ERASMUS UNIVERSITY ROTTERDAM
ERASMUS SCHOOL OF ECONOMICS
MSc Economics & Business
Specialization Financial Economics

The Effect Of The Switch In Monetary Policy By The FED On Bank Stock Prices

Author: L.B. Drost
Student number: 467902
Thesis supervisor: Dr. J.J.G. Lemmen
Second reader: Dr. J.C.M. Kil
Finish date: 28-2-2023

PREFACE AND ACKNOWLEDGEMENTS

I would like to thank my thesis supervisor Dr. J.J.G. Lemmen for his patience, detailed feedback, and thoughtful insights throughout the master thesis trajectory.

ABSTRACT

This study examines the effect of switching from monetary expansion to monetary tightening by the FED, signaled by an interest rate increase, on US bank stock prices. First, an event study is conducted to calculate the abnormal returns of the interest rate increase. The study finds statistically significant cumulative average abnormal returns of -5.16%, -2.48%, -1.86%, and -2.41% across the four event windows. After establishing the abnormal return, a regression analysis is conducted to analyze the influence of financial stability factors on the abnormal return. The regression analysis produces statistically significant negative results for bank size, indicating that the effect of monetary tightening on bank stock returns is more pronounced in banks with a larger number of assets, which is in accordance with the findings of previous studies. Existing literature attributes this effect to the fact that large banks finance a more significant share of their borrowings through short-term borrowings in the money market, which the FED does not insure. Thus, large banks are associated with higher risk following the switch in monetary policy. However, this study finds statistically significant evidence that banks that rely more on retail funding than wholesale funding experience a more significant negative effect of monetary policy on bank stock returns. Possible explanations for this finding are that banks relying less on retail funding are better able to generate profits because of the increased capital available. Also, banks with a more diverse mix of funding sources are perceived as more financially stable and less exposed to liquidity risk. The analysis does not find statistically significant results for capital ratio and credit reserves, indicating that investors disregard these factors as indicators of the financial stability of banks after the interest rate increase. However, when performing the regression with the ratio of tier 1 capital of banks instead of the combined tier 1 and tier 2 capital ratio, a statistically significant positive effect of tier 1 capital ratio on the abnormal return is found, which is in accordance with theory.

Keywords: Event study, monetary policy, bank stock prices, financial stability
JEL Classification: G14; G18; G21

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1 Introduction

"Inflation is as violent as a mugger, as frightening as an armed robber, and as deadly as a hit man." This quote by Ronald Reagan, former president of the United States of America, emphasizes the severity of the effects that extreme inflation withholds. In February 2022, inflation reached 7.9%, the highest since 1982. By doing so, the drastically high inflation level restrained the Federal Reserve (hereafter referred to as FED), the central bank of the USA, from fulfilling its mandate of keeping prices constant. Consequently, on the 16th of March this year, the FED announced a series of interest rate increases (CNBC, 2022). The announcement marked the first rise in interest rates since December 2018. During the post-meeting testimony, FED chairman Jerome Powell expressed the committee's awareness of the potential risks of increasing inflation and inflation expectations and emphasized their determination to implement measures to restore price stability. In a subsequent press event, Powell reiterated the importance of seeing a clear and convincing decrease in inflation and affirmed the committee's commitment to persist in their efforts until that is achieved (FED, 2022). As follows from above, in an attempt to battle the soaring levels of inflation, the FED yields its most important tool, namely the target federal funds target rate[1]. In doing so, the announcement of the interest rate increase marks a notable shift in the monetary policy of the FED, namely, a shift from monetary expansion to monetary tightening.

Numerous studies exist on monetary policy, particularly the association between monetary policy and stock market prices. However, the literature presents a mixed view, as some studies show a positive correlation, while others demonstrate a negative correlation. For example, Thorbecke (1997) and Bernanke and Kuttner (2005) posit that expansionary monetary policy is positively associated with stock market prices, while tight monetary policy is negatively associated with stock market prices. Sellin (2001) presents arguments for a positive and negative relationship between monetary policy and stock prices. Bernanke and Kuttner explain that monetary policy aims to influence macroeconomic variables such as output and inflation, and the most direct effects of monetary policy actions are on financial markets. However, the relationship between monetary policy and bank stock prices is less extensive, despite banks' central role in monetary policy. Notable studies regarding monetary policy and bank stock prices are that of Madura and Schnusenberg (2000) and Yin and Yang (2013), which find a negative relationship between an interest rate increase and bank stock prices. This study contributes to the existing literature in two ways. First, there is no study regarding the effect of the recent interest rate increase by the FED because it occurred so recently. Second, this study investigates the state-dependent effectiveness of monetary policy, in this case, monetary tightening, while taking yet uninvestigated

[1] The Federal Reserve yields three tools of monetary policy; open market operations, the discount rate, and reserve requirements (FED website). By adjusting the supply of reserves in the market and encouraging or discouraging banks from lending to each other, the FED can affect the federal funds rate.

financial stability considerations into account. Following from what is stated above, the research question of this study reads:

RQ: *How will switching from expansionary to tight monetary policy by the Federal Reserve affect commercial bank stock prices in the US?*

In an attempt to wholly answer the research question, an event study is conducted in which the presence of abnormal returns will be examined. After this, a regression analysis is performed to analyze the drivers of the abnormal return obtained through the event study. The drivers are four bank-specific characteristics: bank size, funding source, capital ratio, and credit reserves. This paper finds negative abnormal returns for US bank stock prices after the interest rate increase by the FED, indicating that monetary tightening has a negative effect on bank stock returns in the US. Furthermore, this paper finds statistically significant evidence that bank size has a negative effect on abnormal returns. To clarify, larger banks, measured by total assets, experience a greater effect of monetary policy on their stock price. Moreover, the paper finds statistically significant evidence that funding source has a negative effect on the abnormal return, indicating that the more a bank relies on wholesale funding instead of retail funding, the larger the negative effect of monetary tightening on bank stock returns. Finally, the paper finds insignificant results for credit reserves and capital ratio, indicating that investors disregard these factors as indicators of the financial stability of banks after the interest rate increase. However, a regression is performed with the ratio of tier 1 capital of banks instead of the combined tier 1 and tier 2 capital ratio as a robustness check, and a statistically significant positive effect of tier 1 capital ratio on the abnormal return is found.

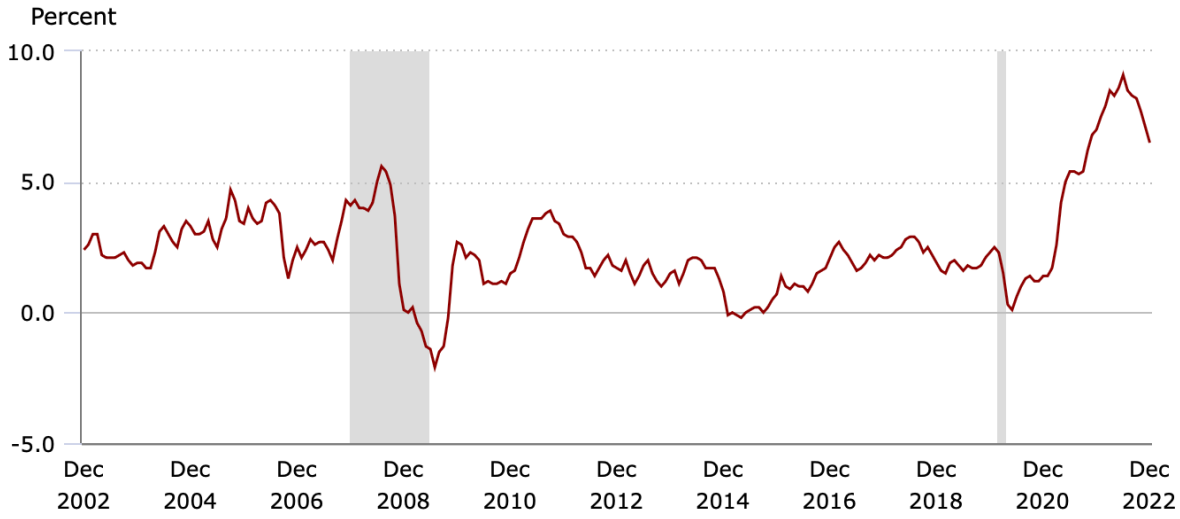
The remainder of the paper is organized as follows. Chapter 2 provides a review of the existing literature. Chapter 3 provides a description of the data. Chapter 4 provides the methodology. In chapter 5, the results are discussed, and several robustness checks are performed. Chapter 6 offers the conclusion and a discussion of the shortcomings of this study and offers ideas for future research.

CHAPTER 2 Literature Review

2.1 Source of the shift in monetary policy: inflation

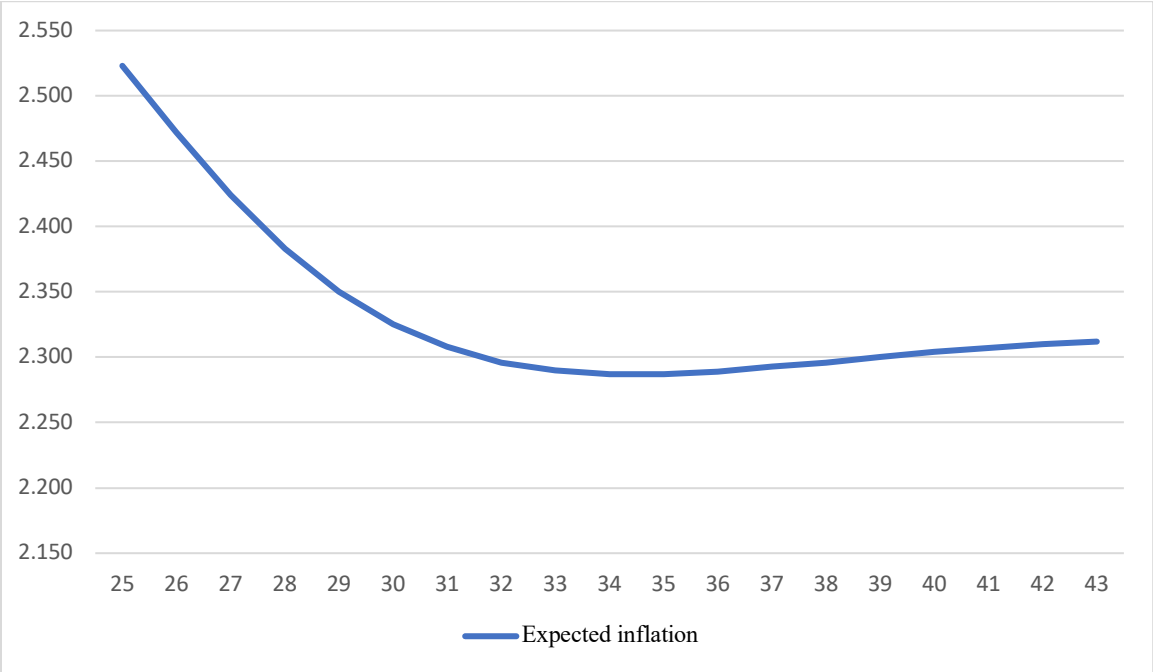
In analyzing the correlation between bank stock prices and the increase in the federal funds rate, it is crucial to investigate the underlying causes of this increase. In the context of this study, the primary driver is the unprecedented inflation currently experienced in the United States. According to the Federal Reserve's website, the Federal Reserve Act mandates that the Federal Reserve conducts monetary policy to maximize employment and maintain price stability. Data released by the Bureau of Labor Statistics showed that over the twelve months since February 2021, the Consumer Price Index (CPI) increased by 7.9 percent, the highest inflation level in forty years. This increase was primarily driven by an increase in energy prices of almost 25.6%. A further main driver of the CPI was food prices which experienced an average price increase of 7.9% since last February. These statistics show that the FED (before March 16, 2022) was not fulfilling its mandate of keeping prices stable and thus needed to act.

