

BANK STOCKS IN A NEGATIVE INTEREST RATE WORLD

by

Aubrey Tully

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Project Approved:

Supervising Professor: David Dubofsky, Ph.D.

Department of Finance

Samuel Arnold, Ph.D

Department of Political Science

Abstract

This paper contributes to the understanding of negative interest rates (NIRP) and their impact on banks. It specifically looks at bank stocks in eight different countries between 2006-2008, when all countries had positive rates, as well as between 2017-2019 when four of the countries had negative rates, and the other four remained positive, and examines their monthly average returns. Utilizing data from Bloomberg Terminal, and drawing upon past research, the results from the study revealed that bank stocks do not collapse under NIRP. They are able to remain fairly steady in terms of their volatility, and their reaction to the market remains relatively unchanged whether they are in negative or positive interest rate environments. This study discusses the potential reasonings and future implications of embracing a negative interest rate policy.

Introduction

The Great Recession (TGR) of 2007 through 2009 devastated the global economy and forced a multitude of countries to think outside the box in order to recover from the economic downturn. The years following TGR of 2007-2009 was saturated with fear and uncertainty regarding the financial markets. Citizens chose to hold onto their money rather than spend or invest. In response, a wave of financial research focused on ways to grow the money supply and boost money circulation. Unconventional monetary tools such as quantitative easing and forward guidance were introduced in efforts to make it easier and cheaper for people to borrow money. The most recent phenomenon has been the idea of implementing negative interest rates, also known as Negative Interest Rate Policy (NIRP).

This abnormal structure of lending ten dollars and receiving nine back shocked the financial world (Warwick 2016). In the traditional setting, someone or some entity, will lend money to another person or entity if they are able to gain from that transaction by earning interest. In this new environment, however, lenders are now penalized and borrowers gain. Savers now pay a bank to hold their money. Therefore, money that is held in a bank or in a financial market is, in essence, taxed and it begins to lose its value. While this appears not to make logical sense, the reasoning behind this is that negative interest rates will encourage people to retrieve their money and spend it, thus spurring economic expansion. Also, the hope is that negative rates will stimulate the movement of money and induce inflation (Arteta, Kose, Stocker, & Taskin 2016).

Negative interest rates were formally introduced in 1891 by a man named Silvio Gesell in his book, *Die Reformation im Münzwesen als Brücke zum Sozialen Staat*. He

was a “German-Argentine businessman and economist,” who suggested imposing a tax on currency and bank reserves (Buiter & Nikol 2003). He did so after living through the economic crisis of Argentina and struggling through opening his own business there in the 1880’s (Ilgmann & Menner 2011). He hated money and wanted to stop people from hoarding cash, providing an incentive for people to spend more freely. Gesell essentially wanted money to “go bad,” losing its value over time if not spent. He made it clear that the nominal zero lower bound was no scientific, technological fact and that it was simply a result of politics and opinions. The bound could be lowered. Rejected by most, especially by the very wealthy, Gesell had a hard time getting his idea adopted. However, he opened the door for over a century of conversation and contemplation. His ideas were actually implemented in the early twenty-first century.

The past two decades, several major countries have pursued Gesell’s idea and have proposed and implemented the use of negative interest rates as a way to jumpstart their economy and get people to spend money. In mid-2012, Denmark became the first country to officially establish negative interest rates. Denmark did this first, by selling two-year loans with negative yields to customers, and then officially, when their central bank cut the interest rate to minus .02 percent in June of that year (Wienberg, Christian, Schwartzkopff, Frances, Brogger, & Tasneem 2012). For the past few years, Denmark banks only taxed its citizens who made approximately over \$1 million, but as of August 2019, they lowered this minimum to about \$100,000 and are now charging at a minus .75% interest rate (Rigillo, Buttler 2019). Danish economists predict this minimum may drop even lower (Rigillo, Buttler 2019).

Following Denmark's early example, Sweden, Japan, Switzerland, and the Euro Area followed suit. According to the company, Trading Economics, a popular provider of historical and financial market data, as of October, 2019, the Central Bank of Japan's interest rate is (-.10%), Sweden's (-.25%), Denmark (-.65%), and Switzerland (-.75%). The European Central Bank adopted negative interest rates in 2014.

This new, atypical model adopted by these countries is incongruent to what many economists have believed in the past as being an effective, successful interest rate. It is also inconsistent to the present system that most developed countries have followed since the 1930s in the years following The Great Depression. Throughout history, the majority of economists have advised avoiding the "zero lower bound." Until the most recent years, it was thought that this "zero lower bound" was obviously zero. A zero percent interest rate was the limit that the nominal interest rate was constrained to, and to which the government could no longer lower rates in its effort to boost the economy (Buiter & Nikol 2003). Dipping below zero was deemed ineffectual. Now, with Sweden, Japan, Switzerland, and the Euro Area in negative territory, the zero lower bound no longer exists.

