Relationship between Interest Rate and Bank Common Stock Return: Evidence from the Top 10 United States Banks and Financial Sector Index

The Honors Program
Senior Capstone Project
Student's Name: Hieu Tran
Faculty Sponsor: H.C. Li
April 2013

Table of Contents

ACKNOWLEDGEMENTS

First, I would like to thank Professor H.C Li for his tremendous time commitment and guidance to the successful completion to this project.

Second, I would like to thank Professor A. Can Inci for being the Editorial Reviewer for this research paper.

I also would like to thank Professor Jim Segovis, Director of the Honors Program, for his continued encouragement. The Honors Program of Bryant University offers a unique opportunity for me to learn and develop many crucial skills for future success.

Lastly, I would like to thank the Bryant Community, my friends, and my family for their tremendous support. With them, I finally made this research paper possible.

The Relationship between Interest Rate and Bank Common Stock Return: Evidence from the to 10 US Banks and Financial Sector Index

Senior Capstone Project for Hieu Tran

ABSTRACT

This research paper investigates the effect of changes in long-term interest rates on the returns of the top 10 US banks included in the Financial Sector Index. There are three main parts of this paper.

The first part uses the Augmented Dickey-Fuller (ADF) test to test the "Random Walk" of banks' common stock returns. Based on the test's results, returns of banks' common stock do not solely follow the "Random Walk".

In the second part, the Two-Factor Arbitrage Pricing Theory is employed to test the effect of changes in long-term interest rate on the return of banks' common stocks. The findings provide strong and consistent evidences that volatility of bank common stock returns is very sensitive to the long-term interest rate movement.

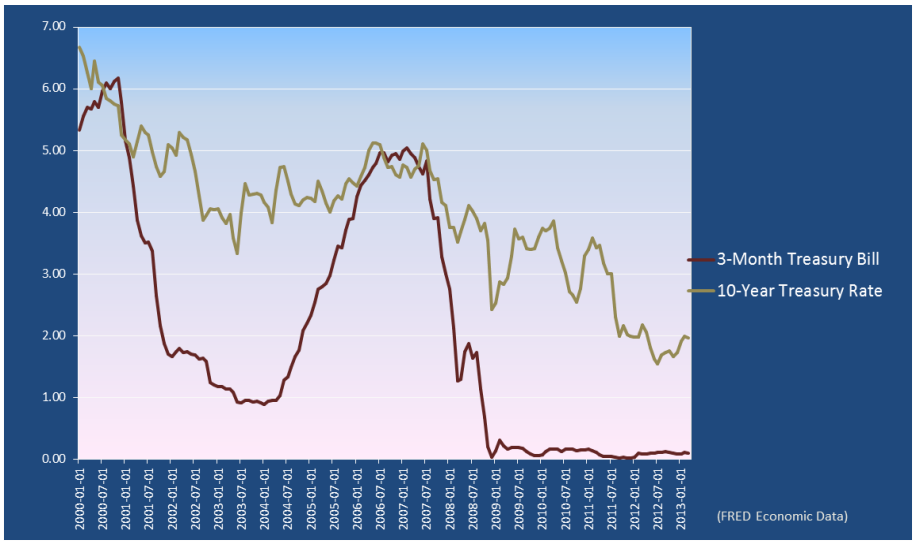
The third part explores the effect of long-term interest rates on returns of banks' common stocks before and after the financial crisis (September 12th, 2008). The same testing methods are used as those in part 1 and 2. The findings suggest that, after the crisis, changes in long-term interest rates exhibit an even more significant impact on banks' common stock returns than that before the financial crisis.

INTRODUCTION

I. Interest Rate, Deregulation, and Monetary Policy

Basically, interest rate is defined as "the cost of capital, means the price paid for using the money for a period of time." Based on the macro economic theory, the interest rates and economic growth are negatively correlated.

After the Financial Crisis in 2008, both long-term and short-term interest rates in the US have been decreasing dramatically. Currently, the 3-Month Treasury rate is close to 0%, and 10-Year Treasury bond is less than 2% (FRED ECONOMIC Data). I picked the financial sector because it is the most sensitive sector to the interest rate movement.



Regulation Q was introduced in 1933. Under this regulation, banks are prohibited to pay interest on demand deposits. In addition, this regulation also set the ceiling rates which banks pay for different types of bank accounts such as saving accounts and NOW accounts. Currently, this regulation was repealed by the Dodd-Frank Wall Street Reform and Consumer Protection Act.

The US Financial Market is affected by many regulations and deregulations during the period 1999- present. First, the Gramm-Leach-Bliley Act, which is known as Financial Services Modernization Act or Deregulation of Financial Services, was passed by Congress in 1999. It is considered a repeal of Glass-Steagall Act of 1933. Under GLB Acts, the US commercial

banks, financial banks and insurance companies can consolidate together to form a financial conglomerate. The removal of barriers among these financial institutions of the GLB Act allows US banks and other financial companies to offer more complex financial products. At the same time, it poses significant risk to the US financial market such as greater systemic risk, and privacy risk of the customers' information.

Second, there is the Financial Crisis in 2008, which was the worst Financial Crisis after the Great Depression in 1930. It led to the threat of the collapse of all US financial institutions. In 2008 alone, US families lost $11 trillion in wealth. One of the most critical causes of the crisis was the collapse of the US housing market and complexity of financial products. In 2006, the US housing market peaked. People assumed that the US housing price would never go down. Therefore, many banks and mortgage lending institutions kept giving out mortgage loans without requirement on a credit check or the ability to pay from their borrowers. After issuing mortgage loans, these institutions packed them into portfolios and issued the mortgage-backed securities to different groups of investors. The system would have run well as long as the US housing price kept escalating and mortgage borrowers paid their loans on time. However, many people were not able to make a payment to mortgage lenders, and there was no money to pay back to investors of mortgage-backed securities. The US housing market started to collapse in 2008 due to a high level of foreclosure. The US housing market kept decreasing in value, and investors lost their money in the mortgage-backed securities. The stock price of financial institutions dropped significantly. On September 15th, 2008, Lehman Brothers Holdings Inc. filed Chapter 11 and declared bankruptcy due to the heavy loss from the mortgage industry. According to the US Senator Levin Coburn, the Financial Crisis in 2008 was the result of "high-risk financial products, undisclosed conflict of interest, the failure of regulators, credit rating agencies, and the market itself."