Figure 1 Year-on-year change in CPI in the US from 2002 – 2022, the shaded areas represent a recession



Adapted source: US Bureau of Labor Statistics

Figure 2 Expected inflation in the US. The y-axis represents the inflation rate as a percentage, and the x-axis represents the year starting from 2025.



Note: the expected inflation is the break-even rate reported by the FED on its website. The break-even rate is the difference between the long-term nominal bond yield and the real yield available on an index-linked bond of the same maturity.

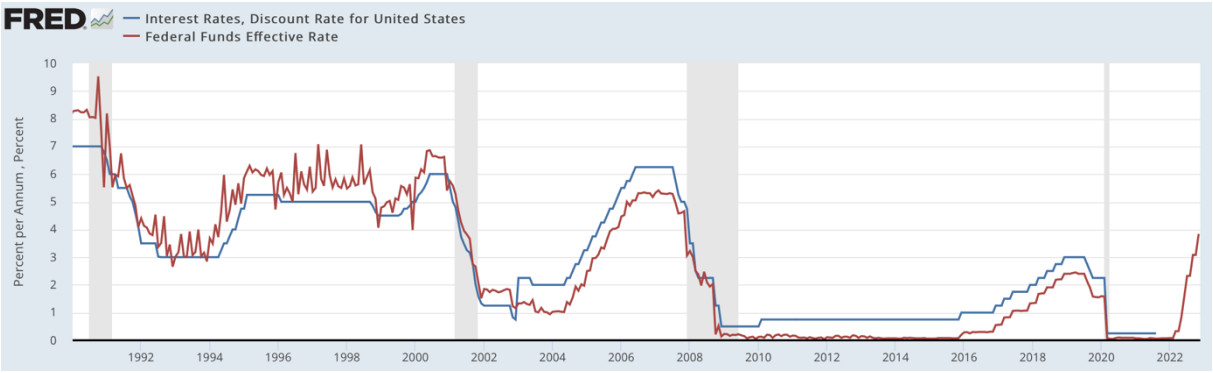
2.2 Monetary policy in the US

When analyzing the current monetary policy in the United States, a comprehensive understanding of the mechanisms and processes of monetary policy implementation is essential. However, before delving into the specifics of monetary policy conduct, it is imperative to establish a clear conceptual framework by defining key terms and relationships.

A distinction must be made between the target federal funds rate and the discount rate. In practice, these two terms are used interchangeably. However, the target federal funds rate and the discount rate are different. First, it must be explained that depository institutions such as banks are obligated by the FED to keep a percentage of these deposits as reserves. These institutions are required by the Federal Reserve (FED) to hold a certain percentage of their deposits in the form of reserves. These reserves can fluctuate on a daily basis due to the lending and borrowing activities of the institutions. As a result, depository institutions may sometimes find themselves with excess reserves and, at other times, with a shortage of reserves. In instances of excess reserves, these institutions typically lend out these funds to other institutions and vice versa in cases of a shortage. This exchange of reserves between depository institutions is known as the federal funds market, and the interest rate used in this market is referred to

as the federal funds rate. Additionally, depository institutions have the option to borrow funds directly from the Federal Reserve. However, the interest rate charged by the FED for these loans, known as the discount rate, is typically higher than the rate charged in the federal funds market. The discount rate is determined by the Boards of Directors of the Reserve Banks under the supervision of the Federal Reserve Board. Since January 2003, the discount rate has been set 100 basis points higher than the federal funds rate to encourage banks to exhaust the federal funds market before turning to the FED for funding. Before 2003, the federal funds rate and the discount rate were not always consistent, with each rate occasionally exceeding the other.

Figure 3 Historical overview of the federal funds rate and the discount rate in the United States from 1990 – 2022



Adapted source: Federal Reserve Bank of St. Louis

Besides the discount rate and reserve requirements, the FED yields open market operations as a tool for monetary policy. Open market operations involve buying and selling government securities, including Treasury bills, notes, and bonds, in the open market. Specifically, when the Federal Reserve purchases government securities, it infuses additional liquidity into the economy, increasing the money supply. Conversely, when the Federal Reserve sells government securities, it drains liquidity from the economy, leading to a reduction in the money supply. Through its ability to adjust the supply of reserves and incentivize or disincentivize interbank lending, the FED has the power to impact the federal funds rate to achieve the target federal funds rate set by the FOMC (FOMC website). During a monetary tightening period, the FED raises the target federal funds rate in an effort to decrease the money supply and impede economic activity. Monetary expansion entails the exact opposite. This form of monetary policy is often employed during economic recessions, in which the FED lowers the interest rate, making it less expensive for commercial banks to meet their reserve requirements. This, in turn, makes saving less attractive and encourages investments and consumer spending.

It is important to note that the Federal Reserve (FED) shifted its monetary policy focus from reserve targeting to targeting the federal funds rate in 1982 (Thorbecke, 2006). However, there is debate surrounding the exact date of this shift. The FED never officially announced when they began targeting the federal funds rate again, and some studies suggest that the shift occurred in 1987. This study will only address existing literature regarding the period before October 1979 and the federal funds rate targeting period after that and will not consider any periods of reserve targeting. Additionally, the relationship between the tools available to the FED and their influence on the target federal funds rate is a topic that demands further research and is not the primary focus of this study. Instead, this study will examine the effect of announcements of changes in the target federal funds rate on bank stock prices in the US, disregarding the dynamics of the federal funds rate itself.

2.3 Existing literature regarding monetary policy and stock prices

There is extensive existing literature regarding the relationship between stock prices and monetary policy. From this extensive literature, it becomes apparent that there is a scholarly consensus that tight (expansive) monetary policy is associated with higher (lower) future interest rates and reduced (increased) levels of economic activity. The earliest studies include that of the influential economist James Tobin in which he described his now-famous Tobin's Q in a paper published in 1969. In this paper, Tobin posits that monetary policy can significantly impact the ratio in question. Specifically, he contends that a tightening monetary policy resulting from a rise in inflation decreases the present value of future earning streams, negatively impacting stock market performance. Since Tobin, many economists have explored this relationship and approached it from different perspectives. This section provides an overview of the most notable and relevant studies to this paper.

The aforementioned theory about the incorporation of future interest rate changes in stock prices is covered extensively in the study by Sellin from 2001. The study analyzes the existing literature on the relationship between real stock returns, inflation, and money growth, specifically focusing on the impact of monetary policy on stock prices. The examination of this literature aims to provide an in-depth understanding of the various theories and perspectives on the topic and how they contribute to our current knowledge on the subject. Sellin presents two relations between monetary policy and stock prices, posited by real activity theorists and Keynesian economists. The former theory suggests a positive relation, while the latter posits a negative relation. The Keynesian hypothesis follows the "sticky-price model", which suggests that an announcement of an increase in money supply will affect asset prices if it alters expectations about future monetary policy. Furthermore, the model predicts that a positive money supply shock will lead to the anticipation of a tightening of monetary policy. The interest rate increases due to the increase in demand, meaning a monetary tightening announcement causes a decrease in stock prices because of the higher discount rate and the lower expected future

output. This leads to lower stock prices as a lower expected future output entails lower future dividends. This contrasts with the real activity hypothesis, which argues that a decrease in the discount rate signals an increase in future money demand induced by higher future output, leading to an increase in stock prices.

Further studies regarding the relationship between monetary policy and stock prices include that of Thorbecke (1997), in which the author conducts an event study to examine the effect of monetary policy on an asset's return. To examine the relationship between Federal funds rate changes and stock market performance, Thorbecke conducts a keyword search of major newspapers during the period 1987 to 1994, analyzing all references to the Federal funds rate to determine if they pertain to policy-induced changes. After this, the responses of the Dow Jones to federal funds rate changes are stated. The results show a significant negative relationship between changes in the federal funds rate and changes in the index, adding to the existing evidence regarding the relation.

Bernanke and Kuttner (2005) investigate the effect of unanticipated changes in monetary policy on equity prices and find several conclusions. The paper finds a negative relation between unexpected interest rate changes by the FED and stock price reactions. To elaborate, an unexpected negative change in the interest rate of 25 basis points leads to a positive stock price reaction of roughly 1%. The paper also tests whether the stock market response depends on the rate change's direction. However, an insignificant coefficient is found for the interaction term between a surprise rate change and whether the change was positive, indicating that the effect of a surprise rate change is the same on the stock market prices regardless of the direction of the change. The authors try to identify the cause of the stock price reaction and propose an intriguing implication. Namely, the authors suggest that monetary policy primarily affects stock prices through its impact on expected future excess returns or expected future dividends rather than through real interest rates. The results suggest that this is because the real interest rate changes induced by unexpected monetary policy actions are short-lived. The authors interpret this to mean that tight monetary policy decreases stock prices due to an increase in the expected equity premium. To elaborate, this increase in the expected equity premium may be caused by, for example, the increased risk of investing in stock due to higher interest costs, which is consistent with the risk premium hypothesis proposed by Cornell (1984). To further specify, the increase in the target federal funds rate leads to an increased risk of investing in the stock market because of, for example, an increase in the risk of potential bankruptcy because of higher interest costs and less access to capital, and hence investors demand a higher return. Because the required rate of return is the discount rate used to calculate the present value of future cash flows, and a higher discount rate leads to lower prices, higher expected returns lead to lower current stock prices.

Further studies include the highly relevant study by Ehrmann and Fratzscher (2004), in which they analyze the effect of monetary policy on stock prices of individual firms listed on the S&P 500 as well as industry-specific effects. The authors find a negative relation between the target federal funds rate and stock prices in the US. Furthermore, the paper finds that an increase in the funds rate of 50 basis points leads to an average decrease in stock prices of 3%. Furthermore, Ehrmann and Fratzscher find that stock markets exhibit a more substantial response when the FED changes the direction of its monetary policy, that is to say, a shift from monetary expansion to monetary tightening and vice versa. Additionally, the authors state that firms operating in industries that are sensitive to interest rates or are highly cyclical are more strongly impacted by monetary policy. These industries include, among others, communications, technology, and cyclical consumer goods such as cars and tourism. It can be argued that the bank industry is also cyclical as their products increase in price in periods of monetary tightening and vice versa in times of monetary expansion. The authors provide strong evidence supporting the idea that these types of industries react 2-3 times more strongly to changes in monetary policy. Moreover, Ehrmann and Fratzscher investigate the influence of firm-specific effects such as capital ratio, Tobin's q, and price-to-earnings ratio on the response of stock markets to monetary policy. These effects are discussed in section 2.4.

2.4 Bank stock prices and expectations

A key element in investigating the effect of switching from expansionary to tight monetary policy by the FED on bank stock prices is the significance of banks. When the interest rate alteration by the FED is mentioned, one usually talks about the alteration of the target federal funds rate, the interest rate used by banks when lending and borrowing to each other. An increase in the federal funds rate makes it more costly for banks to borrow funds to meet reserve requirements set by the Federal Reserve. As a result, banks pass on the increased borrowing costs to consumers by charging higher interest rates on loans. Therefore, it can be inferred that the direct impact of monetary policy is on banks, while the effect on individuals is indirect.

