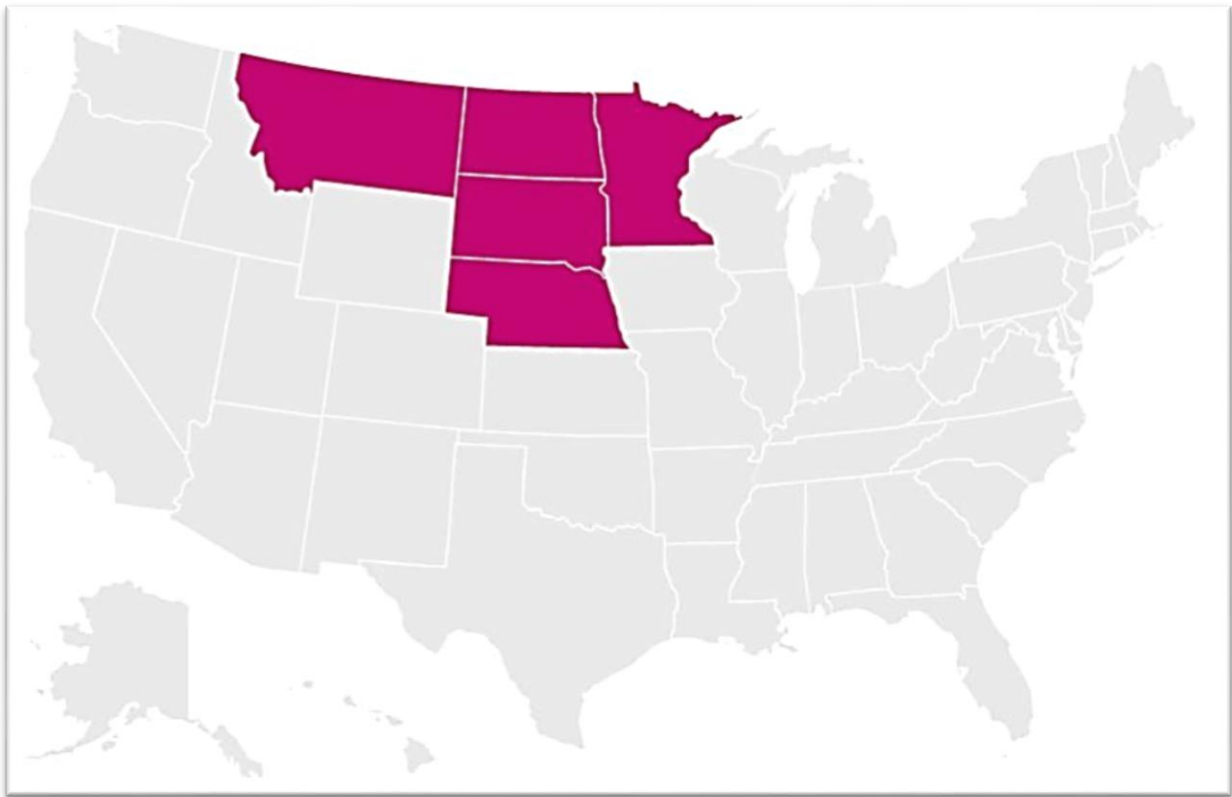
4.2.1. Location
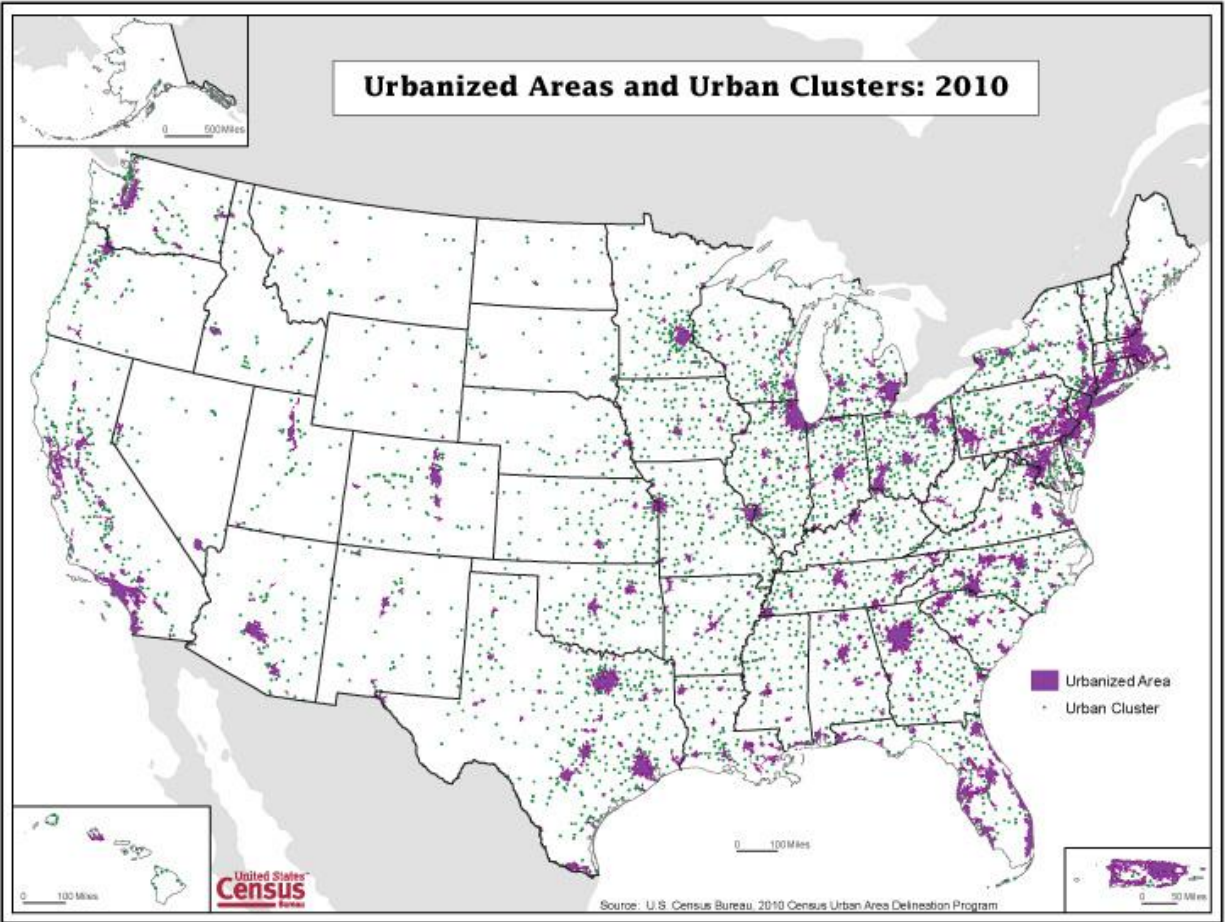

Figure 4.1. Northern Great Plains

Figure 4.2. Metropolitan, Micropolitan, and Rural Areas

This map shows the population density of the United States. The purple areas on the map show the metropolitan areas; in the five state region of this study those include, but not limited to: Duluth, Minneapolis and Saint Paul, and Rochester in Minnesota, Billings, Montana, Omaha and Lincoln Nebraska, in the state of North Dakota Fargo, Bismarck, and Grand Forks and Sioux Falls in South Dakota. The micropolitan or suburban areas included on the study are green spots on the map. The white or blank area is the rural part of the analysis; as one can see the rural area covers quite a large quantity of land, especially in the Northern Great Plains region.

According to the 2010 U.S. census there were 308,745,538 citizens of the United States. Minnesota had 5,303,925 citizens, Montana had 989,415 Nebraska contained 1,826,341, North Dakota had a mere 672,591, and South Dakota had 814,180 residents within its state boundary.

For a total of 9,606,452 United States citizens reside in the region of this study. To break it down even further only 3.1% of the United States total population live in this region; Minnesota accounts for 55% of the population within the region and Nebraska is the proud home to almost one fifth of the five state regional population. Montana, South Dakota, and North Dakota account for the remaining ten, eight, and seven percent of the regional population makeup respectively.