Third, due to the Financial Crisis in 2008, there were major reforms and regulations on the Financial industry to lessen the shock of the US and global economy. Dodd-Frank Wall Street Reform and Consumer Protection Act was passed by Congress in July 2010. There are four

main parts of the Dodd-Frank reform. First, it is the Volcker Rule, which is similar to Glass-Steagall Act. Volcker Rule "prohibits depository banks from proprietary trading", which separates the activities of commercial banking from investment banking. Commercial banks cannot use the money of their depositors to involve in high risk investment activities. This rule affects the banks' profitability by limiting their income from investment activities. Second, Durbin Amendment puts a restriction on debit card inter-charge fees. These fees have to be "reasonable and proportional to the actual cost." This act limits the banks' non-interest income. The third purpose of Dodd-Frank is to bring the transparency and accountability to the derivatives market. A new committee is formed under supervision of the Federal Reserve to observe and regulate the derivatives market. Lastly, Dodd-Frank reform also stated "Ending Too Big to Fail Bailouts", which means the Federal Reserve would not use any taxpayers' money to bail out any US financial conglomerate. In summary, after the Financial Crisis, more regulations are imposed on the US Financial Sector.

In addition, the financial sector is strongly affected by the monetary policies such as Quantitative Easing I, II, and III, Operation Twist and Fiscal Cliff. They have a big impact on other financial institutions' operations.

Quantitative Easing is used by central banks to push and pump more money into the economy because the traditional monetary policies are ineffective. A central bank uses its money to buy financial assets from commercial banks and other financial institutions in order to increase the liquidity of the financial market.

Operation Twist is a plan to push down the long-term interest rate. Under the Twist, the Federal Reserve sells short-term bonds (maturities less than 3 years) to purchase long-term bonds (maturities of 6 to 30 years). The main purpose of the Twist is to keep the long-term rate down to help the housing market.

II. Interest Rates and Operations of Financial Institutions

Financial holding companies engage in a wide range of activities of commercial banks, investment banks, and insurance companies. First, interest rates directly affect activities of commercial banks. One of the traditional ways that retail banks make money is taking

deposits from depositors or savers and issuing different kinds of loans to their customers such as business loans, personal loans, credit cards, and mortgage loans. The interest that banks pay savers and depositors is short-term, while they charge interest of their borrowers for a longer term. The difference between the short-term rate and the long-term rate is banks' net interest spread. The steeper the yield curve, the higher interest spread that commercial banks generate. Currently, both short-term rates and long-term rates are kept at a historically low level. Therefore, the US commercial banks cannot acquire the net-interest margins they desire. Although profitability of banks comes from a variety of sources, interest rate movement still has some effect on it. Besides, commercial banks are also involved in the activities of underwriting municipal bonds and are able to take part in some bond investment. So, the interest rates also have an impact on the performance of commercial banks.

For investment banks and insurance companies, interest rates indirectly affect their operations through bond and stock markets. For the bond valuation, the present value of a bond is negatively correlated with interest rates movement.

The present value of bond is the discount of expected future cash flows, which are coupon payments and face value at maturity day. Based on the formula, if interest rates go up, the present value of a bond will go down, and vice versa.

$$V_{Bond} = \left[\sum_{t=1}^{n} \frac{CP_t}{(1+r)^t}\right] + \frac{MV}{(1+r)^n}$$

For the stock market, interest rates are considered as a base for any equity valuation because stock value is estimated based on the forecasted future cash flows and then use the interest rate to discount it back to present value.

Financial holding companies are active in trading derivatives which are also sensitive to interest rate volatility.

Therefore, theoretically, interest rates have a strong connection to the performance of financial holding companies in the US.

III. Overview of top 10 US Financial Holding Companies

JP Morgan and Chase is a biggest financial holding company. The corporation was found in 1968 and is headquartered in New York, NY. The company offers a wide range of financial products divided into different segments such as Corporate and Investment Bank, the Commercial Bank, Asset Management, and the Corporate/ Private Equity. The current value of market capitalization is $179.5 billion with a revenue of $108.3 billion in 2012. (1)

Bank of America is a banking holding company. It also offers a wide range of banking and nonbanking financial service and products in the US and international market. Their business operations are divided into 5 different groups, which are Consumer & Business Banking, Consumer Real Estate Services, Global Banking, Global Markets and Global Wealth & Investment Management. The company was found in 1904 and has headquarter in Charlotte, NC. The current value of market capitalization is $126.8 billion with a revenue of $95.3 billion in 2012. (2)

Citigroup, Inc. is a global diversified financial services holding company whose businesses provide consumers, corporations, governments and institutions with a broad range of financial products and services. The company operates through two segments: Citicorp, consisting of Citi's Global Consumer Banking businesses and Institutional Clients Group; and Citi Holdings, consisting of Brokerage and Asset Management, Local Consumer Lending and Special Asset Pool. Citigroup was founded on October 8, 1998 and is headquartered in New York, NY. The current value of its common stock is $137.4 billion with a annual revenue of $93.3 billion in 2012. (3)

Wells Fargo & Co. is a nationwide, diversified, community-based financial services company. Wells Fargo provides banking, insurance, investments, mortgage, and consumer and commercial finance through its stores, ATMs, the Internet, and other distribution channels across North America and internationally. The company operates through three operating segments: Community Banking, Wholesale Banking, and Wealth, Brokerage and Retirement.

The company was founded by Henry Wells and William G. Fargo on March 18, 1852 and is headquartered in San Francisco, CA. The current market value of its common stock is $194.3 billion. (4)

The Goldman Sachs Group, Inc. is a global investment banking, securities and investment management firm. It provides financial services to a substantial and diversified client base that includes corporations, financial institutions, governments and high-net-worth individuals. The company operates through four segments: Investment Banking, Institutional Client Services, Investing & Lending, and Investment Management. The Goldman Sachs was founded by Marcus Goldman in 1869 and is headquartered in New York, NY. The current value of market capitalization is $64.3 billion with a revenue of $42.1 billion in 2012. (5)

Morgan Stanley is a global financial services company engaged in investment banking, securities, investment management and wealth management services. It provides products and services to a diversified group of clients and customers, including corporations, governments, financial institutions and individuals through its subsidiaries and affiliates. The company also provides investment banking, capital raising, financial advisory and corporate lending services. It operates through three business segments: Institutional Securities, Global Wealth Management Group and Asset Management. The company was founded by Harold Stanley and Henry S. Morgan in 1935 and is headquartered in New York, NY. The Goldman Sachs was founded by Marcus Goldman in 1869 and is headquartered in New York, NY. . The current value of market capitalization is $40.8 billion with a revenue of $33 billion in 2012. (6)