As the new reality sets in, this neoteric, unorthodox framework poses many new questions on the slew of its underlying effects. Brand new to the system, the effect negative interest rates may have on banks, corporate businesses, financial systems, financial markets, and currency exchange is widely unknown. For the past seven years, countries like Denmark, Sweden, Switzerland, and Japan have served as experimental case studies in analyzing these questions. While the information and research done on these countries is relatively young and limited compared to other financial data, it is still

possible to gauge the efficiency, effectiveness, and potential for negative interest rates in spurring the growth of the economy. A growing stream of research has been conducted on the possible future outcomes.

This goal of this paper is to delve deeper into this topic and attempt to analyze some of these questions that have been raised. In order to accomplish this, it will draw on research done in the past two decades on fluctuating interest rates and the potential implications they have towards the economy. Specifically, it will look at recent research analyzing how well negative interest rates have worked in countries up to this point. Then, it will test the prediction that bank stocks trading in negative interest rate environments will have lower average returns than those trading in positive interest rate environments. Additionally, it will test the hypothesis that banks stocks under NIRP will be more volatile, and more volatile relative to the market (beta). The analysis will be done by examining bank stocks that trade in negative interest rate environments compared to those trading in similar positive interest rate environments.

The reasoning behind making banks the fundamental focus of this paper is because their performance is highly integrated and tied to interest rates. Generally, when interest rates increase, banks profit, loans become more profitable, bond prices decrease and (all else equal) stock prices decrease. Through analyzing how negative interest rates affect banks, their activities, and their assets, this information helps in making educated predictions regarding the impact they will have on the entire economy. This paper will uncover some of the benefits and drawbacks of negative interest rate environments.

Literature Review

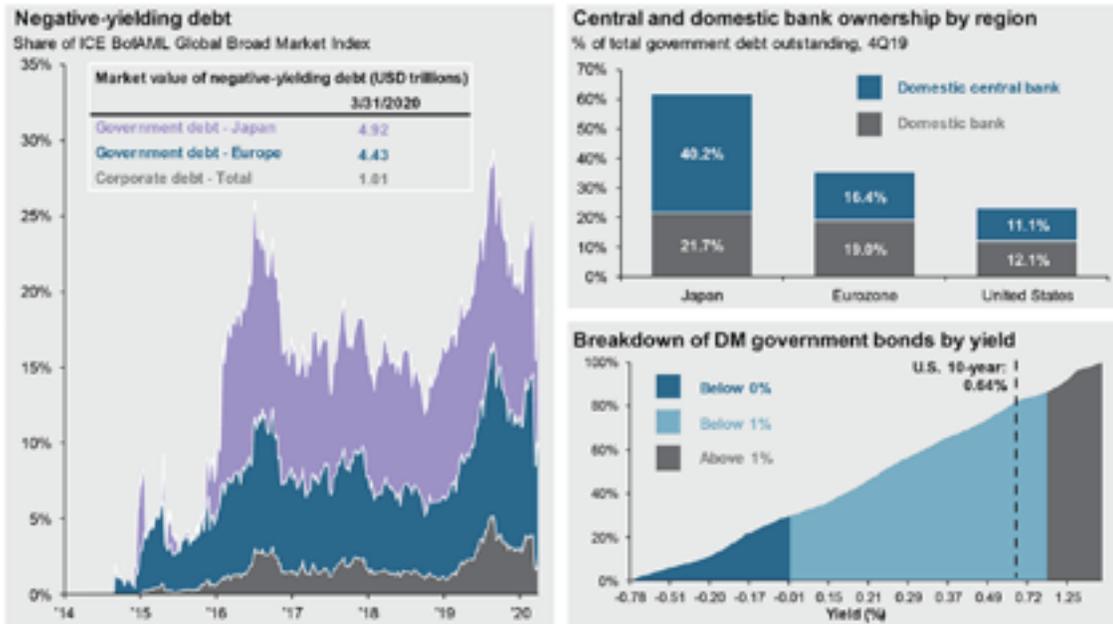
Over the past decade, the world has suffered from the repercussions of the Great Recession. It left many countries in a massive amount of national debt. This public debt continues to proliferate year after year. According to the US Department of the Treasury, the United States is now over 25 trillion dollars in debt. In order to combat this large sum of debt that is present in nearly all developed countries, leaders have suggested refinancing the debt at a negative interest rate. This “would eliminate the net interest component of the debt, which has been mounting as interest rates have climbed,” (Ermey 2019). Until now, the United States has been tentative to enter these uncharted territories and unknown waters. However, both the European Central Bank and the Bank of Japan now have had a few years of negative rates, and the US can use their experience and data in order to determine whether NIRP is a viable strategy. Watching them closely, United States’ economists have begun to analyze the European and Japanese financial statements over the past few years in calculating the potential benefits, drawbacks, and risks of choosing this modern, economic model. In recent years, a growing body of research has taken place, examining how negative interest rates affect bond yields, bank stocks, and bank profitability, with a heavy emphasis on the overall effect they have on banks. There are many contradicting opinions on how negative interest rates will affect banks. In the past, evidence has pointed to banks profiting as interest rates rise (Obamuyi 2013), (Rudegear, Glazer 2019). Therefore, a natural reaction is that as interest rates fall, banks profits will also fall. However, some research, (Rogoff 2016), points to the idea that because people may run to banks to grab their cash, and avoid losing money, the decline in the supply of loanable funds

could actually increase interest rates. Thus, this will cause a reverse effect of what economists and policy makers are attempting to accomplish. Still other economists (Jobst & Lin 2016) believe that bank profitability may rise in the short run, but decrease in the long run. With so many differing opinions, there has been a spiked interest in studying bank lending practices, as well as bank volatility under NIRP. The review below examines some of these questions raised.