Table 4.1. Bank Summary Statistics

Sector	Number of Banks	Average Asset	Min Asset	Max Asset	Correlation
NGP	874	$ 1,494,141,786	$ 4,486,000	$ 1,334,292,000,000	-0.56316
Metro	285	$ 4,477,416,120	$ 6,507,000	$ 1,334,292,000,000	-0.32408
Micro	322	$ 147,028,701	$ 4,486,000	$ 30,108,000,000	-0.43070
Rural	267	$ 113,557,626	$ 7,370,000	$ 4,135,498,000	-0.56433

Table 4.1 displays the number of banks, average asset size, minimum asset size, maximum asset size, and the correlation between business and financial risk of the banks per their respective sector. One can see the metro banks on average are quite large; while the rural banks are drastically smaller. Metro banks on average are just under 4.5 billion dollar banks; with the largest being over one trillion dollars. The number of banks per sector are relatively evenly split between the three. The Northern Great Plains banks' have an average asset size of almost $1.5 billion. The negative correlation is evidence of risk balancing. Rural banks show stronger evidence of risk balancing than the other sectors. The negative coefficient between business and financial risk is strong evidence of risk balancing. Preliminary regression analysis of risk measures show, objective one, in that there is evidence of risk balancing occurring in the banking sector.

4.2.2. Common Production Region

Agriculture plays a very essential and significant economic role in the Northern Great Plains region. This area is a very similar production region in terms of agriculture products. According to the USDA Economic Research Service the top five agriculture outputs of the region are as follows: cattle and calves, corn, soybeans, hogs, and wheat (USDA ERS). That is the exact same order of top five agriculture outputs as the state of Nebraska. For each state's top five agriculture outputs, only two others are not in the overall top five, these other two are dairy and vegetables and melons. This region accounts for 17.3% of all United States agriculture production based upon cash receipts of commodities (USDA ERS).

CHAPTER V. EMPIRICAL RESULTS

5.1. Presenting Results

First, some figures will be displayed to show the relationship between business and financial risk; and also of the variables in the model. Just as a reminder this is the equation and calculation for business risk.

5.1.1. Presenting Business versus Financial Risk
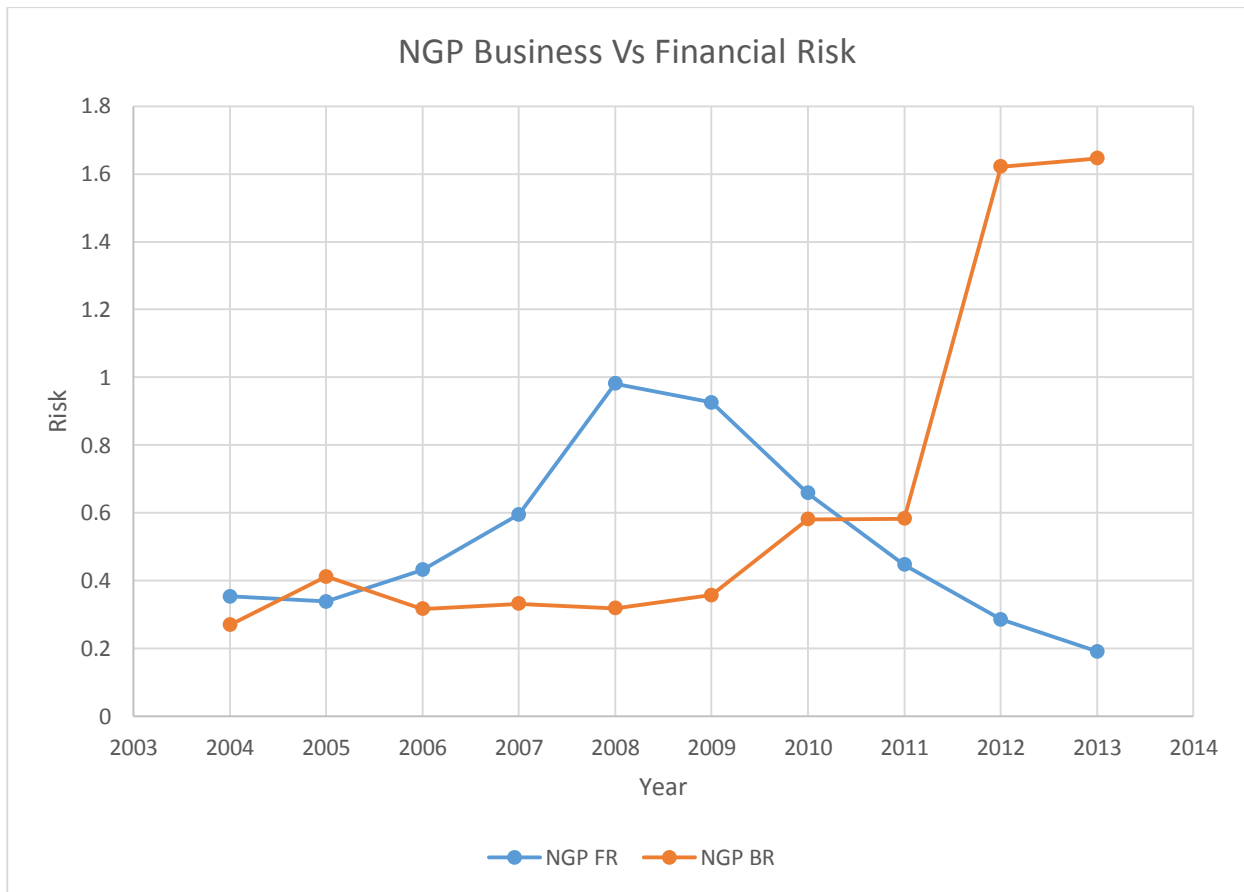
Figure 5.1. Northern Great Plains Business versus Financial Risk

Displayed is the annual business risk and financial risk over the five state region of Minnesota, Montana, Nebraska, North Dakota, and South Dakota. As one can see from the figure above the two lines move approximately in opposite directions, having an inverse relationship; when business risk decreases, financial risk increases. For example, in the time period from 2006