U.S. Bancorp operates as a bank holding company, which through its subsidiary provides banking services. It provides a full range of financial services, including lending and depository services, cash management, foreign exchange and trust and investment management services. The company also engages in credit card services, merchant and ATM processing, mortgage banking, insurance, brokerage and leasing. Its subsidiaries engage in the general banking business, principally in domestic markets. The company's subsidiaries provides a wide range of products and services to individuals, businesses, institutional

organizations, governmental entities and other financial institutions. The current value of market capitalization is $60.5 billion with the revenue of $20 billion in 2012. (7)

The Bank of New York Mellon Corp. is a bank holding company, which engages in global financial services. It provides financial services for institutions, corporations and high-net-worth individuals, offering investment management and investment services through a worldwide client-focused team. The company operates through three segments: Investment Management, Investment Services and Other. The Bank of New York Mellon was founded by Alexander Hamilton in 1784 and is headquartered in New York, NY. The current value of market capitalization is $31.5 billion with a revenue of $14.9 billion in 2012. (8)

PNC Financial Services Group, Inc. provides diversified financial services, including retail and business banking; residential mortgage banking; specialized services for corporations and government entities, including corporate banking, real estate finance and asset-backed lending; wealth management and asset management. The company operates through six segments: Retail Banking segment, Corporate & Institutional Banking segment, Asset Management Group segment, Residential Mortgage Banking segment, BlackRock segment and Non-Strategic Assets Portfolio segment. PNC Financial Services Group was founded in 1983 and is headquartered in Pittsburgh, PA. The current value of market capitalization is $34.6 billion with a revenue of $15.5 billion in 2012. (9)

Capital One Financial Corp. is a financial holding company operating through its subsidiaries, which include Capital One, NA and Capital One Bank USA, NA. Its offers financial products and services to consumers, small businesses and commercial clients. The company operates through three operating segments: Credit Card, Consumer Banking and Commercial Banking. The company was founded by Richard D. Fairbank in 1988 and is headquartered in McLean, VA. . The current value of market capitalization is $32.3 billion with a revenue of $24.5 billion in 2012. (10)

The performance of the stock market and interest rates movement are two important factors of the U.S economic growth. They both have a crucial implication for risk management, financial market activities, securities valuation and the housing market in the

U.S. This research focuses on the relationship between interest rates and stock returns of financial holding companies. Knowing the relationship of two dominant factors of the U.S economy, investors will have a great benefit to have a better view to predict the stock movement of the financial sector based on macroeconomic conditions.

The issue of interest rate sensitivity of bank common stock returns is of major interest for regulators, banks and academics for that reason has explored a voluminous literature on the issue. Empirical studies have provided substantial evidence for bank stock returns exhibiting a statistically significant inverse relationship with interest rate changes (Flannery and James, 1984; Brewer and 4 Lee, 1985; Scott and Peterson, 1986; Kane and Unal, 1988; Saunders and Yourougou, 1990; Kwan, 1991; Akella and Greenbaum, 1992; Choi et al., 1992).

Based on the previous research and methodology, this paper tries to discuss and answer these following questions:

- Does the Excess Return on Common Stock just follow the "Random Walk"?
- Do long-term interest rates have an impact on excess return of common stock? Statistically, is the relationship significant?
- Is the impact of long-term interest rates on excess returns ***uniform*** across the top 10 US banks?
- Is the effect of long-term interest rates on the excess return of bank common stock different before and after the financial crisis?

This research paper is organized into five sections. Section 1 is the Introduction. A literature review is provided in Section 2. This is followed by a section which deals with data, and econometric methodology. Findings are shown in Section 4. Conclusions and implications are given in the last section.

LITERATURE REVIEW

The effect of interest rates on stock returns has received considerable attention in literature. In the research paper in 1981, Fama proves that the expected inflation and short-term interest rates are negatively correlated with real economic activities. That is, the higher the

inflation rate, the lower the growth of real economic activities. Then, anticipated real activities are positively related to the return of stock prices since stock prices reflect values of corporations based on their actual growth. Therefore, expected inflation has a negative correlation with stock prices. In addition, the research also indicates the influence of long-term interest rates on stock prices through the effect of discount rates on the present value model.

Instead of focusing on the short-term interest rate and long-term interest rate, in 1987, Campbell investigated the effect between the yield spreads and stock market return by analyzing the effect of long-term interest rates on the excess return of the stock market. The yield spread is the difference between long-term and short-term interest rates. Excess return is the result of stock return after subtracting inflation rate (short-term interest rate). The result supports the effectiveness of term structure of interest rate by analyzing the return on the US stock market.

Kaul, in 1990, finds the opposite result to that of Fama (1981). The inflation rates are positively correlated with the return of stock price. In 1996, Zhou also concludes in his research that the interest rate has a crucial impact on the stock returns. His paper also finds that the high volatile return of the stock market is related to the high level of volatility of long-term bond yields due to the variation in price-dividend ratios.

In 1997, Lee analyzed the relationship of short-term interest rates and the stock market. He used the 3-year rolling regression to forecast the excess return with short-term interest rate as an independent variable. However, the relationship is not the same over time. Based on the earlier research, the interest rate has a negative correlation with the movement of stock market return.

Instead of examining the relationship between interest rates and stock returns in general, this paper focuses on the impact of interest rates on returns on stocks issued by financial holding companies. The long-term interest rate is used as a predictor to explain the excess returns which is defined as the difference between stock returns and short-term interest rates.

DATA AND METHODOLOGY

I. DATA

One of the dataset is the weekly closing common stock prices of the 10 largest US financial holding companies listed in New York Stock Exchange (NYSE) from 07/7/2000 to 03/08/2013. There are 660 observations. These banks are JP MORGAN CHASE (JPM), BANK OF AMERICA (BAC), CITIGROUP (C), WELLS FARGO CORPORATION (WJC), GOLDMAN SACHS (GS), MORGAN STANLEY (MS), U.S BANCORP (USB), BANK OF NEW YORK MELLON (BK), PNC FINANCIAL SERVICE GROUP (PNC), and CAPITAL ONE (COF). There are 84% of banking assets on the hand of the top 10 US banks.

In addition, the closing price of Financial Sector Index (XLF) of Select Sector SPDR was chosen for the same period. The 10-Year Swap Rate was chosen to represent the long-term interest rates, and One-Week Interbank was chosen as a short-term interest rate, which is used to calculate the excess returns.

The historical stock prices of banks and the financial sector was collected from the Factset, while The One-Week Interbank weekly rates and 10-Year Swap Rate are obtained from the Economic Research Data Center of the Federal Reserve Bank's website.