Bond Yields

Bond yield movements have been useful indicators of the direction of interest rates, as well as the general economy. Due to NIRP in Europe and Japan, the interest rate on bonds in these places has decreased significantly, and the rest of the world's bond yields have followed in their footsteps (Ermev 2019). This phenomenon, also known as the "Bond Yield Spillovers," was studied by Belke, Dubova, and Volzjust (2016). In this study, the authors researched how deeply one economy's bond yields were able to influence another economy's. The authors of this study used vector autoregressive (VAR) variance decompositions and discovered that, "there has been growing evidence that advanced countries' unconventional monetary policies (UMP) have caused significant spillovers to the financial markets of emerging market economies." When Europe and Japan use NIRP as an unconventional monetary policy, the changes in their bond yields and other asset pricing evokes change in other economies' pricing. The chart below quantifies how much NIRP has permeated the globe. It shows that as of April 30, 2020, almost 40% of global government bonds have negative percent yields.

Fixed Income



Source: J.P. Morgan Asset Management; (Left) Bloomberg, BofAMerill Lynch; (Top right) Bank for International Settlements International Banking Statistics, ECB, Eurostat, IMF Coordinated Portfolio Investment Survey (CPIIS), IMF Currency Composition of Official Foreign Exchange Reserves (COFER), IMF International Financial Statistics (IFS), IMF-World Bank Quarterly External Debt Statistics; (Bottom right) Bloomberg, BofAMerill Lynch. Countries included in Europe are: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Slovenia, Spain, Sweden, and Switzerland.
Guide to the Markets - U.S. Data are as of April 30, 2020.



Based on the previous authors' research, they also believe that it is impossible to separate the markets of Europe and the US from Asia's. Due to this geopolitical culture, the consequences of lowering interest rates in one country are magnified. Growing closer together, the world economy is as intertwined as ever. The stakes for negative interest rates are even higher.

Negative interest rates have indicated signs of economic weakness. Since NIRP has shown to have a negative effect on bond yields, (Aizenman, Cheung, & Chantapacdepong 2017), this system, coupled with rising geopolitical tensions and associated trade wars, have left the world economy in a feeble state. While lowering interest rates may be stimulative, they may only be impelling up to a certain point. There may truly exist a lower bound to which low enough rates end up becoming an

impediment to the economy. Sweden may have hit that point as the country has recently decided to abandon NIRP as of December 2019, due to the fact that they have not seen major economic improvements (Hannon 2019). Six years into negative interest rates and the ECB has also not experienced great economic revival. This points to the idea that banks would most likely suffer under NIRP.

Bank Stock Sensitivity

From a banking perspective, the success of a banking sector relies heavily on the Central Bank's interest rate. Examining various banks' behaviors and performance allows economists to quantify the effects of varying interest rates. Theoretically, it is plausible that negative rates could decrease the profit margin on bank assets to such a degree that banks would choose to lend less. Bank stocks, in particular, have been helpful in measuring the effects of NIRP. However, with the lack of adequate information regarding negative interest rates today, the data collected on bank stocks relating to negative interest rates is rather inconclusive. Another problem is that it may take months, or even years, for the effects of negative interest rates to show up tangibly. Nonetheless, over the past few decades, economists have attempted to calibrate the effects of low versus high interest rate sensitivity on bank stocks. This information is useful in predicting what may happen to the economy in negative interest rate settings.

One study by Flannery and James (1984) tested common stock returns and their correlation with interest rate changes. They did this by analyzing weekly data from a sample of commercial banks and comparing their balance sheets with their associated returns. They predicted that, as interest rates increase, the returns of bank stocks would

decrease. Their results agreed with their hypothesis that stock prices and interest rate changes are highly negatively correlated (Flannery & James 1984). The authors went even further to show that interest rate sensitivity is also correlated with the maturity of the issuer’s assets and liabilities. Below is a chart of their results.

Table III
Estimates of Interest Rate Sensitivity for a Portfolio of Commercial Bank Stocks^a

$$\tilde{R}_t = \beta_0 + \beta_m \tilde{R}_{mt} + \beta_I \tilde{R}_{It} + \tilde{\epsilon}_t$$

Index ^{b,c}	$\hat{\beta}_0$	$\hat{\beta}_m$	$\hat{\beta}_I$	R^2	Durbin-Watson Statistic
R_{GNMA}	0.002 (0.001)	0.556 (0.030)	0.133 (0.038)	0.57	1.74
R_{G7}	0.002 (0.001)	0.560 (0.031)	0.069 (0.027)	0.56	1.73
R_{TB}	0.001 (0.001)	0.555 (0.031)	0.515 (0.160)	0.57	1.73

^a Estimated using weekly data for the period January 1, 1976 to November 1981, $N = 302$.