In the study by Madura and Schnusenberg (2000), the authors find a negative relationship between interest rate changes by the FED and bank stock prices. The authors also find that the effect of an interest rate change on bank stock prices is ten times stronger for an interest rate decrease than for an increase. This negative relation is supported by the evidence presented by Yin et al. (2010). According to Yin and Yang (2013), there are two ways that a change in the federal funds rate can impact bank stock prices. Conforming the conclusions of Bernanke and Kuttner (2005), Yin and Yang suggest that a change in the target federal funds rate affects bank stock prices because of expected future cash flows and the equity premium hypothesis rather than through real interest rates, as explained in section 2.3. Yin et al.

(2010) debate the effect of an interest rate increase on bank profits by stating the existence of a negative correlation between the noninterest income of banks and the federal funds rate. Moreover, they find a strong negative correlation between the federal funds rate and the gains earned on portfolio sales. Additionally, fixed-rate loans decrease in value if the current interest rate rises. In contrast, variable-interest loans yield a higher return for banks, adding to the obscurity of the net income effect of the rate increase. Acharya et al. (2020) investigate the effect of all these potential consequences of an interest rate increase on bank profitability, and the authors find a positive relationship between the interest rate and bank profitability in New Zealand. Furthermore, an interest rate increase also increases the costs for banks to meet the reserve requirements, negatively impacting their profits. Additionally, higher interest rates may negatively impact bank revenue because there is less demand for credit because of the increased cost. The severe inflation may also impact bank profits due to substantially increased costs for banks through wage increases and rising energy costs. On the other hand, when interest rates rise, banks may increase profits by exploiting the interest rate mismatch that follows. Banks invest money in short-term notes and receive higher interest payments than the interest that they pay to deposit holders. Borio, Gambacorta, and Hoffman (2017) find a positive relationship between the level of interest rates and the steepness of the yield curve and ROA, indicating that higher interest rates and a steeper yield curve enhance bank profitability. The authors further state that interest rate increases also negatively impact the net income of banks through the increase in loan loss provisions, as higher interest rates may cause borrowers to be unable to repay their loans. Additionally, the increase in interest rates may lead to adverse selection. To elaborate, the increased cost of borrowing may cause only high-risk clients to apply for loans and repel low-risk clients, leading to an increase in the risk of the average loans of a bank. Furthermore, Yin et al. (2010) state the existence of a positive correlation between the federal funds rate and interest income and a positive correlation between the federal funds rate and interest expense. They elaborate by stating that a bank's income increases by a rise in the federal funds rate if a bank is asset sensitive, that is to say, the repricing of assets occurs more than that of liabilities. Furthermore, Yin et al. find statistical evidence for an inverse relationship between interest rate changes and bank stock prices. They also find that a change in monetary policy has twice as strong an effect on bank stock prices as an interest rate change in the same direction. They also find that the direction of the interest rate, that is to say, an increase or a decrease, does not have a significant effect. Also, bank stock prices may be expected to go down because of the motivation to increase the interest rate by the FED and what an interest rate increase signals. The soaring inflation leading up to the interest rate increase could indicate financially troubling times in the near future. The rising interest rate impedes future investments in innovation and growth as external financing increases in costs (Forbes, 2022). This shows that both business and consumer clients are expected to borrow less in the future, and bank income may diminish. To further substantiate, Conover et al. (1999) state that "a restrictive monetary environment serves as bad news as it is generally associated with higher future interest rates and decreases in the level of economic activity". Furthermore, Romer and Romer (1989) investigate periods of monetary

tightening after 1960 and find that these periods are followed by reductions in industrial production and increases in unemployment. The papers by Conover et al. and Romer and Romer essentially justify monetary policy as lower output leads to less consumption and, thus, less inflation. A study by Paul (2020) examines the correlation between monetary policy and changes in asset prices within the United States, focusing on the impact of monetary tightening on said asset prices. The study finds that, generally speaking, tightening monetary policy results in decreased asset prices. However, a thorough examination of data spanning the past three decades reveals that the relationship between monetary policy and asset prices is not consistent over time. The contradicting evidence presented in the literature highlights the need to reinvestigate the topic. This leads to the following hypothesis:

H1: *The increase of the target federal funds rate by the FED has a negative effect on publicly listed bank stock prices in the US.*

Several studies investigate the difference in stock price sensitivity between small and large firms. In his study from 1981, Banz finds the existence of a size effect. Banz attributes the larger effect of an interest rate change on the stock prices of smaller firms compared to large firms to the higher perceived risk of smaller firms but states that there is no theoretical foundation for such an effect. Banz suggests that this higher risk may be partially attributed to the lesser availability of information about small firms. Furthermore, Thorbecke (1997) finds that small firms are affected more by an interest rate increase than large firms. The proposed explanation is that large firms are less credit constrained because of their superior collateralization. Ehrmann and Fratzscher (2004) find that small-size firms listed on the S&P500 are affected significantly more by monetary policy but suggest that this effect is driven by the fact that smaller firms have less access to credit. Several studies, including those of Madura and Schnusenberg (2000) and Yin et al. (2010), investigate the effect of bank-specific characteristics on stock price changes in particular and find evidence for an inverse relationship between bank size and interest rate changes. Madura and Schnusenberg find that large banks are more strongly affected by an interest change than small banks, but the authors do not provide a clear explanation for the experienced effect. Another possible explanation for a potential size effect stems from the findings of Booth, Henderson, and Officer (1985). In their paper, the authors conclude that money-center banks have higher levels of systematic risk compared to non-money-center banks. Additionally, Booth et al. find a positive correlation between systematic risk and the interest rate level of these types of banks. As risk is associated with higher returns, and it is assumed that money-center banks are predominantly large banks, stock prices of large banks are more volatile. Hence, the effect of monetary tightening on bank stock returns is expected to be more pronounced in large banks. Yin and Yang (2013) also find that larger banks are affected more by interest rate changes. The authors suggest that this can be attributed to the unique features of large banks. First, they argue that big banks finance a larger portion of their total borrowings from the federal funds market. Thus, when the federal funds rate increases, the cost of

financing for big banks increases more than for small banks. Second, they claim that large banks finance a large portion of their loans through short-term borrowings in the money market. These loans are not insured by the federal reserve and are thus more interest-rate sensitive. Furthermore, it could be expected that large banks have less freedom to do business and perhaps higher related operating costs because of more stringent regulations. However, it is expected that investors seek stability in changing market conditions, in the case of this study, the switch from monetary expansion to monetary tightening, and hence the heightened level of regulation for large banks, could lead to a decrease in risk. Considering all of the above, the second hypothesis reads:

H2: *Stock prices of large banks are affected more strongly by an increase in the target federal funds rate than stock prices of small banks.*

Following what is proposed in the second hypothesis, how banks fund their borrowings could potentially impact the sensitivity of their stock prices to an interest rate increase. When banks cannot attract sufficient funds through deposits, they often turn to other sources for funding. Bradley and Shibut (2006) attribute this search for other funding to the exponential growth of bank assets compared to deposits. They state that it is doubtful that deposit growth will meet banks' funding needs, and hence the need for external funding will continue to exist. The authors claim that external funding often entails more risk and demands a more advanced management approach, potentially leading to higher costs. However, Bradley and Shibut find that bank customers react to interest rate increases by transferring their funds from bank accounts with lower interest rates to high-yielding accounts such as certificates of deposit. This could entail that banks that rely more heavily on deposit funding may experience a relatively greater effect of an interest rate increase because a relatively larger share of their funding could shift to wholesale funding, and wholesale funding is affected more strongly by an interest rate increase. In their paper, Huang and Ratnovski (2008) explain how wholesale funding, where banks borrow from other institutions, could lead to financial instability. They argue that wholesale financiers, such as other banks or large investors, may be motivated to withdraw funding from a bank based on faulty or uncertain signals of the bank's solvency. If enough financiers act on these signals and withdraw funding, it could lead to the failure of a bank that is actually financially sound. Hence, relying on external funding sources could increase the risk of banks. Booth et al. (1985) find that the systematic risk of banks tends to increase over time and propose a similar explanation. The authors propose the explanation that commercial banks are becoming more reliant on funds that they acquire from external sources rather than relying on deposits from customers. As banks become more dependent on these purchased funds, their risk of default increases because wholesale funders are incentivized to withdraw funds more quickly than retail funders, which would increase systematic risk. As risk is associated with higher returns, the findings of Huang and Ratnovski and Booth et al. could imply that the stock prices of banks that rely more on external funds are more volatile. Yin and Yang (2013) mention that deposits are

protected through deposit insurance, reducing the risk of withdrawal. Another proposed explanation is that commercial banks are increasing their use of financial leverage or borrowing money to invest in order to amplify returns. As banks take on more debt, their risk of default increases, which would also increase systematic risk. Lastly, wholesale funding is generally more expensive than retail funding, causing banks that rely more on wholesale funding to experience greater costs following the interest rate increase, resulting in more negative stock returns. Following the above, a positive relationship between the proportion of retail funding and bank stock prices is expected. Hypothesis 3 reads:

H3: *Stock prices of banks that rely more on retail funding are affected less by the interest increase by the FED.*

Next, the capital ratio of banks may be relevant regarding an interest rate increase by the FED because of two reasons. Madura and Schnusenberg (2000) argue that banks with a high capital ratio are generally considered safer investments because of their enhanced ability to absorb losses. Furthermore, maintaining a higher capital ratio by a bank implies having a lower degree of leverage, making banks with a higher capital ratio less susceptible to interest rate changes. Booth et al. (1985) find that commercial banks are increasing their use of financial leverage or borrowing money to invest in order to amplify returns. As banks take on more debt, their risk of default increases, which would also increase systematic risk, most likely causing the stock prices of banks with high leverage to be more volatile. In a more general study, Ehrmann and Fratzscher (2004) find that firms listed on the S&P500 with a low debt-to-capital ratio are affected more by monetary policy. The authors elaborate by stating that maintaining a low debt-to-capital ratio indicates that a firm is financially constrained and not the opposite. This conclusion is driven by the view that firms prefer maintaining a high debt-to-capital ratio over a low ratio and that maintaining a low ratio is a direct consequence of a firm's inaccessibility to credit. On the other hand, it can be argued that maintaining a lower leverage level can positively influence a company's access to credit as maintaining a low level of leverage reduces the risk of a company's default and, thus, a company's credit risk. This argument leads to the expectation that the effect of monetary tightening on bank stock returns is less pronounced in firms with a low debt-to-capital ratio. In support of this, Ehrmann and Fratzscher (2004) find that financially constrained firms react stronger to monetary policy. When interest rates are raised, it can make borrowing more expensive and thus more difficult for firms, which can be especially problematic for financially constrained firms that are already struggling to access capital. Access to capital is crucial for firms as capital is needed to sustain the ongoing operations of a business and to invest, for example, in innovation. Ricci (2013) finds that banks with a higher capital ratio are less sensitive to monetary expansion for the reasons stated above. Sutorova and Teply (2011) investigate the effect of the Basel 3 regulations on the market value of banks. The authors find that the higher capital requirements of Basel 3 lead to a decrease in the market value of banks. Furthermore, they find that even though higher capital ratios lower banks' risk, investors

do not consider this when choosing which shares to purchase, leading to the expectation that capital ratio has an insignificant effect on bank stock prices following an interest rate increase. Demirguc-Kunt et al. (2010) investigate the influence of capital levels on bank stock returns during the financial crisis of 2008. The paper finds no consistent relationship between initial capital levels and subsequent bank stock returns before the crisis. However, the significance of capital becomes apparent during a crisis period, leading to the conclusion that there is a positive relation between the capital ratio and the market value of banks during the financial crisis of 2008. Carlini et al. (2020) find that high capitalization mitigates the effect of adverse news reports on bank stock prices. The authors attribute this effect to the lower perceived risk of a bank by the market. This leads to an interest in examining to what extent capital, and thus leverage, influences the effect of a federal funds rate increase on bank stock prices. Therefore the fourth hypothesis reads:

H4: *The effect of a federal funds rate increase on bank stock prices is more pronounced in banks with a lower capital ratio.*

One of the most direct effects of an interest rate increase by the FED is most likely the effect the raise has on loan write-offs for banks. A loan write-off is the process of a lender canceling or forgiving a borrower's debt. This happens when the borrower is unable to repay the loan, and the lender determines that the debt is unlikely to be collected, which results in a loss for the lender. An interest rate increase may affect loan write-offs in several ways. Firstly, higher interest rates make borrowing more expensive, which may cause some borrowers to default on their loans if they can no longer afford the payments. Moreover, higher interest rates tend to slow down the economy, which could lead to more unemployment and a higher default rate on loans. Banks account for potential loan write-offs through reserves for credit losses. Reserves for credit losses (hereafter also referred to as loan loss reserves and credit reserves) are funds allocated by financial institutions to safeguard against any potential losses that may arise from loans or other credit instruments that are likely to default. The purpose of these reserves is to secure the institution from any unforeseen losses and to guarantee that it has enough funds to cover any expected or unexpected defaults. Docking et al. (1987) find that when a financial institution announces that it is adding more funds to its loan loss reserves than what is generally expected on an annual basis, the market reacts negatively. This effect is attributed to investors interpreting the increase in loan loss reserves as a sign of more negative news in the near future. Anderson et al. (1993) find evidence supporting this claim. Agusman et al. (2008) conclude that investors do not view additions to loan loss reserves as a reliable indication of a bank's efforts to address problematic loans. Agusman et al. find a negative relationship between an increase in credit reserves and bank stock returns. However, because reserves for credit losses are a safeguard against unexpected write-offs, it could be expected that maintaining a higher level of reserves could indicate a bank’s superior preparation for the interest rate increase. In conclusion, it is relevant to examine the impact of the amount of loan loss reserves of a

bank on bank stock prices because the number of loan defaults is expected to increase following the interest rate change. Driven by the findings of previous studies, the fifth hypothesis of this study reads:

H5: *Banks with a higher ratio of credit reserves to total assets are affected less by the shift from monetary expansion to monetary tightening by the FED.*

Table 1 provides a summary of the existing studies regarding monetary policy and stock prices, discussed in section 2.4 of the paper.

Table 1 Overview of historical literature regarding monetary policy and bank stock prices

Author(s) (Publication year)	Time period	Method	Control variables	Results	Conclusion
Madura & Schnusenberg (2000)	1974-1996	Regression	Bank size, Capital ratio	+1% Δ in FED funds rate → -0.62% Δ in bank stock prices Insignificant effect of capital ratio on bank equity returns Large banks are affected more than small banks by an interest rate decrease (0.0092**), insignificant results for increase or other sizes	A significant inverse relationship between a federal funds rate increase and bank stock prices in the pre-October 1979 period and post-August 1987 period. Significant effect of bank size on the effect of federal funds increases on bank stock prices in the pre-October 1979 period and post-August 1987 period.
Yin, Yang & Handorf (2010)	1988-2007	Event study, regression	Joint change, size, policy reversal, direction	0.01% surprise rate increase (decrease) → 0.04% stock return decrease (increase) R-Squared = 0.064	An inverse relation between unexpected interest rate increases and stock prices
Yin & Yang (2013)	1988-2007	Regression	Bank size, business activity mix, funding sources, bank soundness indicators	+0.01% surprise → -0.065%*** in the one-day holding period return of US bank stocks. Amount of employees = -0.011*** Deposit share = 0.064** Capital-to-asset ratio = 0.06 (insignificant) R-Squared = 0.052	Bank stocks are more adversely affected by target changes accompanied by a simultaneous discount rate change than a target rate shift alone and by target changes that represent a new policy direction versus a continuation of prior policy. The magnitude of change is irrelevant, as well as the direction of the change (negative or positive).
Ricci (2015)	2007-2013	Event study, regression, BMP test	An interest rate cut, liquidity provision, monetary easing, capitalization, liquidity, and perceived risk	Event window (-1;+3): CAAR= -0.0127*** Deposit share = -0.00015 Tier 1 = -0.00036 RWA = -0.00005 R-Squared = 0.05	Less capitalized, riskier, and less liquid banks are more sensitive to monetary policy changes

CHAPTER 3 Data

To investigate the effect of the interest rate increase by the FED on bank stock prices, a data sample needs to be selected. This study focuses solely on banks listed in the US because, at the time of the first rate increase announcement, the Federal Reserve was the first and only central bank to do so. To obtain a list of US bank stocks, the Wharton Research Data Services (WRDS) website was used. The website was used to access the CRSP database for stock data. To obtain the list of banks listed in the US, 4-digit SIC codes were used. The Standard Industrial Classification (SIC) codes are assigned by the U.S. government to businesses to identify their primary activity. These codes consist of four digits and are used to categorize the economy into 11 divisions, further divided into 83 major groups, 416 industry groups, and ultimately, 1,005 individual industries (SIC website). The database was then filtered for the bank SIC code, namely all codes between 6000 and 6099. By setting this range of SIC codes, an attempt was made to select banks and bank-like companies most accurately in the US. This range of SIC codes comprises state commercial banks, savings institutions, and functions related to depository banking (SEC website). After doing so, all duplicate companies were eliminated from the list. This left a data sample comprising 274 companies. 9-digit CUSIP codes were used as company identifiers, and the identification code was used to obtain company data and stock prices and to link different spreadsheets. Next, the CRSP database was used to obtain the daily stock prices of each company in the data sample and the S&P500 daily return. This study uses the S&P500 because the index is used in regularly throughout previous studies to calculate expected returns. Kothari and Warner (2007) highlight the superiority of the use of daily stock returns over the use of monthly stock returns, and thus, this study uses daily stock returns. The return for each company was computed as follows:

$$\frac{P_t - P_{t_1}}{P_{t_{-1}}} \tag{1}$$

The CRSP/Compustat merged database was used to collect the bank-specific characteristics needed to perform the regression analysis. As described in section 2.4, the required bank-specific characteristics are firm size, capital ratio, reserves for credit losses, and funding source. CRSP returned data for 250 companies, hence the data sample was reduced to 250.

Table 2 provides an overview of the descriptive statistics of the variables used in the regression analysis. N represents the number of observations for each variable. Table 2 shows 230 observations for capital ratio, as there were 20 missing observations.

Table 2 Summary of descriptive statistics of the variables used in the regression analysis

Variable name	**N**	**Mean**	**Std. Dev.**	**Median**	**min**	**max**	**skewness**	**kurtosis**
Total Assets (in millions in US$)	250	119105.56	461034.20	7398.00	338.06	3743567.00	5.44	34.32
Capital Ratio	230	15.71	3.81	14.93	10.82	55.60	5.56	54.67
Credit Reserves	249	.87	1.61	0.74	.03	25.35	14.28	217.56
Funding Source	250	.91	.10	.94	.40	.99	-2.52	9.74

Note. Total Assets represents the total assets of a bank measured in millions in US$, *Capital Ratio* is the sum of tier 1 and tier 2 capital divided by risk-weighted assets, *Capital Ratio* is reported by banks themselves, *Credit Reserves* is the reserves for credit losses divided by total assets and *Funding Source* is total amount of deposits divided by total liabilities.

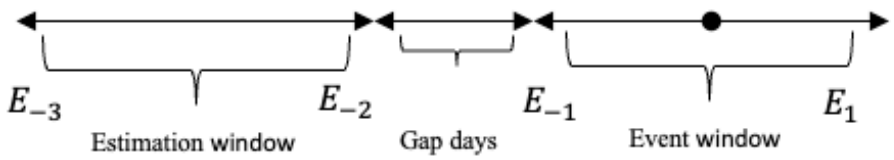
CHAPTER 4 Methodology

The first hypothesis will be tested by conducting an event study. An event study is an empirical analysis of how the value of a security reacts to a particular event. In the case of this paper, the event is the increase in the target federal funds rate, and the security is bank stock prices. This study follows the steps proposed by MacKinlay (1997) in his paper regarding event studies.

First, an event window must be determined. The announcement of the first interest rate increase was at 02:00 pm on the 16th of March 2022. On this day, the FED announced that it would undertake actions to increase the federal funds rate by at least 0.25%, starting on the 17th of March 2022. The announcement was made at 02:00 pm EDT (Eastern Daylight Time, also known as Eastern Time), and because most US stock exchanges are listed in New York, which uses Eastern Time, stock markets had ample time to react to the announcement on the 16th of March. Hence, the event date $[t_0]$ in this study is March 16, 2022. MacKinlay further states that it is customary to extend the event window by a number of days before and after the announcement date, this captures "the price effects of announcements which occur after the stock market closes on the announcement day". However, a longer event window could lead to less power, that is, the probability of detecting abnormal performance (MacKinlay, 1997, Brown & Warner, 1985, Kothari & Warner, 2007). In an attempt to fully capture the effect of the event while minimizing the effects of other events, the event window is 5 days, that is to say 2 days prior and 2 days after the event and the event date itself $[t_{-1}, t_1]$. Three other event windows are included as robustness checks, namely a 21-day [-10;+10], 7-day [-3;+3], and a 3-day [-1;+1] window. The event window is based on the finding by Allen, Harrison, and Oler (2007) that 76.3% of the 62 articles that make use of event studies that they reviewed make use of an event window of up to 11 days [-5, +5]. Next, an estimation window must be selected to estimate the parameters which are mentioned below. The literature on financial estimation looks for the ideal time frame for measuring performance. Choosing the right time frame involves balancing the potential for outside influences and the precision of the results. A longer time frame increases the likelihood of outside factors affecting the results, but a shorter one results in less accurate predictions of returns. Armitage (1995) suggests that a range of 100 days is optimal, with a range of 90 to 200 days being acceptable. Therefore, this study uses an estimation period of 100 days $[t_{-3}; t_{-2}]$. Furthermore, a gap period of 30 days $[t_{-2}; t_{-1}]$ is used. Using a gap period ensures that the returns in the estimation window and in the event window do not overlap. The choice of a gap window of 30 days is motivated by the testimony of the FED chairman, Jerome Powell, which he gave on the 2nd of March 2022 in the semiannual monetary policy report to Congress. In this, Powell acknowledged the soaring inflation in the US, stating that 2021 saw a significant rise in inflation, which exceeded the target of 2% in the long term. He further elaborated by stating that the high inflation rate caused significant difficulties, particularly for individuals who had a more challenging time affording basic necessities such as food, housing, and transportation. To ensure a robust labor market, the priority

of the FED was to maintain a prolonged period of economic growth, and that could only be achieved through stable prices (Federal Reserve Website, 2022). Investors who follow FED announcements may have concluded that the FED would increase the interest rate on the forthcoming announcement date. To ensure that the returns in the estimation window are not affected by the announcement, gap days are used.

Figure 4 An overview of the event study windows



Next, a normal return model must be specified. The study by Brown and Warner (1980) regarding various event study methodologies concludes that differences in the ability to detect abnormal returns were minimal between normal return models. Brown and Warner state that they do not find evidence that the more complicated methodologies used in their study convey any benefit. They further specify that more complicated methodologies can actually make the researcher worse off. Hence, the Market Model, as specified in MacKinlay 1997, is used. The model is constructed as follows:

$$R_{it} = \alpha_{it} + \beta_i R_{mt} + \varepsilon_{it}$$
$$E(\varepsilon_{it} = 0); \qquad var(\varepsilon_{it}) = \sigma_{ei}^2 \tag{2}$$

Where R_{it} is the return on security i in period t and R_{mt} is the market portfolio return in period t; ε_{it} is the zero mean disturbance term; α_{it}, β_i and σ_{ei}^2 are parameters of the market model. In line with MacKinlay (1997), the S&P500 index is used for the market portfolio. The estimation of parameters α_{it}, β_i and σ_{ei}^2 is done through OLS during the estimation window $[t_{-3}; t_{-2}]$ described above.