For the weekly return of stock prices, I compute the continuous compounding, which follows the formula:

$$R_t = 100^* \ln (P_t/P_{t-1})$$

Where P_t is the closing price at time t, P_{t-1} the closing price at time t-1, and Ln the natural log of price ratio.

As previously defined, the excess return is the difference between stock return and the One-Week Interbank rate.

$$R_{Excess} = R_t - R_f$$

R_f is the One-Week Interbank rate

II. MODEL

There are 3 main parts in my research paper:

a. Part 1: Randomness of Stock Return: Augmented Dickey-Fuller Test
b. Part2: The effect of long-term interest rates on banks' common stock excess return
c. Part 3: The relationship of long-term interest rates and excess return of banks' common stock **before and after** the Financial Crisis

Part 1: The first model was used to explore the Randomness of bank stock return is the Augmented Dickey-Fuller Test (A Unit Root Test). Augmented Dickey-Fuller Test is a test for unit root in a time series sample. The change in excess stock return is analyzed by the stock return of the previous period. I run simple regression to find out the coefficient of previous stock return and its t-ratio. Besides, the adjusted R Square is used to figure how strong the model is. R Square stands for coefficient of determination, which provides how well observed outcomes are explained by the model.

Test for a unit root:

$$\nabla y_t = \delta y_{t-1} + u_t$$

Part 2: The second model used to explore the effect of interest rates on bank stock return is a Two-Factor Model based on the Arbitrage Pricing Theory, which was introduced by the economist Stephen Ross in 1976.

Arbitrage Pricing Theory is "a general theory of asset pricing that holds that the expected return of financial asset can be modeled as a linear function of various macro-economic factors or theoretical market indices, where sensitivity to changes in each factor is represented by a factor-specific beta coefficient. "

The risky asset returns follow a group of factors, which is stated as the formula:

$$E(r_j) = r_f + b_{j1}RP_1 + b_{j2}RP_2 + b_{j3}RP_3 + b_{j4}RP_4 + ... + b_{jn}RP_n \quad (1)$$

where:

$E(r_j)$ = the asset's expected rate of return

r_f = the risk-free rate

b_j = the sensitivity of the asset's return to the particular factor

RP = the risk premium associated with the particular factor

In this research, I assume that there are only two factors, which are identified in the APT's model as the market portfolio and long-term interest rate changes. The formula in (1) then becomes:

$$R_{i,t} = \alpha_0 + [\alpha_1 - E(R_m)]\,\beta_{i,m} + [\alpha_2 - E(I)]\,\beta_{i,I} + \beta_{i,M} R_{M,t} + \beta_{i,I} I_t + \varepsilon_{i,t}$$

However, this model is not testable due to the lack of a market database. There is another model, which its form lacks theoretical foundation, but it is more flexible to test based on the price history and change in long-term interest rate. The general from of the new model is:

$$\mathbf{XR_{i,t}} = \alpha + \sum_{j=1}^{k} \beta_{i,j} \mathbf{XR_{i,t-j}} + \boldsymbol{\theta}_i \Delta I_{t-1} + \boldsymbol{\varepsilon}_{i,t}$$

Under this formula, the return on the bank stock is dependable on a set of variables Xi. In this research paper, I test the past returns on stock and the changes in long-term interest rates. I run a multiple regression based on 640 observations of data to find out the results, which I discuss in next part.

EMPIRICAL RESULTS

I. PART 1

Eleven hypotheses have been tested in regard to the stock returns of top 10 US banks and the Financial Sector Index. Each hypothesis follows a 5-step:

Step 1: State the null hypothesis and alternative hypothesis.

Step 2: Select the level of significance.

Step 3: Determine the test statistic.

Step 4: Formulate the decision rule.

Step 5: Make the decision regarding H_0 and interpret the result.

Summary statistics of excess returns on bank stocks are given in Appendix Ia, and the randomness of these is shown in Appendix 1b.

At 98% of confidence interval, all top 10 US Banks' excess returns and the financial Sector Index DO NOT follow the Random Walk. The t-values fluctuate from negative 23 to negative 27, which are significant at a 98% confidence interval for rejecting the null hypothesis. Therefore stock returns of top 10 US Banks and the Financial Sector Index. The next problem is which variables we choose to predict for banks' stock excess return. The change in long-term interest rates was selected as an independent variable to predict the excess return of banks common stock.

II. PART 2

A summary of my key research questions is shown on the Appendix 2a and 2b. The model proves sufficient explanatory power. Long-term interest rates and excess return of banks' common stock are positively correlated. Starting with the result for the Financial Sector Index, change in the long-term interest rate is presented and also affected positively on excess return on banks' common stocks. Similarly to the top 10 US banks, at 98% of confidence interval, the coefficient θ is always positive and is significant in all top 10 US Banks and the Financial Sector Index. The adjusted R square is the highest for the Financial Sector Index, which is 10.7%. R square of Citigroup is 3.5%, which is the lowest. R square of Bank of New York Mellon is 7.5%, which is the highest across the top 10 US banks. Even though the R square is not as high as we expected, the model still proves the significant effect of long-term interest rates on bank common stock return. In addition, the return on banks' stock depends on so many factors, not just solely on interest rate movement. Therefore, the low R square is understandable.

Second, the hypothesis of uniform interest rate sensitivity across top 10 US banks, where null hypothesis was that all changes in long-term interest rate coefficients are the same in

magnitude, is rejected. Therefore, change in long-term interest rates affects banks differently.

III. PART 3

Interest rates affect the banks' stock return differently before and after the Financial Crisis. Before the Financial Crisis, only 3 out of 10 banks had a testing significant at a 98% of confident interval to reject the null hypothesis, which means only 3 out of 10 banks' stock are significantly sensitive to interest rate movement. After the Financial Crisis, 10 out of 10 banks are significantly sensitive to interest rate movement. In addition, adjusted R square of 9 out of 10 banks of the model is significantly higher after the financial crisis compared with before the Financial Crisis. Therefore, after the Financial Crisis, interest rates not only have a stronger affect but also become a more accurate prediction factor on the banks' stock returns.

CONCLUSION

The research paper focused on the effect of long-term interest rates on banks' common stock return: evidence from the top 10 US banks and the Financial Sector Index. There are three main parts of hypothesis testing with the following results:

1. Banks' Stock Returns DO NOT Solely Follow the Random Walk.
2. Banks' Stock Returns are sensitive to interest rate movement.
3. Long-term interest rate and excess return of banks' common stock are positively correlated.
4. Interest rates affect the banks' stock return differently before and after the Financial Crisis.
5. After the Financial Crisis, interest rates not only have a stronger affect but also are a more accurate prediction factor on the banks' stock return.