to 2009, business risk decreases, while financial risk increases during the same time frame. Also after 2011 business risk increases while financial risk decreases. This figure shows evidence that supports the risk balancing hypothesis in the banking sector.
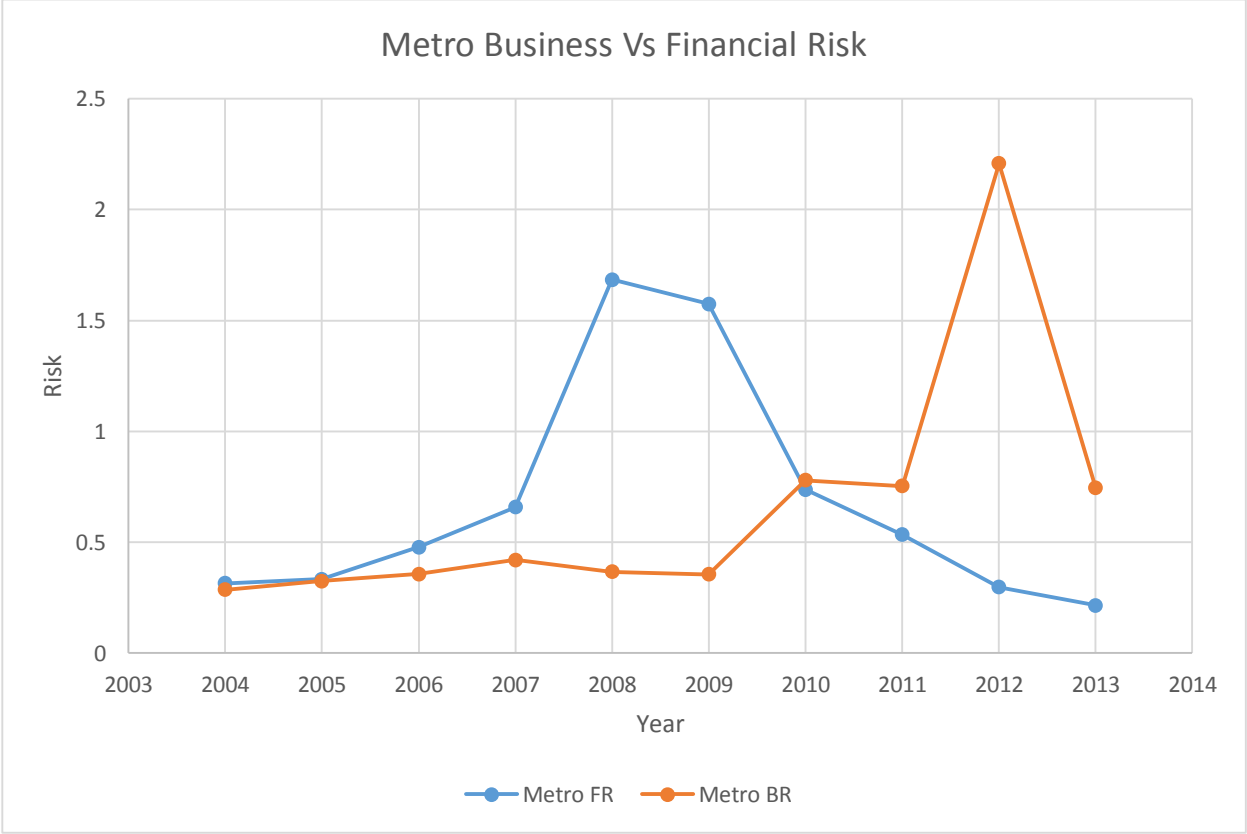
Figure 5.2. Metropolitan Business versus Financial Risk

Presented here is the business and financial risk relationship for the metropolitan banks in the five state region. One can see evidence of risk balancing again in this figure. Also, the Global Financial Crisis can be seen by the large increase in financial risk in 2007 through 2009. From 2007 to 2009 financial risk is increasing, while business risk was decreasing. One can see the risk balancing hypothesis holding true in this figure.
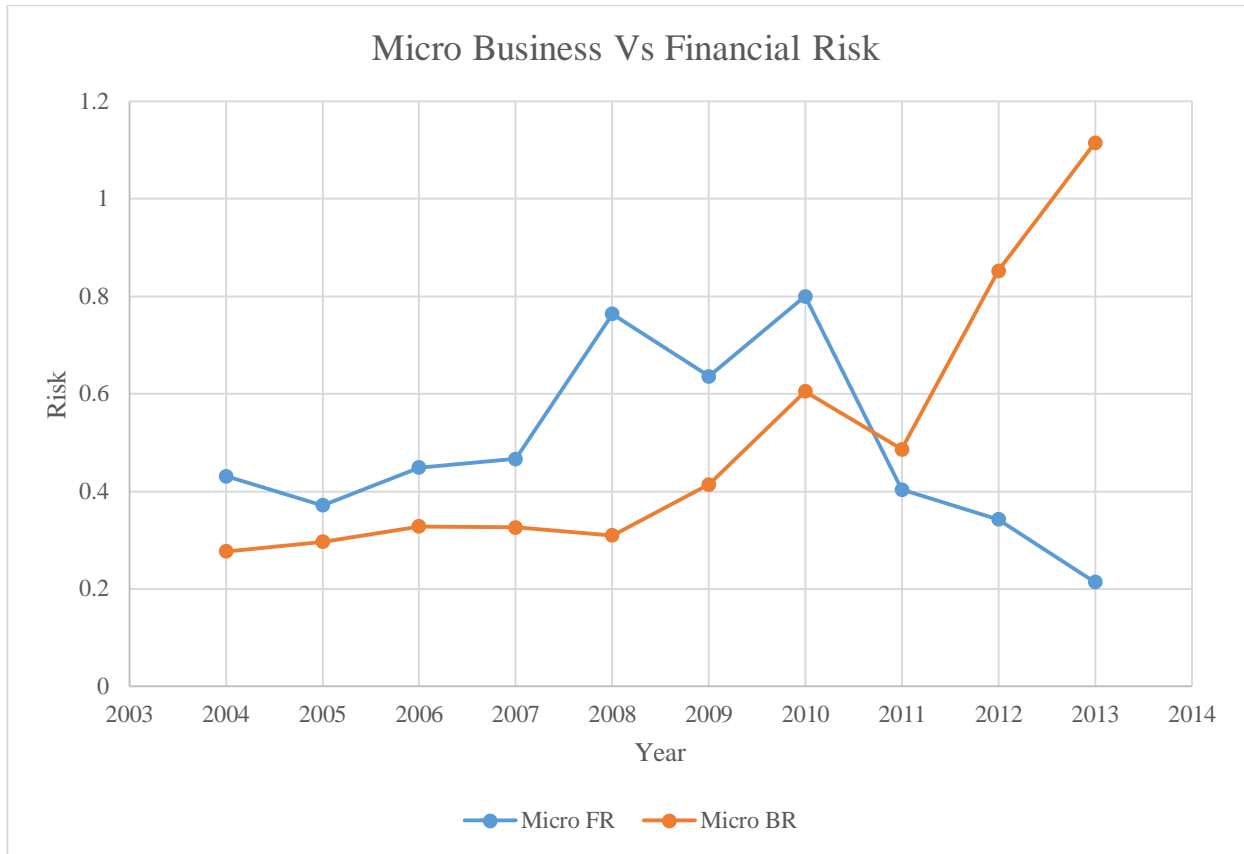
Figure 5.3. Micropolitan Business versus Financial Risk

Figure 5.3 shows how business and financial risk are related to one another in the micropolitan sector of the Northern Great Plains. There is some evidence of risk balancing, as can be seen in the figure above, especially from the time period of 2011 to 2013; where business risk and financial risk are moving in complete opposite directions. Again, evidence of risk balancing is revealed through this figure.
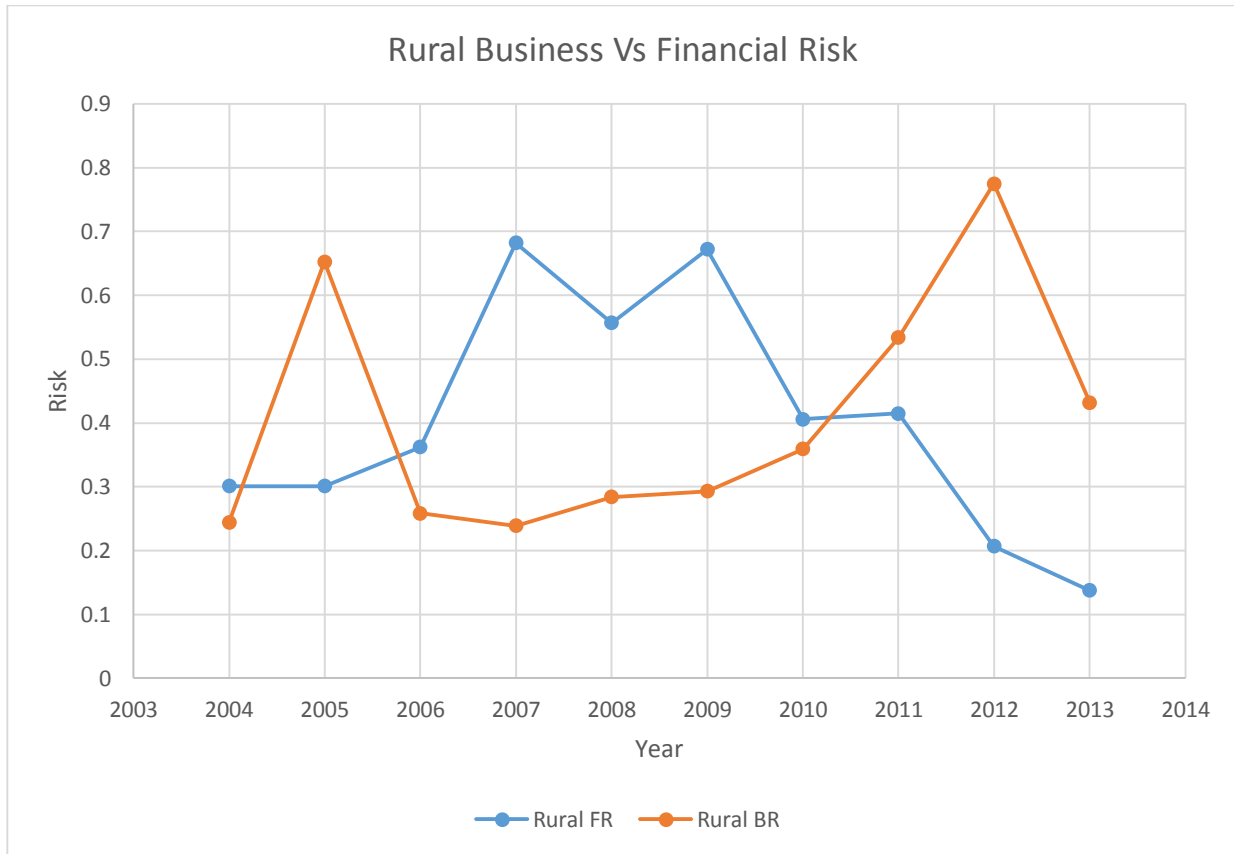
Figure 5.4. Rural Business versus Financial Risk