Next, abnormal returns are calculated, which can be defined as the forecast error of the normal return-generating model (Ricci, 2015). This is done by following the steps described by MacKinlay (1997). For each security, the return on the security for time period t relative to the event R_{it} is:

$$AR_{it} = R_{it} - E(R_{it}) \tag{3}$$

AR represents the abnormal return for company i on day t. R_{it} represents the actual (observed) return of company i on day t and $E(R_{it})$ is the expected return of company i on day t.

Subsequently, the abnormal returns of each security in the sample can be aggregated and computed through the following formula:

$$AAR_t = \frac{1}{N}\sum_{i=1}^{N} AR_{it} \tag{4}$$

As it is of interest to study abnormal returns in periods surrounding the event date, the Cumulative Average Abnormal Return (CAAR) is calculated. This entails aggregation of the average abnormal performance of every company on every day in the event window, and this is executed through the following formula:

$$CAAR(t_1, t_2) = \sum_{t=E_{-1}}^{E_1} AAR_t \tag{5}$$

Equation 5 will be used to test hypothesis 1 regarding the event study. After conducting the event study, a regression analysis will be performed to examine the drivers of the abnormal return following the event study if this is present. To obtain the dependent variable for the OLS regression, the abnormal returns are aggregated over the event window:

$$CAR_i = \sum_{t=E_{-1}}^{E_1} AR_{it} \tag{6}$$

A t-test is performed to test the null hypothesis that the abnormal return is equal to zero. The test statistic for testing, $H_0 : E(CAAR) = 0$ is obtained through the following formula:

$$t_{CAAR} = \sqrt{N}\frac{CAAR}{S_{CAAR}} \tag{7}$$

Where S_{CAAR} denotes the standard deviation of CAR at time *t:*

$$S^2_{CAAR} = \frac{1}{N-1}\sum_{i=1}^{N}(CAR_i - CAAR)^2 \tag{8}$$

A t-test is a statistical test used to determine if there is a significant difference between the means of two groups. It compares the means of the two groups and calculates a t-value, which is compared to a critical

value from a t-distribution table. If the probability is less than a pre-specified significance level, the null hypothesis is rejected, and it is concluded that there is a significant difference between the means of the two groups. The t-test assumes the two groups are independent and the data is normally distributed. Since the proposed test statistic is a *t-test,* a Shapiro-Wilk test is conducted to test whether the data is normally distributed.

To control for nonnormally distributed data, a further robustness check is conducted using a BMP-test. The ordinary cross-sectional method uses a t-test to compare the average event-period residual to its standard error. It requires that the residuals across firms are uncorrelated but does not require the event-induced variance to be insignificant. However, if the event-period residuals for different firms come from different distributions, the test will not be accurate. A further shortcoming of the t-test is that it assumes that the variance of abnormal returns is the same in event and non-event periods, leading to an underestimation of the true variance and an over-rejection of the null hypothesis. Additionally, the t-test assumes normality and a homoscedastic distribution with identically and independently drawn samples. Boehmer, Musumeci, and Poulsen (1991) (hereafter referred to as BMP) proposed a test addressing the misspecification problem stated above. BMP state that their standardized cross-sectional method addresses the misspecification problem of the ordinary cross-sectional test by first standardizing the residuals using the estimation-period standard deviation (adjusted for forecast error). The ordinary cross-sectional technique is then applied to the standardized residuals. The test statistic is obtained by dividing the average event-period standardized residual by its contemporaneous cross-sectional standard error. This method is similar to the ordinary cross-sectional method in that it allows for event-induced variance changes and requires security residuals to be cross-sectionally uncorrelated. However, it also incorporates information from the estimation period, which may improve its efficiency and power. According to the Boehmer, Musumeci, and Poulsen, the standardized cross-sectional test (BMP test) is superior when the average abnormal performance is 1%. The authors state that the standardized-residual test has the highest ability to correctly reject the null hypothesis, while the standardized cross-sectional test tends to more frequently reject the null hypothesis when compared to the other tests. However, "when average abnormal performance averages 2%, all of the tests except the method-of-moments method reject the null hypothesis close to 100% of the time" (BMP, 1991). When the average abnormal performance is zero, the BMP test performs similarly to other tests. The BMP test is constructed as follows:

$$SR_{iE} = \frac{A_{iE}}{\widehat{s_i}\sqrt{1 + \frac{1}{T_i} + \frac{(R_{mE} - \bar{R}_m)^2}{\sum_{i=1}^{T_i}(R_{mt} - \bar{R}_m)^2}}}$$

With:

A_{iE} = security i's abnormal return on the event day

$\widehat{s_i}$ = security i's estimated standard deviation of abnormal returns during the estimation period

T_i = number of days in security i's estimation period

R_{mt} market return on day t

$\bar{R}_m$ average market return during the estimation period

SR_{iE} = security i's standardized residual on the event day

With test statistic $H_0: E(CAAR) = 0$ computed by:

$$z_{bmp} = \frac{1}{N}\sum_{i=1}^{N} SR_{iE} / \sqrt{\frac{1}{N(N-1)}\sum_{i=1}^{N}(SR_{iE} - \sum_{i=1}^{N}\frac{SR_{iE}}{N})^2}$$

After obtaining the results from the event study, a regression analysis is performed to test whether the abnormal return, which is tested in the event study, is driven by certain firm-specific characteristics. These characteristics are firm size, capital ratio, reserves for credit losses, and funding source. The calculation required to obtain the ratios and other variables is described in section 3. The formula for the regressions is constructed as follows:

$$CAR_i = \beta_0 + \beta_1 ln(TotalAssets) + \beta_2 CapitalRatio + \beta_3 CreditReserves + \beta_4 FundingSource + \varepsilon \quad (11)$$

The dependent variable is CAR_i, obtained through formula (6). The independent variables are firm-specific characteristics, namely *TotalAssets,* which are the total assets of each bank used as a proxy for firm size, *CapitalRatio* which represents the sum of tier 1 and tier 2 capital divided by the risk-weighted assets of each bank, *CreditReserves* which is calculated by dividing the number of reserves for credit losses by the total assets of each company, and finally *FundingSource* which represents the funding source of each company which is obtained by dividing the total number of deposits by the total liabilities for each company.

A Breusch-Pagan test is performed to test for heteroscedasticity in the errors. Heteroscedasticity violates the assumption of constant variance in a linear regression model. This means that the variance of the residuals (the differences between the observed values and the predicted values) is not constant across the range of the predictor variables. Heteroscedasticity can occur when the relationship between the

predictor variables and the response variable is non-linear or when the error term has a different variance at different levels of the predictor variables. When heteroscedasticity is present, the standard errors of the regression coefficients are biased, and inferences made from the model (such as hypothesis tests and confidence intervals) may be invalid. To control for heteroskedasticity in the errors, robust standard errors are used.

CHAPTER 5 Results

In this section, the results of the hypotheses will be presented and used to answer the research question.

5.1 Event study

Table 3 depicts the results of the event study. In the table, it can be seen that the CAAR is statistically significant across all four event windows. To specify, the 25 basis point increase in the target federal funds rate by the FED is associated with a negative abnormal return of bank stock prices in the US, ranging from 1.86% to 5.16%, depending on the event window. The CAARs for the 21-day, 11-day, 7-day, and 3-day event window are -5.16%, -2.48%, -1.86%, and -2.41%, respectively. Interestingly, the CAAR decreases in value as the event window shortens and increases for the shortest window. The findings suggest that initially, the market reacted strongly to the interest rate announcement, after which the market reaction weakened. However, the results show that the market reaction increased strongly again after a number of days, indicating that perhaps the market needed several days to recognize the expected impact of the interest rate increase. The statistical significance of the CAAR values for all four event windows leads to the acceptance of the first hypothesis, which states that an increase in the target federal funds rate by the FED has a negative effect on publicly listed commercial bank stock prices in the US. When studying the CAARs over the event windows, it becomes apparent that the average CAAR is around -3%. The average CAAR value can be interpreted as relatively large compared to previous studies regarding the general stock market. When comparing to existing studies regarding the effect of monetary policy on bank stock prices, namely the studies by Madura and Schnusenberg (2000), Yin et al. (2010), and Ricci (2014), the average CAAR of this study can also be interpreted as relatively large. The average abnormal returns of the regarding studies are close to -1% following a change in the target federal funds rate of 25 basis points. Table 1 provides an overview of the results of these studies.

Table 3 Event study CAAR Results with cross-sectional t-test

Event window	CAAR	t_{cs}
(-10;+10)	-5.16%	-11.521***
(-5;+5)	-2.48%	-7.184***
(-3;+3)	-1.86%	-7.959***
(-1;+1)	-2.41%	-12.016***

Note. *** p-value < .01, ** p-value <.05, * p-value <.1

The cumulative abnormal return is the actual return of the data sample compared to the expected return obtained through the S&P500. As described in section 3, the S&P500 was used as the benchmark index. As the S&P500 portrays the general return of the US stock market, the results from Table 3 show that

stock prices of the banking sector, in particular are affected by the interest rate increase compared to the general stock market in the US.

A Shapiro-Wilkes test was performed to test for normality. The results of the test can be seen in the appendix. The shortcomings of the t-test and the non-normal distribution of the data led to the execution of a BMP test. The results from the BMP test are presented in Table 4.

Table 4 Results of the BMP test for all four event windows

Event window	CAAR
(-10;+10)	-5.16%***
(-5;+5)	-2.48%***
(-3;+3)	-1.86%***
(-1;+1)	-2.41%***

Note. CAAR denotes the cumulative average abnormal return. *** p-value < .01, ** p-value <.05, * p-value <.1

The results from Table 4 again show the CAAR values across all four event windows. However, the *** indicates the significance level of the CAARs after conducting a BMP test. The table shows that all four event window CAARs are significant at the 1% level. The results of the BMP test confirm the conclusion of the t-test, namely the acceptance of the first hypothesis.

5.2 Regression analysis

The results of the event study led to the affirmation of the existence of negative abnormal returns for US bank stock prices in response to the shift to monetary tightening by the FED. A regression analysis was performed to identify the drivers of this abnormal return. The drivers which were analyzed were size, capital ratio, funding source, and reserves for credit losses.

First, the data per variable was fitted for the regression by winsorizing or taking the LN. Table 5 shows the descriptive statistics of the variables. Every first of two variables depicts the bank-specific data as obtained from CRSP, every second of two variables shows the summary statistics of the modified data. The natural logarithm (LN) of *Total Assets* was used because of the non-normal distribution of the data. Also, taking the LN of a variable reduces the disproportionate influence of possible outliers. The other three variables (*Capital Ratio, Credit Reserves, and Funding Source)* were winsorized at the 1st and the 99th percentile to control for outliers.