IMPLICATION AND POTENTIAL FUTURE RESEARCH

I. IMPLICATION

These results indicate that the change in long-term interest rates has a positive correlation with the excess return of banks common stock. In December 2012, the Federal Reserve announced that they would push down the interest rate only if the jobless rate goes down. Pushing down the interest rate, especially long-term rate, for a long period of time might have a negative impact on the stock return of the financial industry. My first recommendation based on the findings of this research paper is to let the market determine the movement of the long-term interest rate. Too many regulations on interest rates really interrupt the growth of the financial sector.

Second, interest rates have a strong impact on bank common stock' return especially after the Financial Crisis. Therefore, investors in banking and financial sector index should observe monetary policies closely before making any investment decision. There are so many factors that affect the performance of banks stocks. However, understanding the correlation of macroeconomic variables like interest rates and predicting the movement of these variables will improve the chance of success in stock investment. Based on the current conditions of the US financial sector, it not a good time to invest heavily on the banking industry due to three main reasons. First, the financial sector is the most volatile sector in S&P 500 Index, which indicates the highest level of risk. Second, the banking industry is dealing with the overcapacity issues. The risks are associated with complicated and complex scope of the banking industry.

Third, the banking industry is facing the pressure of over regulations and low interest rate risk. These regulations include the higher capital requirement (Basel 3) and the change in accounting rule. Besides, the Fed continues to keep interest rates low for as long as it takes, past 2014.Based on the findings of this research paper, change in interest rate and stock return are positively correlated. Therefore, the decrease in interest rate is associated with the possibility of the decrease in stock return of financial holding companies.

Certain short-term opportunities still occur, but investors and portfolio managers should invest with caution and skepticism.

II. FUTURE RESEARCH CONSIDERATION

Although this research paper does prove the connection between interest rates and banks' stock return across the banking sector, the specific effect of change in interest rates on a specific bank is not discussed. It will be my intension to have further research about this topic, which is how individual banks react to the change of interest rates by managing their asset allocation to hedge the risk. Change is asset sensitivity and liability sensitivity will be focused to see how different banks manage the interest rate risk differently. Then, their performance is tested through their stock returns. It is promising for my future projects. A connection of stock return with the balance sheet and income statement of each bank will provide a better picture to make a better investment decision. In addition, instead of focusing on the excess return of banks stock and interest rate, the effect of the spread of yield curve on bank stock returns is also a promising topic for further research.

APPENDICES

Table 1A: Summary Statistics of Banks Excess Return

EXCESS RETURN	Mean	Standard Deviation	Sharpe Ratio	ADF
JP MORGAN CHASE (JPM)	-2.30	4.72	-0.49	-25.72
BANK OF AMERICA (BAC)	-2.36	7.40	-0.32	-24.69
CITIGROUP (C)	-2.60	8.83	-0.29	-26.09
WELLS FARGO CORPORATION (WJC)	-2.18	5.94	-0.37	-27.17
GOLDMAN SACHS (GS)	-2.18	5.78	-0.38	-25.63
MORGAN STANLEY (MS)	-2.44	8.07	-0.30	-29.62
U.S BANCORP (USB)	-2.19	5.68	-0.39	-27.34
BANK OF NEW YORK MELLON (BK)	-2.35	5.30	-0.44	-25.38
PNC FINANCIAL SERVICE GROUP (PNC)	-2.22	5.82	-0.38	-28.00
CAPITAL ONE (COF)	-2.24	7.41	-0.30	-25.93
FINANCIAL INDEX (XLF)	-2.30	4.72	-0.49	-23.04

Note: Descriptive statistics for the sample period from July 7th, 2000 to March 15th, 2013. ADF stands for Augmented Dickey-Fuller test (Dickey and Fuller, 1979 and 1981). The Sharpe Ratio is the result of the sample mean divided by the sample standard deviation.

Part 1B: Randomness of Stock Returns: Augmented Dickey-Fuller Test

- **Does the Excess Return on Bank Common Stock just Follow the "Random Walk"?**

Test for a unit root:

$$\nabla y_t = \delta y_{t-1} + u_t$$

"Random Walk" Testing by using Augmented Dickey-Fuller Testing Method				
Summary of Key Research Questions, Specificationof Hypothesis Test and Major Findings				
Research Question	*Null Hypothesis*	*t-value*	*Test Result*	*Answer*
Q1: Are the excess returns of **Financial Sector Index (XLF)** solely "Random Walk"?	Ho: β1 = 0	-23.040	Reject the Null Hypothesis	**NO**
Q2: Are the excess returns of **JP MORGAN CHASE (JPM)** solely "Random Walk"?	Ho: β2 = 0	-25.716	Reject the Null Hypothesis	**NO**
Q3: Are the excess returns of **BANK OF AMERICA (BAC)** solely "Random Walk"?	Ho: β3 = 0	-24.692	Reject the Null Hypothesis	**NO**
Q4: Are the excess returns of **CITIGROUP (C)** solely "Random Walk"?	Ho: β4 = 0	-26.095	Reject the Null Hypothesis	**NO**
Q5: Are the excess returns of **WELLS FARGO CORPORATION (WJC)** solely "Random Walk"?	Ho: β5 = 0	-27.171	Reject the Null Hypothesis	**NO**
Q6: Are the excess returns of **GOLDMAN SACHS (GS)** solely "Random Walk"?	Ho: β6 = 0	-25.628	Reject the Null Hypothesis	**NO**
Q7: Are the excess returns of **MORGAN STANLEY (MS)** solely "Random Walk"?	Ho: β7 = 0	-29.621	Reject the Null Hypothesis	**NO**
Q8: Are the excess returns of **U.S BANCORP (USB)** solely "Random Walk"?	Ho: β8 = 0	-27.336	Reject the Null Hypothesis	**NO**
Q9: Are the excess returns of **BANK OF NEW YORK MELLON (BK)** solely "Random Walk"?	Ho: β9 = 0	-25.378	Reject the Null Hypothesis	**NO**
Q10: Are the excess returns of **PNC FINANCIAL SERVICE GROUP (PNC)** solely "Random Walk"?	Ho: β10 = 0	-27.998	Reject the Null Hypothesis	**NO**
Q11: Are the excess returns of **CAPITAL ONE (COF)** solely "Random Walk"?	Ho: β11 = 0	-25.929	Reject the Null Hypothesis	**NO**

Note: Alternative is acceptable at 98% confidence interval.