^b Interest rate series are the residuals of the AR(3) models.

^c Standard errors are in parentheses.

The equation above is looking for $R(t)$, or the holding period return of a stock over the period ending at time t . $R(I_t)$ is “the holding period return on an index of constant maturity default-free bonds over the period ending at time t .” Looking at the column under “B(I)” it correlates the market value of the bank stocks to the interest rates. B(I) is the effect nominal interest rate changes have on the common stock returns of a particular firm in relation to the market index. Because the HPR on bonds are negatively correlated with changes in the level of interest rates, the positive estimates represent an inverse relationship between interest rates and bank equity values. Thus,

as interest rates increase, bank stock returns decrease. B_1 also gets larger, according to their model, the longer the bank's net nominal assets are held to maturity (Flannery & James 1984). "Since the holding period returns on bonds are negatively correlated with changes in the level of interest rates," the longer a bank's nominal assets are held, the more its value will decline as interest rates rise. In other words, interest rates rise and bond prices fall, so holding period returns on bond portfolios fall. Because this data collected by Flannery and James does not test for negative rates, it is difficult to base the effects of negative interest rates on this data. However, it lends to the idea that "the effect of nominal interest rate changes on common stock prices is related to the maturity composition of a firm's net nominal asset holding," and it is important to take into account the life of the financial instruments when testing for the results under NIRP. Because my data that I reference later in this paper does not take the life of the instrument into account, this could contribute to the weaker, less significant results.

Several years after Flannery and James published their paper, Akella and Chen (1990) compile a similar array of studies. The studies they examined derived conflicting results. Each work attempted to determine how sensitive bank stocks were to interest rates in general, but the studies failed to reach a consensus, (Akella & Chen 1990). Differing methodologies, interpretations, data, and age all contributed to the discrepancies. The authors contribute the variability of the study to its "orthogonalization procedures." Below is a chart of the combined studies results.

TABLE 2. Interest Sensitivity of Bank Stock Returns.

Panel A		Panel B		
Equation	Interest Index ^a	Equation	Interest Index	Interest Index Dummy: 80-84
1a/2a	1.763 (1.481) ^a	1c/2c	-1.782 (-0.748)	4.849 (1.407)
3a	-1.914 (-1.664)	3c	-5.302* (-2.290)	4.495 (1.398)
4a/5a	0.826 (0.322)	4c/5c	-11.528 (-1.857)	15.125* (2.243)
6a	-9.555* (-4.016)	6c	-20.641* (-3.671)	13.495* (2.182)
1b/2b	0.353* (3.036)	1d/2d	0.820* (3.22)	-0.536 (-1.87)
3b	0.789* (7.194)	3d	1.270* (5.1)	-0.602* (-2.20)
4b/5b	0.327* (2.577)	4d/5d	0.858* (3.241)	-0.630* (-2.07)
6b	0.871* (7.500)	6d	1.405* (5.553)	-0.684* (-2.44)

^aEquations (1a)-(3a) and (1c)-(3c) employ returns on Treasury bills while equations (4a)-(6a) and (4c)-(6c) employ innovations in these returns. Equations (1b)-(3b) and (1d)-(3d) employ returns on long-term government bonds and the remaining equations employ innovations in these returns.

^bt-statistics are in parentheses.

*Significant at the 5 percent level.

Panel A of the above table illustrates the variability in the interest sensitivity of bank stock returns, with equation 6a exhibiting the most sensitive stocks, and 4a/5a exhibiting the least sensitive.

Even though there are many differing results, the majority of the studies conducted noticed a similar trend that “interest rate risk exposure of banks has declined since the 1980s,” and “overall, banks seem to have better hedged themselves against interest rate movements in the 1980s,” (Akella & Chen 1990). Through monetary policies such as buying and selling interest rate futures, long-term bonds, or high yield bonds, and engaging in swaps, banks may be more able to mitigate their risk to

fluctuating interest rates. If they continue to improve in this manner, banks will be better prepared for adapting to changes in interest rates. As a consequence, it is presumed that bank stocks in the present age can remain relatively stable even when interest rates are negative. To the extent that banks hedge themselves against the declining rates, they may not experience any immediate results of negative interest rates. However, over time, the hedges will expire, and banks will eventually feel the impact of NIRP.

Many other studies have been conducted relating to interest rate risk and bank exposure. Not reaching a consensus, several economists agree with Akella and Chen such as Drechsler et al. (2018), who believe that, through maturity transformation, banks have enough of a natural hedge to prevent too much fluctuation in the valuation of banks as interest rates change. Their relative stability was confirmed by analyzing the stock prices of banks, which demonstrated that there was “no relationship between a bank’s long-term asset share, as reflected in its income beta, and its equity interest rate exposure.” This indicates an efficient source of bank hedging. Along with maturity mismatching, restructuring a company's debt and equity combination is also used to hedge against interest rate risk. While these policies may work in some economies when the interest rates are low, bank hedging strategies may be insufficient if interest rates decline significantly, and become negative.

Taking the other side of the debate, economists such as Begenau et al. (2015) and Gomez et al. (2017) do not agree that banks will remain as stable in times of negative interest rates. They believe the potential volatility is due to their lack of fully hedging against the risk and due to the newness of nominal negative interest rates.