Exhibited above is the annual business and financial risk relationship in the rural banks of the Northern Great Plains. Yet again evidence of risk balancing is presented in this figure. Looking at the years 2009 through 2012 it can clearly be understood. In this time frame financial risk decreased, while business risk was increasing.

5.1.2. Presenting Other Variables

The variables used in the analysis will be displayed next to show their relationship with one another over the years in the analysis. Starting with the return on equity.
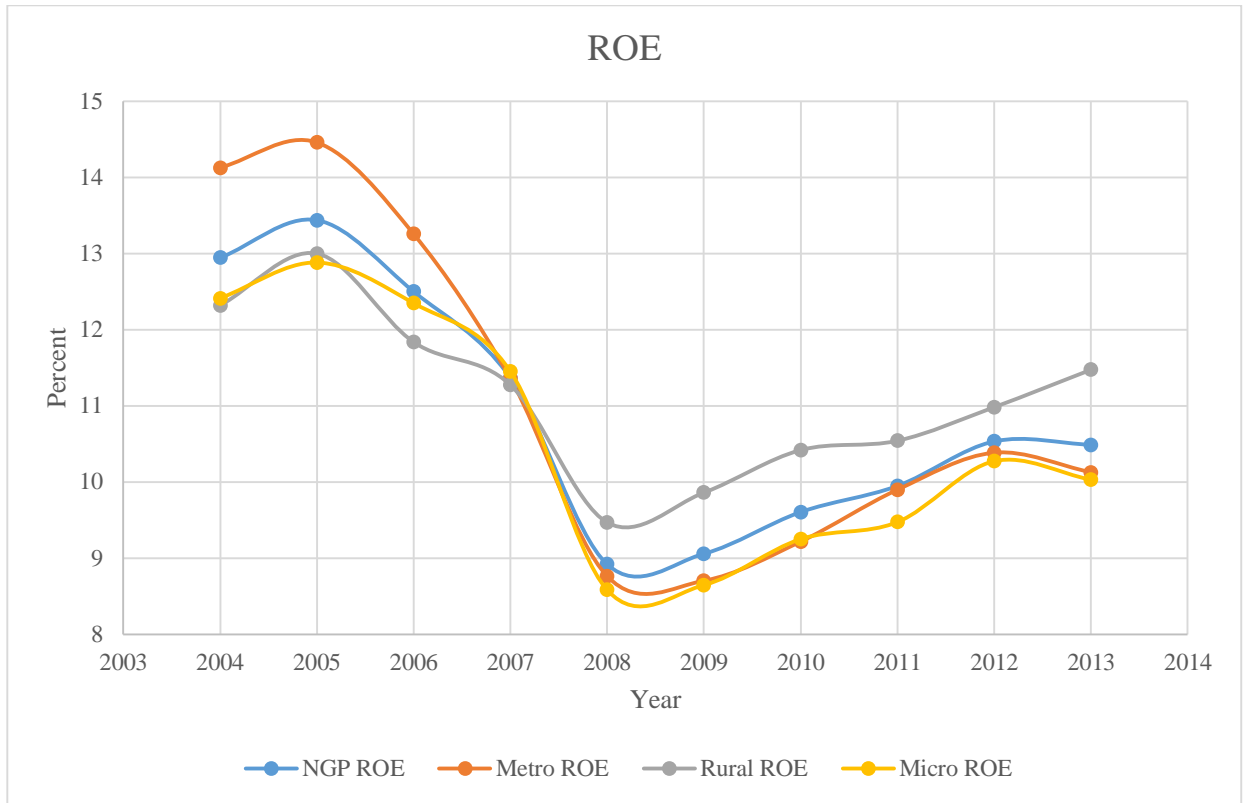
Figure 5.5. Return on Equity

$$ROE = \frac{Net\ Income}{Total\ Equity}$$

Return on equity for the different population sectors in the five state region is on display above. Metropolitan banks have the most volatile ROE, from 2004 to 2007 they have the highest return on equity, but then from 2008 to 2013 they have the lowest or second lowest return on equity. Rural banks appear to be the most stable of the sectors. From 2004 to 2007 rural banks had low ROE comparatively, but then from 2008 to 2013 they had the highest ROE in the Northern Great Plains. All banks appear to have the same pattern for their return on equity.
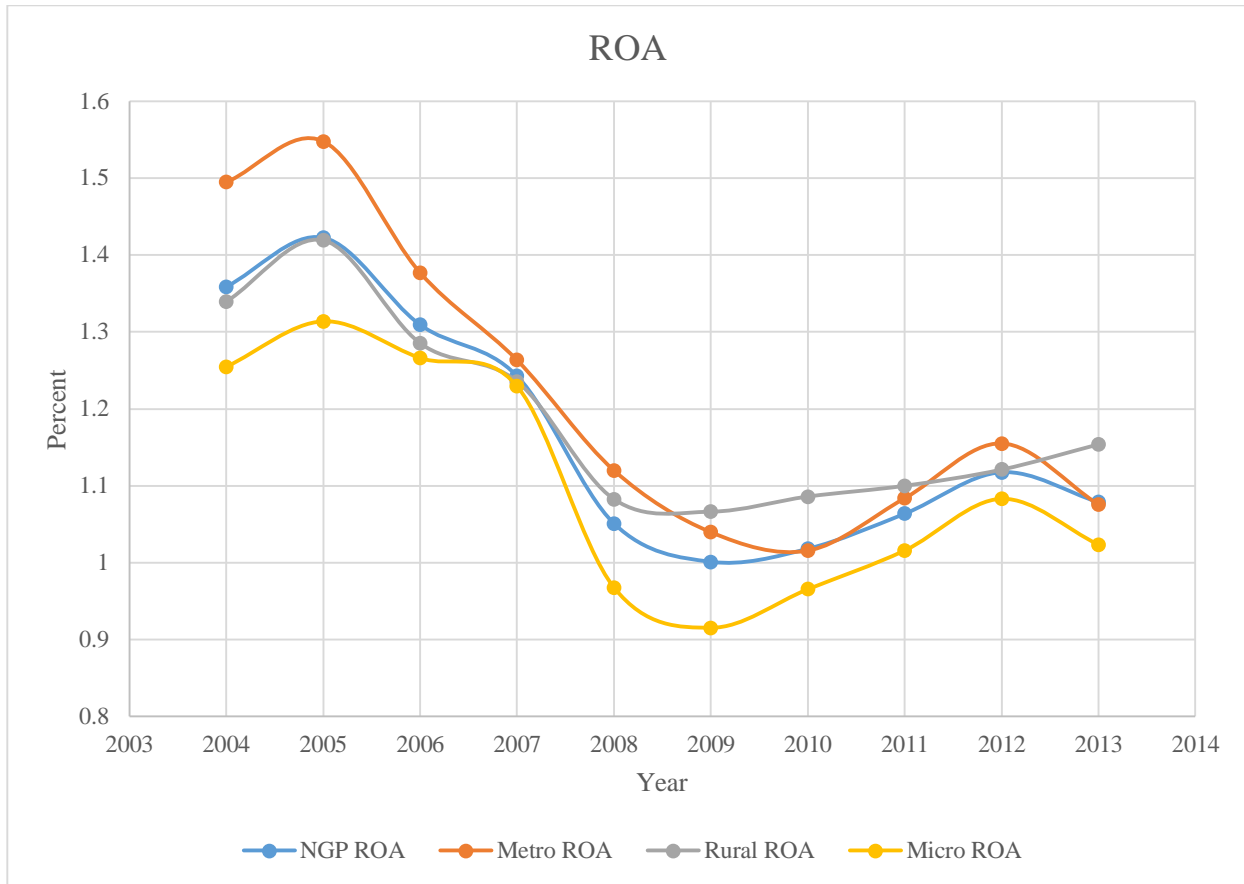
Figure 5.6. Return on Assets