Part 2: The Effects of Long-Term Interest Rate on Banks' Common Stock Excess Return

- **Weekly Return: $R_t = 100\%* \ln (P_t/P_{t-1})$ (Continuously Compounding)**
- **Excess Return: $R_{Excess} = R_t - R_f$**
  - **R_f is the One-Week Interbank rate**

$$\mathbf{XR}_{i,t} = \alpha + \sum_{j=1}^{k} \beta_{i,j} \mathbf{XR}_{i,t-j} + \theta_i \Delta I_{t-1} + \varepsilon_{i,t}$$

Table 2: Regression Test Results					
2000-2013					
Banks	**α**	**β1**	**β2**	**θ**	**Adjusted R Square**
JP MORGAN CHASE (JPM)	-1.849	-0.019	0.168	**8.861**	5.119%
	-6.981	*-0.500*	*4.425*	*4.288*	
BANK OF AMERICA (BAC)	-1.898	0.031	0.117	**12.828**	4.999%
	-6.161	*0.828*	*3.072*	*5.226*	
CITIGROUP (C)	-2.383	-0.025	0.065	**14.188**	3.470%
	-6.484	*-0.643*	*1.701*	*4.796*	
WELLS FARGO CORPORATION (WJC)	-1.807	-0.054	0.195	**6.953**	5.418%
	-7.072	*-1.415*	*5.148*	*3.533*	
GOLDMAN SACHS (GS)	-1.747	-0.004	0.172	**9.630**	6.623%
	-7.080	*-0.106*	*4.559*	*5.055*	
MORGAN STANLEY (MS)	-2.425	-0.133	0.094	**14.057**	6.794%
	-7.254	*-3.498*	*2.462*	*5.281*	
U.S BANCORP (USB)	-1.762	-0.056	0.224	**6.081**	6.331%
	-7.163	*-1.491*	*5.934*	*3.251*	
BANK OF NEW YORK MELLON (BK)	-1.862	-0.010	0.175	**10.522**	7.517%
	-7.948	*-0.272*	*4.674*	*6.053*	
PNC FINANCIAL SERVICE GROUP (PNC)	-1.970	-0.086	0.168	**6.915**	4.738%
	-7.732	*-2.236*	*4.403*	*3.555*	
CAPITAL ONE (COF)	-1.794	-0.018	0.188	**8.630**	4.741%
	-5.829	*-0.468*	*4.948*	*3.493*	
FINANCIAL INDEX (XLF)	-1.515	0.062	0.250	**8.179**	10.683%
	-7.278	*1.665*	*6.738*	*5.367*	

TABLE 2A: REGRESSION TEST RESULTS

Note: The numbers in the italic below the point estimates stand for t-ratios. Adjusted R Square stands for adjusted coefficient of determination.

TABLE 2B

Cross-Sectional Variation of Interest Rate Sensitivity: 2000-2013				
Summary of Key Research Questions, Specificationof Hypothesis Test and Major Findings				
Research Question	***Null Hypothesis***	***t-value***	***Test Result***	***Answer***
Q12: Are the excess returns of **Financial Sector Index (XLF)** sensitive to the changes in long-term interest rate?	Ho: $\theta 1 = 0$	5.367	Reject the Null Hypothesis	**Yes**
Q13: Are the excess returns of **JP MORGAN CHASE (JPM)** sensitive to the changes in long-term interest rate?	Ho: $\theta 2 = 0$	4.287	Reject the Null Hypothesis	**Yes**
Q14: Are the excess returns of **BANK OF AMERICA (BAC)** sensitive to the changes in long-term interest rate?	Ho: $\theta 3 = 0$	5.226	Reject the Null Hypothesis	**Yes**
Q15: Are the excess returns of **CITIGROUP (C)** sensitive to the changes in long-term interest rate?	Ho: $\theta 4 = 0$	4.796	Reject the Null Hypothesis	**Yes**
Q16: Are the excess returns of **WELLS FARGO CORPORATION (WJC)** sensitive to the changes in long-term interest rate?	Ho: $\theta 5 = 0$	3.533	Reject the Null Hypothesis	**Yes**
Q17: Are the excess returns of **GOLDMAN SACHS (GS)** sensitive to the changes in long-term interest rate?	Ho: $\theta 6 = 0$	5.055	Reject the Null Hypothesis	**Yes**
Q18: Are the excess returns of **MORGAN STANLEY (MS)** sensitive to the changes in long-term interest rate?	Ho: $\theta 7 = 0$	5.281	Reject the Null Hypothesis	**Yes**
Q19: Are the excess returns of **U.S BANCORP (USB)** sensitive to the changes in long-term interest rate?	Ho: $\theta 8 = 0$	3.251	Reject the Null Hypothesis	**Yes**
Q20: Are the excess returns of **BANK OF NEW YORK MELLON (BK)** sensitive to the changes in long-term interest rate?	Ho: $\theta 9 = 0$	6.053	Reject the Null Hypothesis	**Yes**
Q21: Are the excess returns of **PNC FINANCIAL SERVICE GROUP (PNC)** sensitive to the changes in long-term interest rate?	Ho: $\theta 10 = 0$	3.555	Reject the Null Hypothesis	**Yes**
Q22: Are the excess returns of **CAPITAL ONE (COF)** sensitive to the changes in long-term interest rate?	Ho: $\theta 11 = 0$	3.493	Reject the Null Hypothesis	**Yes**
Q23: Are the excess return of banks' common stock of the top 10 US banks and Financial Sector index sensitive ***UNIFORMLY*** to the change in long-term interest rate?	Ho: $\theta 1 = \theta 2 = \theta 3 = \theta 4 = \theta 5 = \theta 6 = \theta 7 = \theta 8 = \theta 9 = \theta 10 = \theta 11$	29.490	Reject the Null Hypothesis	**NO**
Q24: Q12: Do the excess return of banks' common stock of the top 10 US banks and Financial Sector index have **POSITIVE CORRELATION** with the change in long-term interest rate?	Ho: $\theta 1, \theta 2, \theta 3, \theta 4, \theta 5, \theta 6, \theta 7, \theta 8, \theta 9, \theta 10, \theta 11 \leq 0$	11.240	Reject the Null Hypothesis	**Yes**

Note: Alternative is acceptable at 98% confidence interval

Part 3: The Relationship of Long-Term Interest Rate and Excess Return of Banks' Common Stock Before and After Financial Crisis