Because long term negative interest rates are such rarities, most banks have not prepared or hedged themselves for this kind of economic novelty. Princeton economists, Markus K. Brunnermeier, and Yann Koby (2018), agree with this statement. Using a DSGE model, or a “dynamic stochastic general equilibrium,” which is used primarily for macroeconomic research, they found that the unexpected shock of long term negative interest rates did end up having a distinctive effect on bank equity pricing and profits. Their research found that the level of interest rates and bank’s profitability was non monotonic. The non monotonicity demonstrates that although there are certain benefits to the economy for lowering interest rates, as interest rates are cut more and more, there reaches a point in which interest rates become too low and the reverse effect happens. Bank valuations and equity pricing become contractionary, or at minimum, fluctuate in a nonlinear fashion. Their results validate the existence of the reversal interest rate and the zero lower bound.

Even though there are conflicting opinions on the weaknesses verses strengths of banks and their hedging capabilities, most economists generally agree on the consensus that short rate cuts are more desirable to “low for long.” Negative interest rates that are kept for too long adversely affect bank profitability because they narrow the marginal gains available to banks.

In addition to analyzing hypothetical scenarios of what economists believe will happen under NIRP, the United States now has the advantage of studying what actually has happened to the economies that have utilized negative interest rates. Japan has been a primary example to examine. As the United States moves closer and closer to negative rates in the past year, The Wall Street Journal has reported frequently on how

they have managed in Japan. Due to Japan's aging population and their 1990 speculative bubbles, the country has had very slow, economic growth in the past 30 years. There are several big take aways from their experience. While the economic growth has been enough to satisfy existing demands, the outlook of growth for the future is compromising. Having to allocate an incredible amount of money towards health-care and retirement funds has diminished the productivity of the working population. In addition, it has become clear that implementing a negative interest rate is not a short term treatment. Japan's central bank, along with other "central banks that have introduced negative interest rates expecting them to be a short-term remedy have been unable to transition back," (Otani 2019). Countries have become reliant on negative rates, and they have simply stalled the deterioration of the economy. They have even helped to keep afloat unpopular industries that the market should have let failed (Kruger 2019). Japan is sliding into a very bad situation that the United States should be cautious not to repeat (Kruger 2019).

There are many other important issues that have been studied and need to be addressed when contemplating the effects of negative interest rates. Before deciding to use this unconventional monetary technique, it is necessary to consider how it will affect a country's tax policy. The Wall Street Journal recently touched on the effect negative interest rates has on taxes. Hypothetically, in the past, if someone borrowed \$100,000 from a bank with 5% interest, they would owe \$105,000 when the amount became due. Then, he or she may be able to write off the extra \$5,000 on their taxes. Under NIRP, if someone borrowed \$100,000 from a bank with -5% interest, they would owe \$95,000 when the amount became due. The question then becomes how does tax fall into play

in this negative interest rate environment? Economists and politicians are still discussing the implication of NIRP on taxes and how to handle the unfamiliar territory, (Kupiec 2019). One more possible dilemma regarding taxes is that some self-employed individuals may try to cheat the system, attempting to overpay their taxes and claiming a zero interest refund later (Rogoff 2016). While important to take note of, these technical troubles seem to be of little concern for policy makers in determining whether or not to utilize this monetary tool.

Other potential complications that governments should be wary about and carefully consider regarding negative rates are the effect on government bonds, pension funds, and liquidity. A recent Bloomberg article, Pohjanpalo (2019), touches on all three of these emerging challenges. In the article, Mikko Mursula, the Chief Investment Officer at Finland's Ilmarinen Mutual Pension Insurance Company said, "reality hit after the summer, when it became virtually impossible to get government bonds at positive yields across most of the euro zone," (Pohjanpalo 2019). Mursula also reports, "the expected risk-return ratio of government bonds has never been this poor, as it is at this moment." With liquidity as a thing from the past, his company has to develop alternative methods in generating cash. Pohjanpalo (2019) also mentions the problem with the lack of access to government bonds due to the fact that the "European Central Bank sucks up the supply of bonds as part of its quantitative easing program." This means that Finland may no longer be able to buy Germany's government bonds in order to help pay their debt. Overall, negative interest rates are pushing investors to "reach for yield," by moving into riskier assets. All of these uncertainties add to the already unpredictable nature of negative interest rates, making the transition to NIRP even more precarious.

Methods and Results

Upon analyzing prior research done on this topic, I drew most of my predictions based on Brunnermeier and Koby (2018). Agreeing with their experimental processes, premises, and results, my predictions were that bank stocks under negative interest rate environments will have higher betas in response to the market than those in positive interest rate environments and that they will also be more volatile in general with a greater standard deviation. I also predicted that there will also be lower bank stock returns under NIRP when compared to positive environments.