$$ROA = \frac{Net\ Income}{Total\ Assets}$$

This presentation of return on assets for the different population sectors in the Northern Great Plains shows the effect the Global Financial Crisis had on the banking sector. The pattern is quite similar to that of the return on equity. Micropolitan banks take the largest drop in return on assets post 2007 and have the lowest return on assets throughout the time period. While metropolitan banks have the highest return on assets from 2004 to 2008 and again in 2012. Rural banks have the slightest drop in return on assets during the Global Financial Crisis.
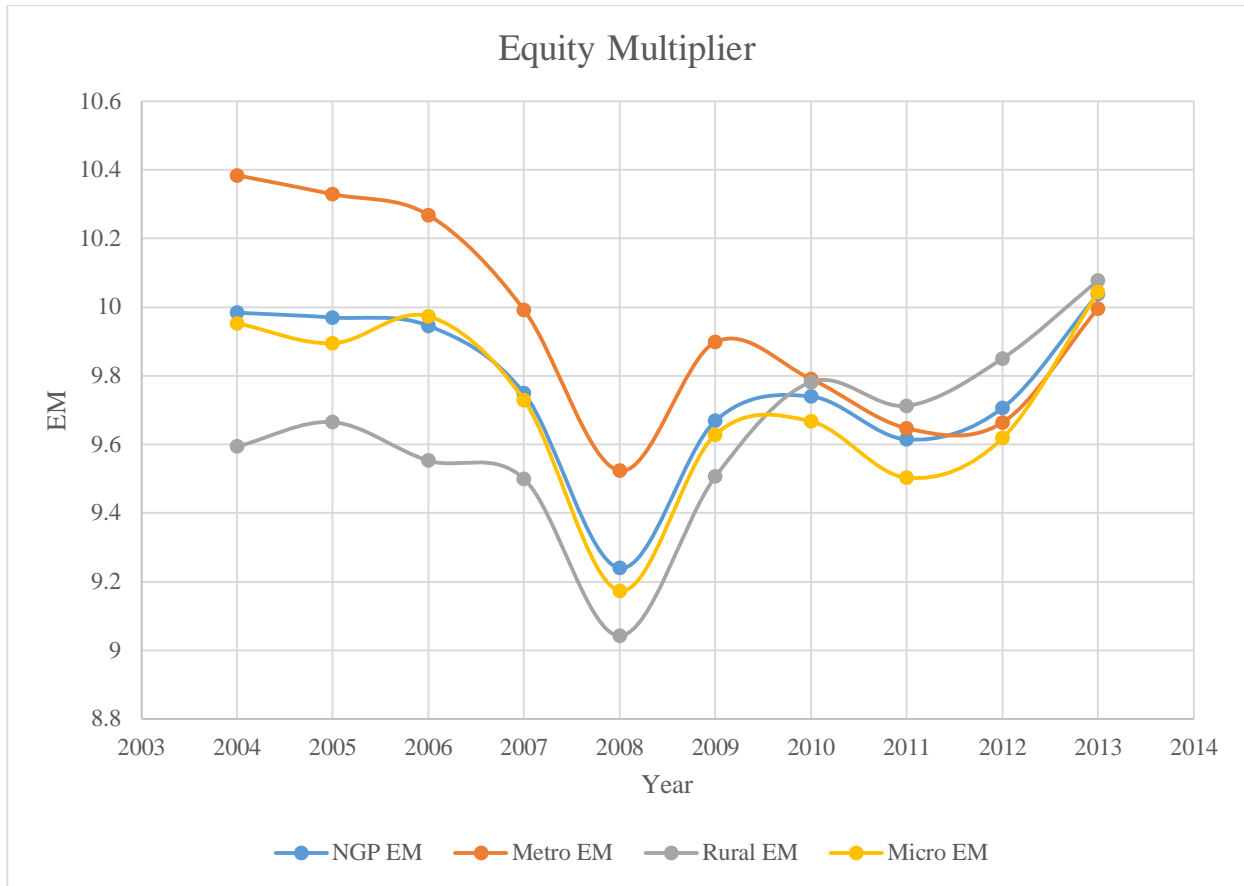
Figure 5.7. Equity Multiplier

$$Equiy\ Multiplier = \frac{Total\ Assets}{Total\ Equity}$$

$$ROE = ROA\ x\ EM$$

$$EM = \frac{ROE}{ROA}$$

Equity multiplier is a measure of financial leverage. During the Global Financial Crisis the equity multiplier dropped significantly; as can be seen. Metro banks have the highest equity multiplier ratio from 2004 to 2010. Rural banks have the lowest equity multiplier ratio from 2004 to 2009, however the highest equity multiplier ratio from 2011 to 2013. Micropolitan banks are in between the other two sectors.
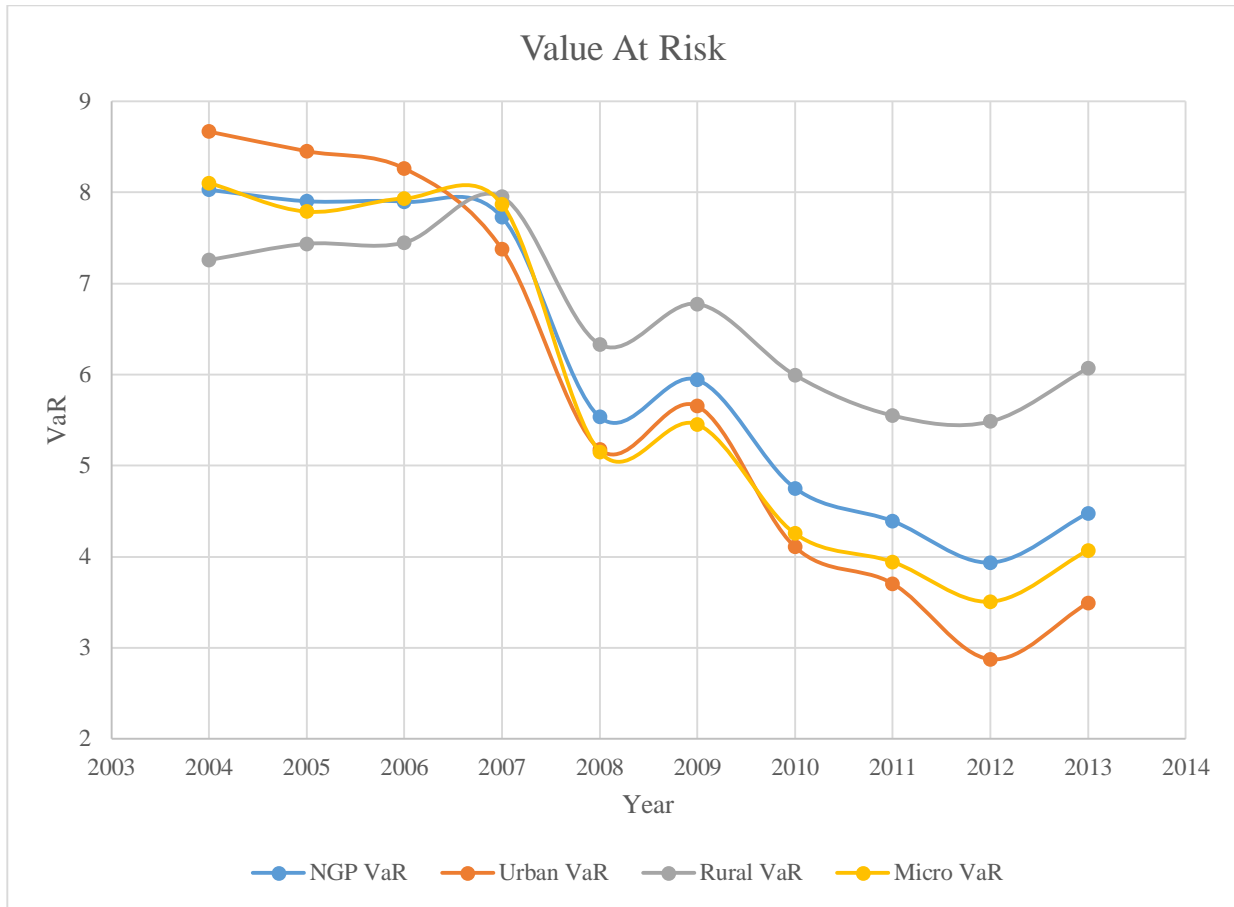
Figure 5.8. Value At Risk