TABLE 3A: BEFORE THE FINANCIAL CRISIS

Table 3: Regression Test Results Before Financial Crisis: 2000-Sep 2008					
Bank	α	β1	β2	θ	Adjusted R Square
JP MORGAN CHASE (JPM)	-2.608	0.107	0.104	**5.196**	3.25%
	-8.022	*2.212*	*2.151*	*2.289*	
BANK OF AMERICA (BAC)	-2.309	0.157	0.116	**2.999**	4.59%
	-8.077	*3.225*	*2.395*	*1.576*	
CITIGROUP (C)	-2.526	0.054	0.218	**6.184**	7.11%
	-8.115	*1.123*	*4.630*	*3.024*	
WELLS FARGO CORPORATION (WJC)	-2.406	0.070	0.169	**1.818**	3.10%
	-8.578	*1.450*	*3.487*	*1.059*	
GOLDMAN SACHS (GS)	-2.417	0.032	0.201	**6.376**	6.01%
	-8.120	*0.675*	*4.271*	*3.183*	
MORGAN STANLEY (MS)	-2.966	0.008	0.128	**6.101**	2.49%
	-8.462	*0.171*	*2.657*	*2.470*	
U.S BANCORP (USB)	-2.341	0.109	0.148	**2.669**	3.68%
	-8.104	*2.273*	*3.099*	*1.407*	
BANK OF NEW YORK MELLON (BK)	-2.686	0.014	0.164	**7.495**	5.33%
	-8.663	*0.303*	*3.463*	*3.764*	
PNC FINANCIAL SERVICE GROUP (PNC)	-2.366	0.095	0.164	**1.341**	3.46%
	-8.489	*1.964*	*3.414*	*0.765*	
CAPITAL ONE (COF)	-2.587	0.139	0.077	**3.801**	2.88%
	-7.341	*2.831*	*1.594*	*1.434*	
FINANCIAL INDEX (XLF)	-2.091	0.119	0.246	**4.202**	10.16%
	-8.168	*2.517*	*5.263*	*2.821*	

TABLE 3B: AFTER THE FINANCIAL CRISIS

Table 4: Regression Test Results After Financial Crisis: Sep 2008-2013					
Bank	α	β1	β2	θ	Adjusted R Square
JP MORGAN CHASE (JPM)	-0.165	-0.258	0.057	15.763	11.64%
	-0.363	*-4.022*	*0.904*	*4.293*	
BANK OF AMERICA (BAC)	-0.497	-0.019	0.079	25.437	8.25%
	-0.727	*-0.304*	*1.257*	*4.691*	
CITIGROUP (C)	-0.754	-0.065	0.000	24.478	4.57%
	-0.880	*-1.009*	*0.006*	*3.604*	
WELLS FARGO CORPORATION (WJC)	-0.214	-0.189	0.107	13.869	8.42%
	-0.415	*-2.954*	*1.672*	*3.385*	
GOLDMAN SACHS (GS)	-0.245	-0.127	0.035	14.875	7.98%
	-0.543	*-2.007*	*0.542*	*4.123*	
MORGAN STANLEY (MS)	-0.487	-0.252	-0.015	24.199	13.55%
	-0.716	*-3.986*	*-0.242*	*4.439*	
U.S BANCORP (USB)	-0.295	-0.281	0.111	10.982	12.55%
	-0.666	*-4.367*	*1.720*	*3.112*	
BANK OF NEW YORK MELLON (BK)	-0.418	-0.179	0.040	14.706	10.93%
	-1.111	*-2.854*	*0.642*	*4.923*	
PNC FINANCIAL SERVICE GROUP (PNC)	-0.363	-0.284	0.041	14.347	11.37%
	-0.744	*-4.412*	*0.635*	*3.673*	
CAPITAL ONE (COF)	-0.152	-0.179	0.160	13.623	8.99%
	-0.262	*-2.795*	*2.496*	*2.959*	
FINANCIAL INDEX (XLF)	-0.260	-0.089	0.128	13.883	9.52%
	-0.697	*-1.417*	*2.054*	*4.683*	

Note: The numbers in the italic below the points estimate stand for t-ratios. Adjusted R Square stands for adjusted coefficient of determination

TABLE 3C: TESTING RESULT (BEFORE THE FINANCIAL CRISIS)

Cross-Sectional Variation of Interest Rate Sensitivity: 2000-Sep 2008				
Summary of Key Research Questions, Specificationof Hypothesis Test and Major Findings				
Research Question	***Null Hypothesis***	***t-value***	***Test Result***	***Answer***
Q25: Are the excess returns of **Financial Sector Index (XLF)** sensitive to the changes in long-term interest rate?	Ho: θ1 = 0	2.821	Reject the Null Hypothesis	**Yes**
Q26: Are the excess returns of **JP MORGAN CHASE (JPM)** sensitive to the changes in long-term interest rate?	Ho: θ2 = 0	2.289	Accept the Null Hypothesis	**No**
Q27: Are the excess returns of **BANK OF AMERICA (BAC)** sensitive to the changes in long-term interest rate?	Ho: θ3 = 0	1.576	Accept the Null Hypothesis	**No**
Q28: Are the excess returns of **CITIGROUP (C)** sensitive to the changes in long-term interest rate?	Ho: θ4 = 0	3.024	Reject the Null Hypothesis	**Yes**
Q29: Are the excess returns of **WELLS FARGO CORPORATION (WJC)** sensitive to the changes in long-term interest rate?	Ho: θ5 = 0	1.059	Accept the Null Hypothesis	**No**
Q30: Are the excess returns of **GOLDMAN SACHS (GS)** sensitive to the changes in long-term interest rate?	Ho: θ6 = 0	3.183	Reject the Null Hypothesis	**Yes**
Q31: Are the excess returns of **MORGAN STANLEY (MS)** sensitive to the changes in long-term interest rate?	Ho: θ7 = 0	2.470	Accept the Null Hypothesis	**No**
Q32: Are the excess returns of **U.S BANCORP (USB)** sensitive to the changes in long-term interest rate?	Ho: θ8 = 0	1.407	Accept the Null Hypothesis	**No**
Q33: Are the excess returns of **BANK OF NEW YORK MELLON (BK)** sensitive to the changes in long-term interest rate?	Ho: θ9 = 0	3.764	Reject the Null Hypothesis	**Yes**
Q34: Are the excess returns of **PNC FINANCIAL SERVICE GROUP (PNC)** sensitive to the changes in long-term interest rate?	Ho: θ10 = 0	0.765	Accept the Null Hypothesis	**No**
Q35: Are the excess returns of **CAPITAL ONE (COF)** sensitive to the changes in long-term interest rate?	Ho: θ11 = 0	1.434	Accept the Null Hypothesis	**No**
Q36: Are the excess return of banks' common stock of the top 10 US banks and Financial Sector index sensitive ***UNIFORMLY*** to the change in long-term interest rate?	Ho: θ1= θ2= θ3= θ4= θ5= θ6= θ7= θ8= θ9= θ10= θ11	30.749	Reject the Null Hypothesis	**No**
Q37: Q12: Do the excess return of banks' common stock of the top 10 US banks and Financial Sector index have **POSITIVE CORRELATION** with the change in long-term interest rate?	Ho: θ1, θ2, θ3, θ4, θ5, θ6, θ7, θ8, θ9, θ10, θ11 ≤ 0	7.126	Reject the Null Hypothesis	**Yes**

Note: Alternative is acceptable at 98% confidence interval.