In order to gather the data needed to test my theories, I utilized the Bloomberg Terminal to look at banks in eight different countries, specifically looking at bank stocks. These countries were Sweden, Switzerland, Denmark, Japan, Canada, Australia, South Korea, and Norway. The first four became negative interest rate countries between 2009 and 2016, and the latter four are positive interest rates countries. The EQS, or equities function, in Bloomberg helped me to get the information on bank stocks, while the FLDS function helped me to find a formula for each country's market returns. To make the process even easier for importing all of this information into excel, I was also able to use the following function: `=BQL("filter(equitiesuniv(['primary','active']),CNTRY_OF_DOMICILE == 'CA' AND BICS_LEVEL_2_INDUSTRY_GROUP_NAME=='Banks'),"Total_return(Calc_Interval=Range(2018-01-01,2018-12-31))","mode=cached")`. I just switched out the country abbreviations. The function listed above is for Canadian banks (CA).

In order to easily access the market returns in excel, I used the following formula: `=BDH("KOSPI Index","RT116","01/01/2006","12/31/2008","Per=M")`. I was able to edit

the different indices as well as dates to obtain market returns for all the major indices between 2006 and 2008 and then between 2017 and 2019. The reason for choosing these dates are explained in the next paragraph.

In selecting the countries chosen, there were several factors that went into the decision making process. Size, population, GDP, type of government, and external events were all taken into consideration. The data collected starts in 2006, which is three years, or 36 months, before the first country (Sweden) went negative. It ends in 2019, which is three years after the last country (Japan) went negative. I chose to compare the same positive 36 months and last 36 months so that the data collected would all be from the same global economic time point. If I had attempted to measure Sweden's data from 2006 to Japan's in 2013, that would be comparing an entirely different economic era. Keeping with the same 36 months minimized the extraneous variables. In addition to the time period, it was also difficult choosing eight countries that were similar enough in terms of their size and government. Because every country is so unique in terms of their structures and economies, matching four positive countries with four negative proved challenging. The main criteria for choosing these countries were that they had to be first world countries, stable democracies, and participate in the global economy. As of December 2019, there are thirty one first world countries. Among those thirty one countries, nineteen of them are in the EU. Choosing both Denmark (negative) and Norway (positive) from this list, I then chose the six most fitting from the remaining twelve. I excluded Iceland because it is so small, with a population of only 362,860 people. I also excluded Israel for its political unrest and corruption (Schwartz & Lieber 2019), as well as Turkey for its economic crisis in 2018 (Sivramkrishna &

Nandipati 2019). The remaining two, New Zealand and Singapore, could have been used in regards to my criteria, however, I chose Norway in order to match Sweden as it's closest counterpart. Therefore, while not perfect, Sweden and Norway, Japan and South Korea, Denmark and Canada, and Switzerland and Australia were the best choices for this particular study.

Table 1. Number of Banks Analyzed

Japan	Switzerland	Sweden	Denmark
87	42	4	21
South Korea	Australia	Norway	Canada
7	15	64	9

I chose to omit the United States in this analysis because it's economy is so much larger than the rest of these economies. With a GDP of \$19.39 trillion dollars according to The World Bank, the U.S. economy is over fourteen trillion dollars greater than the next closest NIR country in the selection, Japan at \$4.87 trillion dollars. In addition, the sheer number of banks in the United States far out numbers any of the other selections chosen.

The other major country that I chose to exclude was the UK. I decided not to include the UK in my data due to the political and economic effects of Brexit that may misrepresent the results. Even though Brexit had not yet gone into effect given the months studied, the economic and financial effects were drastic enough to distort the

outcome of the study and stock returns. The turmoil surrounding this uncertainty played a large role in the stock market volatility (Ramiah & Pham & Moosa 2016).

After collecting my data, I tested my predictions. In order to test my first prediction and estimate Beta, I chose to analyze bank stocks for these countries using the statistical technique, “Diff in diff regression,” also known as the difference in difference estimator. This technique is “the difference in average outcome in the treatment group before and after treatment minus the difference in average outcome in the control group before and after treatment: it is literally a “difference of differences,” (Albouy 2013). For the purpose of this paper, the treatment group is the four countries that had negative interest rates, Sweden, Switzerland, Denmark and Japan. The control group is the four countries that remained positive, Canada, Australia, South Korea, and Norway. The treatment years are from 2017-2019, and the market for each bank in the market model is each country’s market.

The actual formula for the outcome is: $Y_i = \alpha + \beta T_i + \gamma t_i + \delta (T_i \cdot t_i) + \epsilon_i$, where Y_i is the Outcome, α is the constant, β is the effect on the treatment group, γ is the time trend common to control and treatment groups, and δ is the true effect of treatment, to the best estimate given all available data (Albouy 2013). This study attempts to evaluate the effect of negative interest rates (the treatment) on a) bank stock returns, b) bank stock betas and c) bank stock total volatility (the Outcomes). In order to test the effect, it analyzes the treatment group mentioned above versus the control group also previously mentioned before and after the implementation of negative interest rates.

The purpose of using this particular technique is that it is intended to mitigate some of the variables and/or biases that may pollute some of the results. It helps

distinguish from the effects of the change in time periods to the effect of the interest rates as well as other omitted variable biases. While it is very efficient in removing some of these biases, it is not perfect. Some of the downsides, or just general aspects to remember are that the difference in difference estimator must meet three main assumptions. First of all, the outcome must be clearly defined, explaining precisely what is ultimately determined. Second of all, the error term must be zero on average. The third assumption, also known as the parallel-trend assumption, is that the error term cannot become muddled with any other variables in the equation (Albouy 2013). If any one of these assumptions falls through, then the estimator is no longer unbiased.