Table 5 Summary of the descriptive statistics of the original and the modified variables used in the regression analysis

Variable name	N	Mean	Std. Dev.	Median	min	max	skewness	kurtosis
Total Assets	250	119105.56	461034.20	7398.00	338.06	3743567.00	5.44	34.32
ln Assets	250	9.21	1.90	8.91	5.82	15.14	.93	3.79
Capital Ratio	230	15.71	3.81	14.93	10.82	55.60	5.56	54.67
Capital Ratio Mod	230	15.59	2.81	14.93	11.60	27.48	1.61	6.58
Credit Reserves	249	.87	1.61	0.74	.03	25.35	14.28	217.56
Credit Reserves Mod	249	.78	.41	.74	.04	2.82	2.24	11.84
Funding Source	250	.91	.10	.94	.40	.99	-2.52	9.74
Funding Source Mod	250	.91	.10	.94	.51	.99	-2.36	8.42

Note. N denotes the sample size

After modifying the data, a Breusch-Pagan test was performed to test for heteroskedasticity. Table A.2 of the appendix shows the results of the Breusch-Pagan test for every event window. The Chi-Square test statistic of the 21-day, 11-day, and 7-day event windows are significant at the 1% level. The test statistic is not statistically significant for the 3-day window. The statistical significance of the Chi-Square test leads to the rejection of the null hypothesis of homoskedasticity and, thus, the assumption of heteroskedasticity in the errors. To correct for heteroskedasticity, robust standard errors were used.

Next, the correlation coefficients between the variables were produced to check for multicollinearity. Multicollinearity is a phenomenon in statistics in which multiple predictor variables in a regression model have a high correlation with each other. This can lead to difficulty in interpreting the specific impact of each predictor and make the model less accurate in predicting the response. It is often considered an issue if the correlation between predictor variables is greater than 0.8 or smaller than -0.8. Table A.3 of the appendix shows the correlation matrix. In the table, no variables have a correlation greater than 0.8 or smaller than -0.8. Furthermore, the variance inflation factor (VIF) was calculated. The results show VIF values between 1 and 2, indicating a low correlation between the independent variables. Therefore, it is assumed that there is no multicollinearity between the variables.

Table 6 shows the results of the OLS-regression analysis. The number of observations in the regression is lower than the total number of companies in the data sample. This is because companies were deleted from the sample if there was missing data for any of the variables. This left a total number of observations of 229. The R-squared differs for each event window and lies between 0.149 and 0.174.

The adjusted R-squared values differ and range from 0.130 and 0.155. The adjusted R-squared value is included because it controls for the number of independent variables in the model. To elaborate, when a predictor is added to the regression, the R-squared value usually increases, regardless of whether the predictor adds to the fit of the model. The adjusted R-squared offers a more precise estimate of the actual explanatory power of the model by imposing a penalty on the inclusion of unnecessary predictors. The values of the R-squared and the adjusted R-squared can be interpreted as relatively large as, on average, 13-15.5% of the variation in CAR can be explained by the bank-specific characteristics. The R-squared value is especially high compared to the existing literature regarding the effect of monetary policy on bank stock prices. The regression model of Yin et al. (2010) has an R-squared of 6.4%, the model of Yin and Yang (2013) has an R-squared of 5.2%, and the R-squared value of the model of Ricci (2015) is 5%.

The regression tests the effect of certain variables on the cumulative abnormal return (CAR) established in the event study. The coefficient for *ln_Assets* is statistically significant at different levels throughout the four event windows. The values are -0.0166***, -0.00424*, -0.00276* and -0.00269** for the 21-day, 11-day, 7-day and 3-day window respectively. The results show that the effect of *ln_Assets* on CAR is predominantly negative and most pronounced in the longest event window. The effect is minimal for the 11-day and 7-day event windows. The predominantly statistical significance of coefficients of *ln_Assets* leads to the acceptance of the second hypothesis, which states:

H2: *Stock prices of large banks are affected more strongly by an increase in the target federal funds rate than stock prices of small banks.*

This finding supports the conclusions of previous literature regarding bank stock prices. Namely, Madura and Schnusenberg (2000) find that large banks are more susceptible to interest rate decreases than small banks, and Yin and Yang (2013) find statistically significant evidence that larger banks, measured through the total amount of employees, experience greater negative abnormal returns following a surprise interest rate increase than small banks. However, the finding does contradict the theory and findings of previous papers regarding monetary policy and stock prices in general (rather than monetart policy and bank stock prices) that smaller firms are affected more strongly by interest rate changes, primarily because of the higher perceived risk of smaller firms.

These results suggest that the size effect for banks opposes the size effect in other industries. Ying and Yang (2013) provide an explanation of why stock prices of large banks may be affected more strongly by an interest rate increase than the stock prices of small firms. The authors argue that the effect can most likely be attributed to the difference in how small and large banks fund themselves. The primary difference is that large banks finance a larger part of their loans through short-term borrowings in the

money market, which are not insured by the Federal Reserve. Additionally, large banks finance a larger share of their borrowings through the federal funds market. However, the results of *Funding Source* contradict this explanation. These results are discussed in the next paragraph. This paper suggests that the observed effect can be attributed to the fact that large banks are better known and receive more media coverage leading to more active trading in their stocks (Fang, Peress & Zhang, 2014). This could entail a negative effect on stock prices because it is highly likely that media coverage of banks would be negative following an interest rate increase.

The results for firm size lead to the expectation that the coefficients of *Funding Source* should be statistically significant and positive. The results for *Funding Source* are -0.306***, -0.229***, -0.159*** and -0.121*** for the 21-day, 11-day, 7-day and 3-day window respectively. The results show that the coefficients are statistically significant at the 1% level for all event windows, and the coefficients of *Funding Source* are the largest in the regression model. However, the results show a relation contradicting the hypothesis. The results contradict those of previous studies, which found a positive relationship between the share of deposits and bank stock prices, most likely attributable to the lower perceived risk of banks with a larger share of deposit funding. To further specify, Yin and Yang (2013) find a statistically positive relationship between the share of deposits and bank stock prices following an interest rate change, and Demirguc-Kunt et al. (2010) find that the amount of deposits of a bank had a positive effect on bank equity value during the financial crisis of 2008. Ricci (2015) also investigates the effect of the proportion of retail funding of banks on bank stock prices but finds an insignificant relation. The results for *Funding Source* lead to the rejection of the third hypothesis, which states that banks that rely more on deposit funding are affected less by the interest rate increase by the FED. The expectation was primarily based on the higher risk of external funding, which has two main explanations. Firstly, the lack of insurance of external funds compared to deposits increases the risk for fund providers and incentivizes them to withdraw the funds more quickly, making banks that are more dependent on external funding riskier. Second, external funds are often subject to market conditions, and the interest rate increase by the FED raises the costs of these funds. A proposed explanation for the established negative relation is that the market believes that banks which rely more on external funding are better able to generate profits because they have more capital available. Another possible reason is that a bank that has a diverse mix of funding sources, such as a combination of deposits, long-term debt, and equity, may be perceived as more financially stable and less exposed to liquidity risk which can lead to increased investor confidence.

The coefficients of *Capital Ratio* are statistically insignificant across all event windows, which leads to the rejection of hypothesis 4. The insignificance of the coefficients of *Capital Ratio* is certainly surprising. As described in section 2.4, it was expected that the capital ratio would have a significant effect on bank stock prices due to numerous reasons. Firstly, a bank maintaining more capital could be

perceived as less risky. This is because the capital ratio is an indicator of a bank's financial stability. A higher capital ratio could indicate a bank's ability to better absorb losses from, for example, loan defaults. This is especially relevant following an interest rate increase as the amount of loan defaults is expected to increase significantly due to the increased credit costs. It was expected that this buffer against potential losses would allow banks to withstand fluctuations in the financial markets better and result in less volatility in their stock prices. Furthermore, it was expected that maintaining a higher capital ratio implies having more access to credit. Access to credit is especially beneficial following an interest rate increase because as interest rates rise, borrowing becomes more expensive and thus more difficult for firms, which can be especially problematic for financially constrained firms already struggling to access capital. Access to capital is crucial for firms as capital is needed to sustain the ongoing operations of a business and to invest, for example, in innovation. Moreover, having better access to credit could enable a bank to generate higher returns. The insignificance of the results could imply that the capital ratio is not a good indicator of a bank's access to credit. However, it is informational to examine the sign of the coefficients despite their insignificance. The signs of the coefficients of the 21-day and 11-day window are positive, which was expected and in accordance with theory, while the sign of the 7-day and 3-day coefficients are negative, contradicting theory. In section 5.3, a regression is performed with the tier 1 capital ratio of banks as opposed to the combined tier 1, and tier 2 capital ratio as a robustness check and statistically significant positive results are found.

The coefficients of *Credit Reserves* are also statistically insignificant across all event windows. This leads to the rejection of hypothesis 5. The rejection of H5 is surprising as it was expected that credit reserves would be of significance following an interest rate increase. A negative relation between maintaining higher credit reserves and bank stock prices was expected because maintaining greater credit reserves can signal that banks expect a challenging financial climate or that they were perhaps prudent when giving loans and therefore expect a greater amount of write-offs. However, the insignificance of *Credit Reserves* could imply that investors disregard the level of credit reserves when valuing a bank. However, there is no evidence for this conclusion.

Table 6 Results of the OLS-regression analysis

	(1)	(2)	(3)	(4)
Variables	**CAAR (-10;+10)**	**CAAR (-5,+5)**	**CAAR (-3;+3)**	**CAAR (-1;+1)**
ln_Assets	-0.0166***	-0.00424*	-0.00276*	-0.00269**
	(0.00365)	(0.00232)	(0.00153)	(0.00122)
Capital Ratio	0.00118	0.00127	-0.000207	-0.000113
	(0.00197)	(0.00143)	(0.000925)	(0.000721)
Credit Reserves	0.0102	0.00265	0.00353	0.00195
	(0.0202)	(0.00944)	(0.00516)	(0.00371)
Funding Source	-0.306***	-0.229***	-0.159***	-0.121***
	(0.0780)	(0.0599)	(0.0331)	(0.0222)
Constant	0.342***	0.193**	0.148***	0.109***
	(0.102)	(0.0781)	(0.0456)	(0.0311)
Observations	229	229	229	229
R-squared	0.172	0.149	0.162	0.174
Adj. R-squared	0.154	0.130	0.143	0.155

Note. Robust standard errors are in parentheses; *** p-value < .01, ** p-value <.05, * p-value <.1

5.3 Robustness check

To verify the credibility and reliability of the findings, this section checks the impact of changes in the assumptions and specifications on the outcomes. By including robustness checks, this paper aims to provide a more comprehensive analysis of the research question and confirm the soundness of the results.

First, the problem of endogeneity has to be addressed. The presence of endogeneity violates the assumption of independence between the explanatory variables and the error term in a regression model. When a statistical model exhibits endogeneity, the relationship between the explanatory variables and the response variable may become distorted, resulting in biased and inconsistent parameter estimates. As a result, the reliability and validity of statistical inference and predictions can be negatively impacted, and the real causal effects of the explanatory variables on the response variable may become unclear. Thus, to ensure that the results are precise and dependable, it is imperative to address endogeneity in a statistical analysis. This study addresses endogeneity by investigating the effect of the announcement of the inflation level in February 2022, measured by CPI. The CPI level is measured by the Bureau of Labor Statistics, and the CPI level of February 2022 was released on March 10, 2022. The CPI level increased by 7.9% over 12 months (BLS). It was chosen to investigate the effect of CPI level on bank

stock prices because the decision for the shift in monetary policy by the FED is predominantly driven by the high inflation levels. It can be argued that the news of high inflation levels would have a similar effect on bank stock prices as an interest rate increase. Both factors indicate unfavorable macroeconomic conditions and hence it can be assumed that investors would assign more value to bank stocks with less perceived risk. By investigating the effect of inflation, this study tries to annul the idea that the abnormal returns of bank stocks are driven by the inflation level and not the interest rate change. Thus, this check aims to add to the credibility of the results. The results of the regression using the alternative model, namely the effect of CPI level information on bank stock prices, are presented in table 7. The 21-day and 11-day windows are not included because these event windows include the interest rate increase announcement by the FED.