TABLE 3D: TESTING RESULT (*AFTER THE FINANCIAL CRISIS)*

Cross-Sectional Variation of Interest Rate Sensitivity: Sep 2008-2013				
Summary of Key Research Questions, Specificationof Hypothesis Test and Major Findings				
Research Question	***Null Hypothesis***	***t-value***	***Test Result***	***Answer***
Q38: Are the excess returns of **Financial Sector Index (XLF)** sensitive to the changes in long-term interest rate?	Ho: $\theta 1 = 0$	4.683	Reject The Null Hypothesis	**Yes**
Q39: Are the excess returns of **JP MORGAN CHASE (JPM)** sensitive to the changes in long-term interest rate?	Ho: $\theta 2 = 0$	4.293	Reject The Null Hypothesis	**Yes**
Q40: Are the excess returns of **BANK OF AMERICA (BAC)** sensitive to the changes in long-term interest rate?	Ho: $\theta 3 = 0$	4.691	Reject The Null Hypothesis	**Yes**
Q41: Are the excess returns of **CITIGROUP (C)** sensitive to the changes in long-term interest rate?	Ho: $\theta 4 = 0$	3.604	Reject The Null Hypothesis	**Yes**
Q42: Are the excess returns of **WELLS FARGO CORPORATION (WJC)** sensitive to the changes in long-term interest rate?	Ho: $\theta 5 = 0$	3.385	Reject The Null Hypothesis	**Yes**
Q43: Are the excess returns of **GOLDMAN SACHS (GS)** sensitive to the changes in long-term interest rate?	Ho: $\theta 6 = 0$	4.123	Reject The Null Hypothesis	**Yes**
Q44: Are the excess returns of **MORGAN STANLEY (MS)** sensitive to the changes in long-term interest rate?	Ho: $\theta 7 = 0$	4.439	Reject The Null Hypothesis	**Yes**
Q45: Are the excess returns of **U.S BANCORP (USB)** sensitive to the changes in long-term interest rate?	Ho: $\theta 8 = 0$	3.112	Reject The Null Hypothesis	**Yes**
Q46: Are the excess returns of **BANK OF NEW YORK MELLON (BK)** sensitive to the changes in long-term interest rate?	Ho: $\theta 9 = 0$	4.923	Reject The Null Hypothesis	**Yes**
Q47: Are the excess returns of **PNC FINANCIAL SERVICE GROUP (PNC)** sensitive to the changes in long-term interest rate?	Ho: $\theta 10 = 0$	3.673	Reject The Null Hypothesis	**Yes**
Q48: Are the excess returns of **CAPITAL ONE (COF)** sensitive to the changes in long-term interest rate?	Ho: $\theta 11 = 0$	2.959	Reject The Null Hypothesis	**Yes**
Q49: Are the excess return of banks' common stock of the top 10 US banks and Financial Sector index sensitive ***UNIFORMLY*** to the change in long-term interest rate?	Ho: $\theta 1 = \theta 2 = \theta 3 = \theta 4 = \theta 5 = \theta 6 = \theta 7 = \theta 8 = \theta 9 = \theta 10 = \theta 11$	100.308	Reject The Null Hypothesis	**No**
Q50: Do the excess return of banks' common stock of the top 10 US banks and Financial Sector index have **POSITIVE CORRELATION** with the change in long-term interest rate?	Ho: $\theta 1, \theta 2, \theta 3, \theta 4, \theta 5, \theta 6, \theta 7, \theta 8, \theta 9, \theta 10, \theta 11 \leq 0$	10.917	Reject The Null Hypothesis	**Yes**

Note: Alternative is acceptable at 98% confidence interval.

REFERENCES

Bernanke, B. S. and K. N. Kuttner (2005): "What Explains the Stock Market's Reaction to Federal Reserve Policy?" *Journal of Finance*, 60, 1221–1257.

Campbell, J.Y. (1987). Stock Return And the Term Structure. *Journal of Financial Economics*, 18, 3730-399.

Choi, J. J. and E. Elyasiani (1997): "Derivative Exposure and the Interest Rate and Exchange Rate Risks of U.S. Banks," *Journal of Financial Services Research*, 12, 267–286.

Dickey, David A. and *Wayne A Fuller* Likelihood Ratio Statistics for Autoregressive Time Series with A Unit Root. *Econometrica*, 1981, 49, (4), 1057-72

Fama, E. (1981). Stock returns, real activity, inflation and money. *American Economic Review*, 71, 545-564. 0119

Flannery, M. J. (1981): "Market Interest Rates and Commercial Bank Profitability: An Empirical Investigation," *Journal of Finance*, 5, 1085–1101.

Flannery, M. J. (1981): "Market Interest Rates and Commercial Bank Profitability: An Empirical Investigation," *Journal of Finance*, 5, 1085–1101.

Kwan, S. H. (1991): "Re-examination of Interest Rate Sensitivity of Commercial Bank Stock Returns Using a Random Coefficient Model," *Journal of Financial Services Research*, 5, 61–76

Kaul, G. (1990). Monetary Regimes and the Relation Between Stock Returns and Inflationary Expectations. *Journal of Financial and Quantitative Analysis*, 15, 307-321.
Kwan, 1991;

Rotkowski, AM 2011, 'Estimating Stock Price Volatility in the Black-Scholes-Merton Model', *Value Examiner*, pp. 13-19, Business Source Complete, EBSCO*host*, viewed 23 September 2012.

Wong, Wing-Keung, Habibullah Khan, And Jun Du. 2006. "Do Money And Interest Rates Matter For Stock Prices? An Econometric Study of Singapore and USA." *Singapore Economic Review* 51, no. 1: 31-51. *Business Source Complete*, EBSCO*host* (accessed September 23, 2012).

Zhou, C. (1996). Stock Market Fluctuations and the Term Structure. Board of Governors of the Federal Reserve System,*Finance and Economics Discussion Series: 96/03*

Walker, Susanne. "Treasuries Rise as Euro Falls; Most U.S Stocks Retreat". Bloomberg Business News. Online Source.