$$VaR = \overline{ROE} + (-1.645 \; x \; \sigma_{ROE})$$

Where $\overline{ROE}$ is the individual banks' past four year average on return on equity and σ_{Roe} is the standard deviation for each individual banks' return on equity. Value at risk is a measure of downside risk. This is the worst loss of return on equity could be suffered in one year for the banks at a 95% confidence level. Meaning, a value of five can be interpreted as that bank could lose five percent of return on equity in that given year. Rural banks value at risk drops the least after the Global Financial Crisis, having the highest value at risk after 2007. Non-rural banks have similar patterns for value at risk, steadily dropping during this time period.

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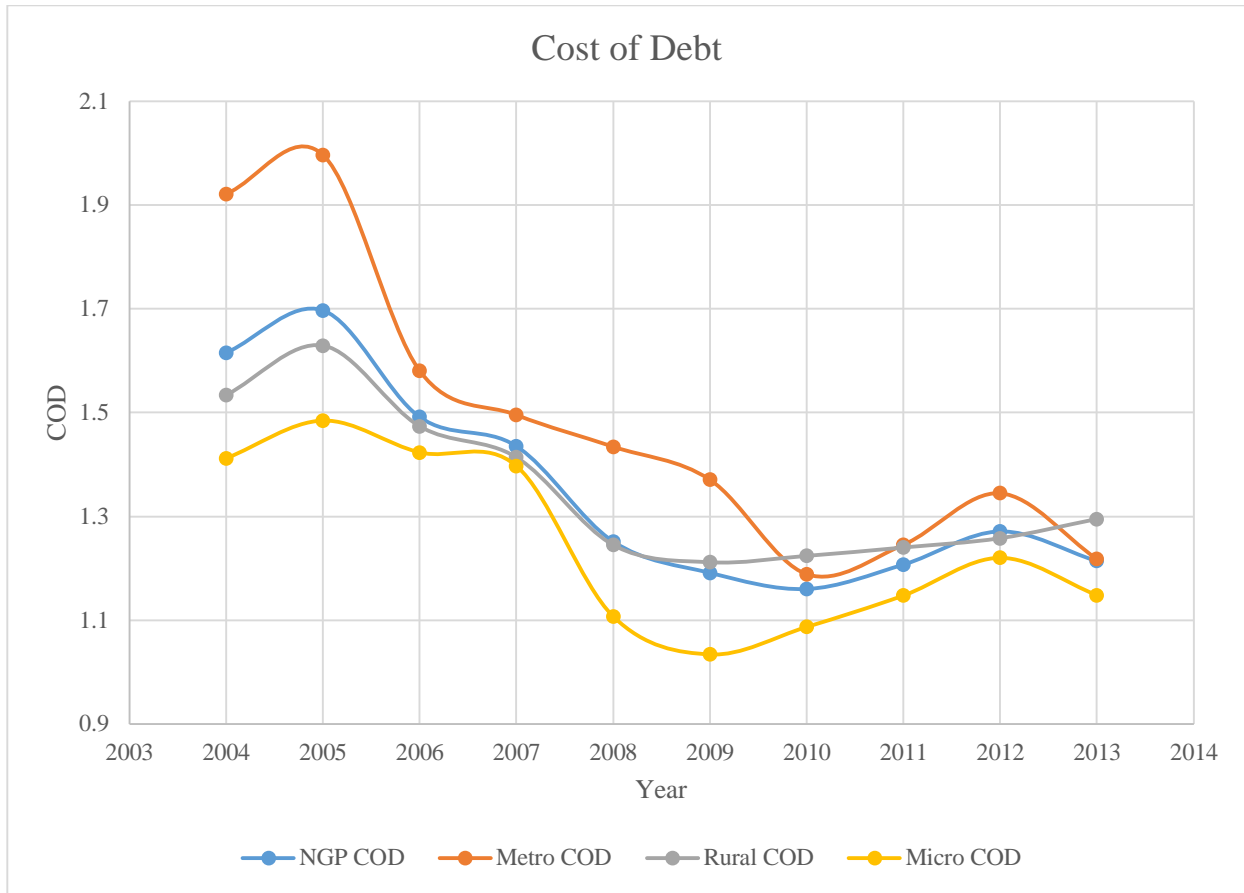
Figure 5.9. Cost of Debt

$$COD = \frac{Interest\ Expense}{Total\ Liabilites}$$

This illustration directly above, shows the cost of debt for the banks. All of the different sectors of banks move in the same pattern for cost of debt. The cost of debt is highly correlated with the federal funds rate, the higher the interest rate the higher the cost of debt. The correlation coefficient for the federal funds rate and cost of debt is 0.65. Metropolitan banks have the highest cost of debt for all but two years, 2010 and 2013.

5.2. Empirical Results

Next, will be the actual analysis with panel least squares.

5.2.1. Northern Great Plains

Table 5.1. Northern Great Plains Financial Risk as a Function

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.73605	0.10739	16.16548	0.00000
Business Risk	-0.00060	0.00006	-10.12759	0.00000
COD	0.17567	0.09336	1.88164	0.05990
ROA	-0.28950	0.25167	-1.15032	0.25010
ROE	-0.09691	0.01680	-5.76781	0.00000
VaR-Dummy	-0.02959	0.00379	-7.80922	0.00000

Table 5.1 is the output of the regression of financial risk as a function of business risk for the entire five state region. The R-squared value is 0.3651 meaning that 36.51% of the variation in financial risk can be explained by the variables in the model. This number is not extraordinarily high, but business risk is the coefficient of variation measure. The model is using a measure of variation for business risk to calculate a direct change in financial risk; therefore a low R-squared value is expected. The big takeaway from the table is that business risk has a significant at the one percent level a negative coefficient; resulting in strong evidence of risk balancing, as the negative coefficient means an inverse relationship between business and financial risk.

Return on assets coefficient is not significant. The constant in the model is statistically significant and positive. Cost of debt (COD) is positive and significant, meaning that as the cost of debt increases for banks their financial risk increases as well. Which, logically, does make sense as financial risk encompasses the risk with leasing and borrowing, if the cost of this debt increases, so should financial risk. Return on equity is significant and negative. Showing that as net income increase with respect to total assets and total equity, financial risk decreases. The Value at Risk Dummy interaction term is significant and negative as well. Showing that after the

Global Financial Crisis and the policies set into place during that time period, financial risk did decrease, as did total risk.