After gathering my data and performing my own research, I had to reject my hypothesis that bank stocks under negative interest rate environments will have higher betas in response to the market than those in positive interest rate environments. The results are documented in the tables below:

Table 2. Average Betas of Bank Stocks for Negative Interest Rate Countries

- Countries	Japan	Denmark	Switzerland	Sweden
Beta 2006-2008	0.63293476	0.75250884	0.25731748	0.62302878
Beta 2017-2019	0.86205655	0.28952650	0.21711904	0.83475880
Difference	0.22912179	-0.46298234	-0.04019844	0.21173002

Table 3. Average Betas of Bank Stocks for Positive Interest Rate Countries

+ Countries	South Korea	Canada	Australia	Norway
Beta 2006-2008	0.5934258	0.44955412	0.84261669	0.2757683
Beta 2017-2019	0.9107851	0.74978246	0.93988375	0.31027932
Difference	0.3173593	0.30022834	0.09726706	-0.03451102

Table 4. Difference in Differences of Bank Stock Betas

	Japan/South Korea	Denmark/ Canada	Switzerland/ Australia	Sweden/ Norway
Diff-in-diff	-0.08823751	-0.76321068	-0.1374655	0.24624104

While Sweden and Japan both had fairly high betas post going negative, Denmark actually decreased tremendously and Switzerland remained very low. In order to find beta, I utilized Bloomberg Terminal again using the formula: =BDH("KOSPI Index","RT116","01/01/2006","12/31/2008","Per=M") which allowed me to view monthly market returns from various points of time for various indices. The above formula uses the KOSPI (South Korean Index) and looks at the months between January 1st 2006 and December 31st 2008. I then compared the remaining countries using the OMX Copenhagen Index (Denmark), OMX Stockholm (Sweden), SMI Swiss Index (Switzerland) NIKKEI 225 (Japan), S&P/TSX Composite Index (Canada), S&P/TSX 200 Index (Australia), and Oslo Exchange All Shares (Norway).

Once I was able to get the monthly returns from 2006-2008 and then from 2017-2019, I was able to average the bank stock returns for all the bank stocks of each individual country from all 72 months and put the data side by side. So overall, each country had 72 observations for the market as well as for the bank stocks. With those 72 observations, I was able to calculate Beta, which measures the volatility of the bank stocks in relation to the volatility of each country's main index. I actually calculated two betas, one for 2006-2008 and one for 2017-2019. I then found the percent change in difference of each country's monthly market returns and then took the covariance of the bank stock returns and market returns and divided that by the variance of the market returns in order to obtain the two betas (before and after NIRP). From there, I was able to find the differences between the before and after for the negative countries as well as the positive countries and then find the difference between these differences in order to take into account the time effect, eliminating it's impact.

A beta that is higher than one demonstrates that the stock returns for the banks move more drastically than the market. A beta that is lower than one indicates that the stock returns for bank stocks are more stable than the markets. If the stock returns moved perfectly with the market, the beta would be equal to one. From the data displayed in the table above, it is clear that bank stocks in general, have been more stable when compared to their market at the time. While Sweden and Switzerland became more volatile post NIRP, Denmark and Switzerland were actually less volatile post implementation. Taking the time aspect into account, only Sweden was slightly more volatile while the other three countries were less, disproving my hypothesis.

I also had to reject my second prediction, that bank stocks in negative interest rate environments will be more volatile than those in regular interest rate environments. While Japan experienced a slight spike in volatility in the past three years, Denmark, Sweden, and Switzerland all saw a decrease in volatility in the years post implementing negative rates. I found the volatility by calculating the standard deviation of monthly returns of all the bank stocks for each country before and after NIRP. The results of average bank stock volatility in negative interest rate countries are shown in the table below:

Table 5: Average Bank Stock Volatility in Countries under NIRP

	JP	DK	CH	SWE
2006-2008	6.5016%	8.7894%	4.2573%	8.1935%
2017-2019	6.6456%	6.914%	2.9336%	5.913%

In addition to looking at the volatility of bank stocks, I also predicted that bank stocks will have lower average returns with negative interest rates than they will under positive rates. After reviewing the returns generated from my eight chosen countries, I had to reject this hypothesis as well. In fact, the only two countries who ended up having greater average monthly returns from 2017-2019 than from 2006-2008 were South Korea and Australia, both of which were positive interest rate countries. The results of the returns are shown below:

Table 6: Average Monthly Returns of Bank Stocks

	JP	DK	SWE	CH	KR	AU	CA	NO
2006-2008	-0.01617	-0.01434	-0.01977	0.00250	0.00375	0.00129	-0.00225	-0.00611
2017-2018	-0.01033	0.00144	0.00157	0.00341	0.0010	0.00089	0.01494	0.00494
Δ	+0.00583	+0.01579	+0.02134	+0.00090	-0.00268	-0.0039	+0.01720	+0.01106