Table 7 Results of the regression using CPI level as the independent variable to check for endogeneity. March 10, 2022, is used as the event date (the date on which the CPI level of February was released by the BLS)

	(3)	**(4)**
Variables	**CAAR(-3;+3)**	**CAAR(-1;+1)**
ln_Assets	0.00791***	0.00310***
	(0.00141)	(0.000956)
Combined Capital Ratio	0.00265*	0.00194**
	(0.00153)	(0.000783)
Credit Reserves	0.0104*	0.00457
	(0.00596)	(0.00480)
Funding Source	0.0543	0.0517**
	(0.0395)	(0.0216)
Constant	-0.163***	-0.0954***
	(0.0567)	(0.0317)
Observations	229	229
R-squared	0.186	0.105
Adj. R-squared	0.168	0.0852

Note. Robust standard errors are in parentheses; *** p-value < .01, ** p-value <.05, * p-value <.1

The results in Table 7 show significantly different results from those in Table 6. The sign of the effect of ln_Assets and Funding Source is positive when using the CPI level as the event date as opposed to negative signs when using the interest rate increase announcement as the event date. Furthermore, the results for Capital Ratio are statistically significant across both event windows, and the result for Credit Reserves is significant for the 7-day window, both opposing the results in Table 6. The contradicting

findings when using the alternative regression model, namely the model which investigates the effect of the release of the CPI level across February 2022 on bank stock prices, as opposed to the regular model in this study, namely the model that investigates the effect of the interest rate increase on March 16th, 2022, by the FED on bank stock prices, lead to the conclusion that the abnormal return observed in the standard regression model is not driven by the inflation levels and thus adds to the soundness of the results of this study.

A further robustness check is performed by using the tier 1 capital ratio of banks rather than the combined tier 1 and tier 2 capital ratio. This check is driven by the insignificance of the results of Capital Ratio in the regression. This result was surprising as previous studies and theory led to the expectation that maintaining higher capital levels would mitigate bank risk and thus lead to a positive effect on abnormal returns following the switch in monetary policy. Table 8 presents the results of the OLS regression with tier 1 capital ratio of banks instead of the combined capital ratio. The data for the tier 1 capital ratios of the banks are obtained through the CRSP database, and the tier 1 capital ratio is calculated by dividing tier 1 capital by risk-weighted assets. The tier 1 capital ratio is reported by banks themselves. Basel 3 defines Tier 1 capital as Tier 1 common equity and Tier 1 additional capital. The former includes common shares, stock surplus, retained earnings, and other comprehensive income and disclosed reserves, while the latter includes several specific other forms of capital.

Table 8 Results of OLS-regression using Tier 1 Capital Ratio rather than the combined capital ratio of banks

	(1)	(2)	(3)	(4)
Variables	**CAAR(-10;+10)**	**CAAR(-5;+5)**	**CAAR(-3;+3)**	**CAAR(-1;+1)**
ln_Assets	-0.0164***	-0.00424*	-0.00244	-0.00245**
	(0.00353)	(0.00219)	(0.00150)	(0.00121)
Tier 1 Capital Ratio	0.00470**	0.00364**	0.00163*	0.00133**
	(0.00210)	(0.00144)	(0.000879)	(0.000645)
Credit Reserves	0.00942	0.00208	0.00315	0.00164
	(0.0203)	(0.00939)	(0.00518)	(0.00356)
Funding Source	-0.289***	-0.220***	-0.145***	-0.110***
	(0.0789)	(0.0574)	(0.0323)	(0.0220)
Constant	0.286***	0.160**	0.109***	0.0798***
	(0.0958)	(0.0675)	(0.0419)	(0.0281)
Observations	229	229	229	229
R-squared	0.193	0.174	0.176	0.189
Adj. R-squared	0.175	0.155	0.158	0.170

Note. Robust standard errors are in parentheses; *** p-value < .01, ** p-value <.05, * p-value <.1

The results of Table 8 show that the coefficients of *Tier 1 Capital Ratio* are statistically significant at different levels across all event windows. Contrary to the results in Table 6, these results show that maintaining a higher tier 1 capital ratio mitigates the effects of monetary tightening on bank stock prices. The significance of the results of the tier 1 capital ratio and the insignificance of the results of the combined capital ratio of banks imply that the level of tier 2 capital of a bank is disregarded as an indicator of bank risk by investors. Furthermore, the results for *Tier 1 Capital Ratio* are positive across all event windows. The positive significant coefficients of *Tier 1 Capital Ratio* can be most likely explained by the fact that the tier 1 capital level is seen as the primary tool of banks to sustain losses. Furthermore, the significance of *Tier 1 Capital Ratio* could imply that investors regard tier 1 capital as an indicator of access to credit, and hence maintaining a higher tier 1 capital ratio can lower the susceptibility of a bank's stock return to monetary tightening. The findings presented above are in accordance with those of Demirguc-Kunt et al. (2010), who find that banks with a higher tier 1 capital ratio are less susceptive to interest rate changes. Demirguc-Kunt et al. also find that superior forms of capital are perceived as more relevant. Ricci (2015) also finds that banks with higher capitalization are less responsive to monetary policy interventions. However, Ricci investigates the effect of monetary expansion rather than the effect of monetary tightening. Yin and Yang (2013) find similar results, namely that better-capitalized banks are less susceptible to unexpected interest rate changes.

Lastly, this study performed a robustness check for the t-test through the execution of a BMP used to test the statistical significance of the abnormal return. A robustness check for the event windows is performed by including four event windows in the study. The methodology and the results of these checks are discussed earlier in the paper.

CHAPTER 6 Conclusion

On March 16th, 2022, the Federal Reserve, the central bank of the USA, announced an increase in the interest rate of 25 basis points. The interest rate change was the first increase since December 2018 and therefore marked a shift in monetary policy, namely a shift from monetary expansion to monetary tightening. The rate increase was driven by the historically high inflation in the US, restraining the FED from fulfilling its mandate of keeping prices stable. The FED aims to stabilize the entire US economy through altering the target federal funds rate, the rate at which banks borrow and lend to each other. Subsequently, banks siphon the increase in their costs through to consumers in the form of higher interest rates. Hence, monetary policy has the most direct effect on banks. However, studies investigating the reaction of bank stocks to monetary tightening are limited. This study investigates the state-dependent effectiveness of monetary policy, in this case, monetary tightening, while taking yet uninvestigated financial stability considerations into account. The research question of the paper is defined as follows:

RQ: *How will switching from expansionary to tight monetary policy by the Federal Reserve affect commercial bank stock prices in the US?*

Analyzing the existing literature regarding monetary policy and stock prices, leads to the conclusion that interest rates and stock prices are negatively related. Acclaimed studies include that of Thorbecke (1997) and that of Bernanke and Kuttner (2005), in which a negative relationship is found. The most relevant existing studies for this paper are that of Madura and Schnusenberg (2000), Yin et al. (2010), and Yin and Yang (2013), in which the authors explore the effect of monetary policy on bank stock prices. All three studies find a negative relationship between interest rates and bank stock prices. However, the studies highlight the ambiguity of the effect of an interest rate increase on bank profits. Firstly, fixed-rate loans decrease in value if the current interest rate rises, while variable-interest loans yield a higher return for banks. Moreover, higher interest rates may negatively impact bank revenue because there is less demand for credit because of the increased cost. Additionally, the overall financial climate is expected to deteriorate following an interest rate increase, leading to the expectation that stock returns will decrease. After performing an event study, statistically significant negative values for CAAR were found across the 21-day, 11-day, 7-day, and 3-day windows for both the t-test and the BMP test statistic. This leads to the acceptance of the first hypothesis, which states that an increase in the interest rate by the FED has a negative effect on US bank stock prices.

After finding statistically significant evidence for the existence of a negative relation between US bank stock prices and an interest rate increase by the FED, a regression analysis is performed to identify the drivers of the abnormal return. The first independent variable analyzed was bank size, this was proxied by taking the natural logarithm of total assets. This study finds statistically significant evidence for an

inverse relationship between bank size and bank stock prices following an interest rate increase, leading to the acceptance of H2. Previous studies attribute the negative relation between bank size and stock prices to the difference in funding sources between large and small banks. However, the statistically insignificant results of funding source lead to the rejection of this explanation. This study offers the explanation that large banks are better known and receive more media coverage leading to more active trading in their stocks which could entail a negative effect on stock prices because it is highly likely that media coverage of banks would be of negative nature following an interest rate increase.

This leads to H3, which states that banks that rely more on deposit funding are affected less by the interest rate increase by the FED. However, this study finds statistically significant evidence for a negative relationship between funding source and bank stock prices following an interest rate increase by the FED, leading to the rejection of H3. A possible explanation for the unexpected negative relation between funding source and bank stock prices is that the market could believe that banks which rely less on deposit funding are better able to generate profits because of the increased capital available. Another possible explanation is that banks that have a more diverse mix of funding sources are perceived as more financially stable and less exposed to liquidity risk.

This leads to the fourth hypothesis, which states that the effect of a federal funds rate increase on bank stock prices is more pronounced in banks with a lower capital ratio. This study does not find statistically significant evidence for a relation between capital ratio and bank stock prices, thereby rejecting the fourth hypothesis. The insignificance could imply that investors disregard the capital ratio when trading in bank stock. However, a robustness check is performed by investigating the significance of the quality of capital by performing the regression with the tier 1 capital ratio of banks instead of the combined tier 1 and tier 2 ratio. This regression produces statistically significant positive results for the tier 1 capital ratio, indicating a positive relationship between the tier 1 capital ratio of a bank and the abnormal return of a bank's stock price following an interest rate increase by the FED. The positive significant coefficients of *Tier 1 Capital Ratio* can be most likely explained by the fact that the tier 1 capital level is seen as the primary tool of banks to sustain losses. Furthermore, maintaining a high-level tier 1 capital ratio could indicate a bank's enhanced access to credit. Hence, maintaining a higher tier 1 capital ratio can lower the susceptibility of a bank's stock return to monetary tightening. The regression results of the robustness check imply that investors disregard tier 2 capital as an indicator of a bank's risk.

The fifth hypothesis states a negative relation between reserves for credit losses and bank stock prices following the interest rate increase by the FED. This hypothesis is rejected because of the statistical insignificance of the concerning results. The insignificance of the results could imply that investors believe that the level of credit reserves does not influence bank stability or is irrelevant following an interest rate increase.

Overall, the results of this paper lead to the conclusion that switching from expansionary to tight monetary policy by the Federal Reserve negatively affects commercial bank stock prices in the US. The paper finds that investors most likely regard bank size and funding source as relevant indicators of bank stability, with funding source being the most important indicator.

With the paper's conclusion, it is important to acknowledge certain limitations and provide recommendations for future research. Regarding the regression analysis, various control variables were utilized to minimize omitted variable bias in the estimates of the parameters used. However, it is uncertain whether all the appropriate control variables were included, which could lead to misinterpretation of the coefficients if relevant variables were left out of the model. Furthermore, this study does not consider the potential influence of other policy interventions, such as fiscal policy, financial sector policies, and rescue programs, on the relationship between monetary policy and asset prices.