5.2.2. Micropolitan

Table 5.2. Micropolitan Financial Risk as a Function

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.52411	0.14802	10.29665	0.00000
Business Risk	-0.00059	0.00007	-8.28581	0.00000
COD	0.44076	0.76164	0.57869	0.56290
ROA	-0.86484	0.96900	-0.89251	0.37220
ROE	-0.05429	0.02073	-2.61923	0.00890
VaR-Dummy	-0.02721	0.00668	-4.07550	0.00000

Table 5.2 is the output of the same regression in the Table 5.1, but only on the micropolitan banks. As one can see from the table the output is quite similar to the whole Northern Great Plains region. The R-squared value is 0.3966; meaning 39.66% of the variation in the financial risk can be explained by the model. This is slightly higher than the five state region as a whole. Again business risk has a negative and significant coefficient; displaying evidence of risk balancing occurring. Cost of debt and return on assets are statistically non-significant in this model. However, return on equity is significant and negative. The value at risk dummy interaction term is significant at the one percent level and is negative. This means that after the Global Financial Crisis, micropolitan banks decreased their financial risk. Proving that in the micropolitan banks, the Global Financial Crisis did have an effect on banks' risk taking behavior.

5.2.3. Metropolitan

Table 5.3. Metropolitan Financial Risk as a Function

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.16160	0.21130	10.22982	0.00000
Business Risk	-0.00210	0.00163	-1.28854	0.19770
COD	0.25629	0.16959	1.51126	0.13090
ROA	-0.47759	0.46196	-1.03383	0.30140
ROE	-0.11114	0.03034	-3.66351	0.00030
VaR-Dummy	-0.04660	0.00839	-5.55613	0.00000

Table 5.3 is the regression output from the metropolitan banks. The explanatory power of this particular model is slightly weaker than the Northern Great Plains and the micropolitan banks; with an R-squared value of 0.3620. Business risk has a negative coefficient associated with it, but it insignificant. Cost of debt and return on assets are also statistically insignificant. Return on equity is negative and statistically significant as should be expected. The value at risk dummy interaction variable is negative and statistically significant. The Global Financial Crisis did effect the metropolitan banks. After the Global Financial Crisis banks decreased their financial risk. The weaker evidence of risk balancing in the metropolitan banks may be explained by their asset size. The average asset size of the metropolitan banks is just under $4.5 Billion. These are very large banks that are well diversified; the un-systemic risks do not effect these banks as much, therefore reducing the risk balancing occurring.

5.2.4. Rural

Table 5.4. Rural Financial Risk as a Function

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.57488	0.20310	7.75417	0.00000
Busniess Risk	-0.00431	0.00491	0.87793	0.03801
COD	0.87909	0.57081	1.54008	0.12370
ROA	-1.14826	0.93487	-1.22825	0.21950
ROE	-0.08351	0.03668	-2.27695	0.02290
VaR-Dummy	-0.02071	0.00514	-4.03116	0.00010

Table 5.4 is the same regression output, but for the rural banks in the five state region. Explanatory power of this model is lower than the metropolitan banks, with an R-squared value of 0.3360. The results are quite similar to that of the other sectors in the region. Again in this model business risk is statistically significant and negative, exhibiting strong evidence that the risk balancing hypothesis holds true in the banking sector. Cost of debt is not significant and positive. Return on assets is not statistically significant. Return on equity is negative and statistically significant. Value at risk dummy interaction term is significant and negative in this model, showing that after the Global Financial Crisis rural banks lowered their financial risk.

Table 5.5. Variable Summary

Variable	Unit	Mean	Std Dev	Min	Max
Financial Risk	Risk Level	0.48599	1.35075	0.00011	24.28955
Business Risk	Risk Level	0.92771	3.29722	0.00013	26.84874
COD	Percent	1.38272	2.22990	-0.46172	96.50313
ROA	Percent	1.19097	1.03500	-0.41051	33.06627
ROE	Percent	11.16522	6.13278	-3.70144	59.60406
VaR	Percent	6.27490	7.04652	-79.89803	34.91793
Dummy_1	Dummy Level	0.46985	0.49909	0.00000	1.00000
Business Risk-Dummy	Risk Level	0.75086	3.29276	0.00000	26.84874
VaR-Dummy	Percent	2.20485	5.35958	-67.93922	34.91793

To reassure the effectiveness of the policies set during the Global Financial Crisis and robustness of the model, the model is also run with an interaction term between business risk and the dummy variable for year. This is to bolster the findings. Here are the results.

Table 5.6. Northern Great Plains Interaction Terms

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.72915	0.10706	16.15069	0.00000
Business Risk-Dummy	-0.00051	0.00006	-8.86509	0.00000
COD	0.17537	0.09400	1.86563	0.06210
ROA	-0.29053	0.25312	-1.14778	0.25110
ROE	-0.09655	0.01684	-5.73364	0.00000
VaR-Dummy	-0.02779	0.00389	-7.13698	0.00000

R-squared 0.3643

Table 5.7. Micropolitan Interaction Terms

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.51006	0.14610	10.33569	0.00000
Business Risk-Dummy	-0.00045	0.00005	-9.30974	0.00000
COD	0.46161	0.77031	0.59925	0.54910
ROA	-0.89716	0.98143	-0.91413	0.36080
ROE	-0.05297	0.02079	-2.54790	0.01090
VaR-Dummy	-0.02304	0.00645	-3.57007	0.00040

R-Squared 0.3946

Table 5.8. Metropolitan Interaction Terms

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.16187	0.21109	10.24159	0.00000
Business Risk-Dummy	-0.00271	0.00212	-1.27949	0.20090
COD	0.25653	0.16952	1.51325	0.13040
ROA	-0.47811	0.46180	-1.03531	0.30070
ROE	-0.11114	0.03033	-3.66453	0.00030
VaR-Dummy	-0.04670	0.00837	-5.57691	0.00000

R-Squared 0.3621

Table 5.9. Rural Interaction Terms

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.58784	0.20700	7.67071	0.00000
Business Risk-Dummy	-0.01397	0.01211	-1.15295	0.02491
COD	0.88117	0.57353	1.53639	0.12460
ROA	-1.15226	0.93943	-1.22656	0.22020
ROE	-0.08381	0.03706	-2.26152	0.02380
VaR-Dummy	-0.02149	0.00503	-4.26882	0.00000

R-Squared 0.3360

As can be viewed in the tables above, the results are quite similar to the first round of analysis. It is now better understood that after the Global Financial Crisis, financial risk did decrease in the banks of the Northern Great Plains.

CHAPTER VI. SUMMARY AND CONCLUSION

6.1. Conclusion

In this study, we extend a mixture of Gabriel and Baker's (1980) and Collins' (1985) analyses into a panel model to investigate a relationship between business risk and financial risk with banks in the Northern Great Plains region of the United States. This five state region includes Minnesota, Montana, Nebraska, North Dakota, and South Dakota. Our econometric model is superior to the existing models because the model enables us to control for unobservable individual firm's heterogeneity which may affect their risk decisions. The statistical tests reveal that the fixed effect model is the most suitable for this study and that there is a statistically significant negative relationship between business and financial risk; thus supporting the risk balancing hypothesis. This paper contributes not only to the banking sector, but also to the policy making field. Our results suggest that policies that reduce firm's business risk may induce firms to increase their financial risk. Policy makers need to be careful when implementing risk-reducing policies, especially in the banking sector.

6.2. Objectives

Objective 1:

Understand how banks adjust their financial risk in response to changes in business risk, commonly known as the risk balancing hypothesis.

This forms the primary objective of the thesis. Specifically, test the risk balancing hypothesis in the banking sector using bank level data. Develop an appropriate measure of both business and financial risk. Use simple descriptive statistics to test the correlation between business and financial risk for different population sectors of banks.

Objective 2:

Develop a panel data framework to analyze if the risk balancing hypothesis is different for metropolitan, micropolitan, and rural banks.

Panel model analysis provides a more detailed analysis and offers more efficient coefficients. This is important to evaluate if one-size-fits-all policies are appropriate for metropolitan, micropolitan, and rural banks. Special care was taken to categorize the banks based on their zip code.

Objective 3:

Assess the effectiveness of polices to mitigate the Global Financial Crisis of 2007 – 2009.

This will be addressed by the use of a dummy variable for year in the data set to determine if the Global Financial Crisis had a lasting impact on banks. This will be useful to address how policies have had an impact on risk levels for banks. Analyze if the bailout policies increased or reduced total risk.

Objective 4:

Analyze the importance of value at risk in explaining the risk balancing hypothesis.

This will be addressed by the statistical significance of the value at risk variable in the model. This will show how effective the value at risk index is at capturing the risk balancing hypothesis in the banking industry.

Table 6.1. Coefficients Summary for First Analysis

Sector	Constant	BR	COD	ROA	ROE	VaR-Dummy	R-Squared
NGP	1.73605***	-0.0006***	0.17567*	-0.2895	-0.09691***	-0.02959***	0.3651
Micro	1.52411***	-0.00059***	0.44076	-0.86484	-0.05429***	-0.02721***	0.3966
Metro	2.1616***	-0.0021	0.25629	-0.47759	-0.11114***	-0.0466***	0.3620
Rural	1.57488***	-0.00431**	0.87909	-1.14826	-0.08351**	-0.02071***	0.3360

* = 10% ** = 5% *** = 1% statistical significance

Table 6.2. Coefficient Summary for Second Analysis

Sector	Constant	BR-Dummy	COD	ROA	ROE	VaR-Dummy	R-Squared
NGP	1.72915***	-0.00051***	0.17537*	-0.29053	-0.09655***	-0.02779***	0.3643
Micro	1.51006***	-0.00045***	0.46161	-0.89716	-0.05297**	-0.02304***	0.3946
Metro	2.16187***	-0.00271	0.25653	-0.47811	-0.11114***	-0.0467***	0.3621
Rural	1.58784***	-0.01397**	0.88117	-1.15226	-0.08381**	-0.02149***	0.3360

* = 10% ** = 5% *** = 1% statistical significance

6.2.1. Hypothesis 1

To test the first objective, the first hypothesis is developed.

Hypothesis 1: Financial risk and business risk are significantly inversely related.

This hypothesis will determine how firms adjust financial risk to business risk. This would suggest that if business risk decreases then financial risk would increase or vice versa. Calculating the rate of change or impact will be important as well. This will be derived from the data and model to see how the two types of risks will vary.

This has been proven through the analysis with the negative correlation coefficient across all sectors. Also, in the analysis there is a statistically significant negative coefficient for business risk in the Northern Great Plains region as well as the rural and micropolitan sectors. With the coefficient being negative, but insignificant for the metropolitan sector.

6.2.2. Hypothesis 2

To test the second objective the second hypotheses is constructed.

Hypothesis 2: Different population sectors will have different risk taking behavior.

Different population sectors of the Northern Great Plains may have different risk balancing hypothesis attributes. The rural areas may be more risk adverse compared with the metropolitan. These will be tested by arranging the data to different population sectors. This is important to evaluate if one-size-fits-all policies are appropriate for metropolitan, micropolitan, and rural banks.

This has been tested by running the analysis on the three separate population sectors. As noted previously, the metropolitan sector does not have a significant coefficient for the business risk variable, while micropolitan and rural banks have a significant negative coefficient. This shows different risk preferences. Also, the magnitude of the coefficient is noteworthy. Rural banks have the most negative number for a coefficient, comparatively. Meaning, rural banks have stronger evidence of risk balancing that the other sectors.

6.2.3. Hypothesis 3

Hypothesis 3: Policies to reduce risk will affect different population sectors differently, in the banking industry.

The Global Financial Crisis of 2007 – 2009 had an impact on the banking industry. The crisis led to a large recession in the United States and the world. Before 2007 banks may have been less risk adverse and more willing to take on risk and their financial risk may have been higher. After the Global Financial Crisis lessons may have been learned and banks would become more risk adverse.

The dummy variable used in the analysis was used to capture the effect of the Global Financial Crisis, as in before and after. The results show that as a whole, the year dummy was not statistically significant. In each of the separate sectors the dummy variable is significant. Metropolitan banks had the largest negative coefficient, showing the largest decrease in financial risk after the Global Financial Crisis. Rural banks had the second largest negative coefficient comparatively with micropolitan banks at the end. Showing that the banks reduced their financial risk post the Global Financial Crisis. This shows that after the Capital Purchase Program and other bailout policies for banks were put into place, financial risk did reduce. However, business risk did rise in this same time period. With the value at risk measure representing total risk, the data

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and analysis show that total risk decreased after the policies and bailout were established. The data shows that the bailout did have the intended effect in reducing total risk, even after the increase in business risk.

6.2.4. Hypothesis 4

To test the fourth objective the following hypothesis is established.

Hypothesis 4: The Value at Risk index will be statistically significant in measuring the risk balancing hypothesis.

Hypothesis four will help understand if Value at Risk is an important index when looking at the risk balancing hypothesis. Value at Risk states with 95% confidence the percent of return on equity that can be lost within a year. It will analyzed through its statistical significance to measure the risk balancing hypothesis.

This has been proven to be true by the statistically significant coefficients for value at risk for Northern Great Plains, metropolitan, and rural population sectors. Proving that Value at Risk is a relevant measure of risk for banks. Proving that Value at Risk is a significant variable to use when analyzing the risk balancing hypothesis ad total risk.

6.3. Final Remarks

As mentioned the financial sector has always played an important role in society. There are risks associated with lending money in the banking sector; most obvious is the risk of default, an example of financial risk. The banks make money off interest to cover the banks opportunity cost of the money. Banks are in business to make a profit while providing capital to individuals and businesses. Banks can take on too much risk, as can be seen by the Global Financial Crisis. The saying of 'more risk, more reward' applies to an extent in the banking sector, as riskier loans have a higher interest rate to allow for more risk allowance. Risk balancing is where the banks

increase risk in one area after a decrease in the other type of risk, or vice versa, by decreasing risk in another area after an influx in the opposite type of risk, to maintain an equilibrium level of total risk. Through this study, evidence has been provided and shown that risk balancing does occur in the banking sector.

Through the use of two separate interaction terms, it can be concluded through my results that the bailout policies did help banks reduce total risk in response to the Global Financial Crisis. The policies set in place helped reduce financial risk. However business risk did increase during the same time period, as can be seen in the figures. This rise in business risk was less than the decrease in financial risk, in absolute power, therefore total risk did decrease.

Future research may still need to be done. The main point of future research is to look into other regions and areas. These may include the New England states or the Southwest region. It will be interesting to look into how other regions compare to the Northern Great Plains.

All four of the hypotheses have been tested and provided evidence for. Policy makers need to be aware of risk balancing to properly construct policies so that the policies have the intended effect. If a policy is set into place to mitigate risk, it may decrease one type of risk, but increase another type of risk, therefore not decreasing total risk at all. Policy makers need to educate themselves fully about their subject area and potential side effects of such policies to make sure that the polices they set into place meet the intended goal. Bank managers also need to be aware of risk balancing in the banking sector to determine if reallocating their portfolio to manage their risk is beneficial to them. If one bank reallocates their portfolio in a risk balancing manner, and outperforms a bank that does not; the underperforming bank needs to be aware of risk balancing and implement the beneficial strategy. Bank managers need to notice and take action accordingly to risk balancing behaviors in their banks.

Through a detailed analysis of both business risk and financial risk in the banking sector of the Northern Great Plains region of the United States of America I have found evidence that risk balancing does occur.

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