Considering the limitations of this study, future research could add to the existing literature by investigating unexplored financial stability factors. The foremost missing factor would be credit rating, as this is the most direct and accurate estimate of a bank's creditworthiness and the market's most convenient indicator of its ability to repay its debt. Next, existing studies find statistically significant evidence for the existence of a negative relationship between a change in credit reserves and the stock price of a bank. Given the insignificance of the coefficients of *Credit Reserves* found in this study and the significant results of previous studies, future studies could investigate the effect of monetary tightening on banks that increased the level of credit reserves relative to total assets in the year before the interest rate increase. Furthermore, future studies may utilize alternative investigation techniques, such as a survey aimed at executives of the companies which invest in bank stock to attempt to identify the foremost financial stability factors. Conducting a survey might provide new insights into how investors evaluate banks. Moreover, this paper believes that there is a limited amount of existing literature that uses direct research methods such as interviews or surveys. Also, the relatively recent announcements of interest rate increases by the ECB lead to the suggestion that this study can be largely reproduced, and the effects of the shift from monetary expansion to monetary tightening by the ECB on bank stock prices in the EU can be analyzed. Additionally, it would be interesting to investigate the spillover effects of the interest rate increase by the FED on other financial markets as the US financial markets are generally leading. It would be especially interesting to examine the spillover effects on the euro area as the US and the euro area have become more interdependent over time. Existing studies find that euro area financial markets react strongly to news about US monetary policy (Ehrmann and Fratzscher, 2005). Furthermore, future studies could replicate this study in a country in which bank-based financing is dominant rather than market-based financing (the US is market-based). It is perhaps

possible that large banks in bank-based financing countries are regarded as “too big to fail” and are hence perceived as less risky banks and, thus, safer investments. This would imply that bank stock prices in bank-based financing countries would experience less abnormal return. Furthermore, if an economy depends more on banks for financing, banks have more market power. They could potentially create a larger interest rate mismatch and hence increase profits, potentially leading to positive abnormal returns of bank stock prices following an interest rate increase by the central bank of the regarding country, rather than the negative abnormal returns observed in this paper. Also, future studies could consider other types of policy interventions, such as those described in the previous paragraph. Lastly, it would be interesting to investigate the effect of the switch in monetary policy by the FED on corporate and government bond prices as bonds are inextricably related to the federal funds rate as the demand for bonds, and thus their prices increase following an increase in the federal funds rate.

REFERENCES

Acharya, S., Ho, L. T. & Kumar, V. (2020). Does monetary policy influence the profitability of banks in New Zealand? *International Journal of Financial Studies*, *8*(2), 35.

Anderson, D. C., Hatfield, G. & Lancaster, C. (1993). Stock price reactions to increases in loan-loss reserves: A broader perspective. *Journal of Economics and Finance*, *17*(3), 29-41.

Allen, M. R., Harrison, J. S. & Oler, D. (2007). Over-interpretation of short-window event study findings in management research: an empirical illustration. *Available at SSRN 665742*.

Armitage, S. (1995). Event study methods and evidence on their performance. *Journal of Economic Surveys*, *9*(1), 25-52.

Agusman, A., Gasbarro, D., Monroe, G. S., & Zumwalt, J. K. (2008, June). Loan loss reserves and bank stock returns: Evidence from Asian banks. In *21st Australasian Finance and Banking Conference*.

Banz, R. W. (1981). The relationship between return and market value of common stocks. *Journal of Financial Economics*, *9*(1), 3-18.

Basel Committee on Banking Supervision. (2010, December). *Basel III: A global regulatory framework for more resilient banks and banking systems*. https://www.bis.org/publ/bcbs189.pdf

Bayly, L. & Wallace, A. (2022, 14 July). *US inflation hit 40-year high in June, driven by record gas prices*. CNN. https://edition.cnn.com/2022/07/13/economy/cpi-inflation-june

Bernanke, B. S., & Kuttner, K. N. (2005). What explains the stock market's reaction to Federal Reserve policy?. *The Journal of Finance*, *60*(3), 1221-1257.

Boehmer, E., Masumeci, J., & Poulsen, A. B. (1991). Event-study methodology under conditions of event-induced variance. *Journal of Financial Economics*, *30*(2), 253-272.

Boesler, M. & Torres, C. (2022, 17 May). *Powell Says Fed Will 'Keep Pushing' Until Inflation Comes Down*. Bloomberg. https://www.bloomberg.com/news/articles/2022-05-17/powell-says-fed-will-keep-pushing-until-inflation-coming-down?leadSource=uverify%20wall

Booth, J. R., Henderson, G. V., & Officer, D. T. (1985). Commercial bank stocks, interest rates, and systematic risk. *Journal of Economics and Business*, *37*(4), 303-310.

Borio, C., Gambacorta, L., & Hofmann, B. (2017). The influence of monetary policy on bank profitability. *International Finance*, *20*(1), 48-63.

Bradley, C. M., & Shibut, L. (2006). The liability structure of FDIC-insured institutions: changes and implications. *FDIC Banking Review*, *18*, 1.

Brown, S. J., & Warner, J. B. (1980). Measuring security price performance. *Journal of Financial Economics*, *8*(3), 205-258.

Carlini, F., Cucinelli, D., Previtali, D., & Soana, M. G. (2020). Don't talk too bad! stock market reactions to bank corporate governance news. *Journal of Banking & Finance*, *121*, 105962.

Conover, C. M., Jensen, G. R., & Johnson, R. R. (1999). Monetary environments and international stock returns. *Journal of Banking & Finance*, *23*(9), 1357-1381.

Consumer prices for food up 7.9 percent for year ended February 2022: The Economics Daily: U.S. Bureau of Labor Statistics. (2022, 15 March). https://www.bls.gov/opub/ted/2022/consumer-prices-for-food-up-7-9-percent-for-year-ended-february-2022.htm

Consumer Price Index News Release - 2022 M02 Results. https://www.bls.gov/news.release/archives/cpi_03102022.htm

Cox, J. (2022, 17 March). *Federal Reserve approves first interest rate hike in more than three years, sees six more ahead*. CNBC. https://www.cnbc.com/2022/03/16/federal-reserve-meeting.html

Demirgüç-Kunt, A., Detragiache, E., & Merrouche, O. (2010). Bank Capital: Lessons from the Financial Crisis *(World Bank: Policy Research Working Paper No. 5473).*

Docking, D. S., Hirschey, M., & Jones, E. (1997). Information and contagion effects of bank loan-loss reserve announcements. *Journal of Financial Economics*, *43*(2), 219-239.

Duggan, W. (2022, 21 September). *Is The U.S. Headed For Another Recession?* Forbes Advisor. https://www.forbes.com/advisor/investing/is-a-recession-coming/

Ehrmann, M., & Fratzscher, M. (2004). Taking stock: Monetary policy transmission to equity markets. *Journal of Money, Credit and Banking*, 719-737.

Ehrmann, M., & Fratzscher, M. (2005). Equal size, equal role? Interest rate interdependence between the euro area and the United States. *The Economic Journal*, *115*(506), 928-948.

Fang, L. H., Peress, J., & Zheng, L. (2014). Does media coverage of stocks affect mutual funds' trading and performance?. *The Review of Financial Studies*, *27*(12), 3441-3466.

Federal Open Market Committee. https://www.federalreserve.gov/monetarypolicy/fomc.htm

Gaunt, C. (2004). Size and book to market effects and the Fama French three factor asset pricing model: evidence from the Australian stock market. *Accounting & Finance*, *44*(1), 27-44.

Hatfield, G., & Lancaster, C. (2000). The signaling effects of bank loan-loss reserve additions. *Journal of Financial and Strategic Decisions*, *13*(1), 57-73.

Huang, R., & Ratnovksi, L. (2009). The Dark Side of Bank Wholesale Funding. (*CentER Discussion Paper; Vol. 2009-59 S).* Finance.

International Monetary Fund, Interest Rates, Discount Rate for United States [INTDSRUSM193N], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/INTDSRUSM193N, November 22, 2022

MacKinlay, A. C. (1997). Event studies in economics and finance. *Journal of Economic Literature*, *35*(1), 13-39.

Madura, J., & Schnusenberg, O. (2000). Effect of Federal Reserve policies on bank equity returns. *Journal of Financial Research*, *23*(4), 421-447.

Paul, P. (2020). The time-varying effect of monetary policy on asset prices. *Review of Economics and Statistics*, *102*(4), 690-704.

Ricci, O. (2015). The impact of monetary policy announcements on the stock price of large European banks during the financial crisis. *Journal of Banking & Finance*, *52*, 245-255.

Romer, C. D., & Romer, D. H. (1989). Does monetary policy matter? A new test in the spirit of Friedman and Schwartz. *NBER Macroeconomics Annual*, *4*, 121-170.

SEC.gov | Division of Corporation Finance: Standard Industrial Classification (SIC) Code List. (2021, June 3). https://www.sec.gov/corpfin/division-of-corporation-finance-standard-industrial-classification-sic-code-list

Sellin, P. (2001). Monetary policy and the stock market: theory and empirical evidence. *Journal of Economic Surveys*, *15*(4), 491-541.

Šútorová, B., & Teplý, P. (2014). The level of capital and the value of EU banks under Basel III. *Prague Economic Papers*, *23*(2), 143-161.

Testimony by Chair Pro Tempore Powell on the Semiannual Monetary Policy Report to the Congress. Board of Governors of the Federal Reserve System. https://www.federalreserve.gov/newsevents/testimony/powell20220302a.htm

The FED - TIPS Yield Curve and Inflation Compensation. https://www.federalreserve.gov/data/yield-curve-tables/feds200805_1.html

Thorbecke, W. (1997). On stock market returns and monetary policy. *The Journal of Finance*, *52*(2), 635-654.

Tobin, J. (1969). A general equilibrium approach to monetary theory. *Journal of Money, Credit and Banking*, *1*(1), 15-29.

What is a SIC Code? - SICCODE.com. (2021, May 4). SIC & NAICS Codes, Company Search, Business Lists - SICCODE.com. https://siccode.com/page/what-is-a-sic-code

Yin, H., Yang, J., & Handorf, W. C. (2010). State dependency of bank stock reaction to federal funds rate target changes. *Journal of Financial Research*, *33*(3), 289-315.

Yin, H., & Yang, J. (2013). Bank characteristics and stock reactions to federal funds rate target changes. *Applied Financial Economics*, *23*(23), 1755-1764.

12-month percentage change, Consumer Price Index, selected categories. https://www.bls.gov/charts/consumer-price-index/consumer-price-index-by-category-line-chart.htm

APPENDIX

Table A.1 Results of the Breusch-Pagan test for heteroskedasticity

Event window	Chi^2
(-10;+10)	23.84***
(-5;+5)	37.12***
(-3;+3)	10.09***
(-1;+1)	0.56

Note. *** p-value < .01, ** p-value <.05, * p-value <.1

Table A.2 Pearson correlation matrix between the variables used in the regression

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) CAAR[-10,10]	1.000							
(2) CAAR[-5,5]	0.768***	1.000						
(3) CAAR[-3,3]	0.665***	0.816***	1.000					
(4) CAAR[-1,1]	0.612***	0.722***	0.799***	1.000				
(5) ln_Assets	-0.225***	0.018	0.066	-0.022	1.000			
(6) Risk-Adjusted Ca~	0.160**	0.181***	0.110*	0.108*	-0.042	1.000		
(7) credit_reserves	0.142**	0.111*	0.144**	0.120*	-0.007	0.062	1.000	
(8) Funding Source	-0.213***	-0.336***	-0.344***	-0.324***	-0.443***	-0.256***	-0.246***	1.000

Note. *** p-value < .01, ** p-value <.05, * p-value <.1

Table A.3 Value inflation factor results

Variable name	VIF	1/VIF
Funding Source	1.845	.542
ln Assets	1.562	.64
Capital Ratio	1.141	.877
Credit Reserves	1.099	.91
Mean VIF	1.414	.