Discussion Section

Before analyzing the results and three hypotheses, it is important to look at other policies that may have coincided with these dates, affecting the results. Other economic measures that took place during the time of implementing negative rates include the “introduction of the Basel III liquidity coverage ratio (LCR) and the ECB’s first series of targeted longer-term refinancing operations (TLTROs),” (Heider, Saidi, & Glenn

Schepens 2018). These increased the amount of liquid assets required by banks as well as provide financing to banks to continue to support and spur bank lending, respectively. Policies such as these in Europe, as well as the changes in bank credit supply, deposits, reserves, fee income, and liquidity provision in Japan (Hee Hong & John Sandarac 2018), all make it challenging to truly study the effect of just negative rates on banks. Recognizing these factors may have played a significant part in these results allows room for more analysis and research. It allows for an open mind and investigative approach to exploring the results.

In regards to my first hypothesis, when referencing “high betas,” this is a measure of volatility, or the fluctuation in price changes of a particular stock relative to the overall market. In other words, it looks at how much the price level moves within a certain amount of time. This volatility is a measure of a stock’s systematic risk, compared to the market’s risk. Systematic risk is the risk that cannot be diversified away; it is inherent to the market. Unpredictable and unavoidable in nature, it is in contrast to unsystematic risk, which can be avoided through proper diversification. If a stock has a beta of one, it means the stock tends to move with the market. If the stock has a beta higher than one, it is more volatile, it will tend to rise (fall) more than the overall market increases (declines). It will outperform the market when the market is doing well, but will also backslide more rapidly in times of market downturn. Comparatively, if a stock has a beta less than one, it will move less dramatically compared to the market.

In the case of these countries bank stocks. They moved less dramatically than the market. Some countries bank stocks really did not move much with the market at all.

While this appeared troubling, this type of reaction has happened for stocks and for industries in the past. There have been periods of times in history where firm or industry specific factors have overpowered systematic factors, in controlling stock prices. Some examples of industry and firm specific factors that have affected stock market returns include the effects of energy prices on stock markets (Basher & Sadorsky 2006), the “Internet Bubble,” the introduction of computerized trading around the late 1980s, wariness surrounding the Persian Gulf, as well as other incidences such as the spinoff of Palm Pilot from its parent 3Com Corporation, where the Palm’s stock market value was almost double the stock market value of its parent company (Malkiel 2003), and more. These examples, while rare, demonstrate that bank stocks do not always follow the market.

Looking back at the results, banks in both Norway and Switzerland have unusually low betas. Research done on Norway stocks and the Oslo Stock Exchange finds that there is “no positive relationship between beta estimated and subsequent returns, which is contradictory to CAPM, (Korneliussen & Rasmussen 2014). One reason why these bank stocks may not follow the market is because many investors might overweight these risky securities in times of uncertainty instead of using leverage, resulting in lower returns, (Korneliussen & Rasmussen 2014). Other industry-specific factors that may have been dominating over the market risk include government regulation, investor confidence in banks, demand for banking services, how capitalized banks are, and cash flow expectations (ECB Financial Stability Review 2006). Also, the sheer size of the banks matters. Smaller banks tend to be more affected by bank-specific factors rather than the market (ECB Financial Stability Review 2006) and many

Norwegian banks tend to be on the smaller side as compared to countries like Japan and South Korea. Also, relating to energy prices, Norwegian return on equity declined in 2018 due to losses in the oil industry being greater than estimated (Cook 2019). All of these factors may have contributed to Norway's low betas.

In the case of Switzerland's irregular betas, the overall median return on equity (RoE) for banks "has remained in a low, very narrow range for around ten years. Instead of approaching a reasonable return of about 8-10% (close to the cost of equity), it continues to fall" (KPMG 2019). While the RoE continues to fall, Switzerland's Market Index has steadily increased. Investigating this oddity, something that stands out that makes Switzerland banks special is there exceptionally high capital requirements and strong deposit protection. The "Too-Big-To-Fail" regime that was passed after the financial crisis made the two biggest banks in Switzerland hold substantial amounts of capital (Junge & Kugler 2018). This framework of high capital requirements actually hurts their returns because less lending is available (KPMG 2019). Even when the market improves, the returns on bank stocks remain low. Additionally, the number of small banks in Switzerland also throws off beta considering they perform much poorer relative to the larger banks, but are weighed no different from the larger banks in my research.

Upon the market returns of these countries, I was exceptionally puzzled by these results. Thinking theoretically, if rates are negative, this would cut into bank profitability. However, after further research, the various effects of negative interest rates seems to be much more complex than this simple thinking (Lopez, Rose, & Spiegel 2020). Due to banks protecting themselves from the effects of NIRP, the correlation between bank

profitability and negative rates is not as linear as first believed. Negative nominal interest rates have had little effect on bank profitability thus far.

Researchers at the European Central Bank (ECB) conducted a similar study on bank profitability for Sweden and Denmark post implementing NIRP in 2017. Their findings mirror mine in that they found that “[Bank] profitability has continued to improve, even with negative monetary policy rates” (Madaschi & Nuevo 2017). Their research looks at bank profitability from 2008 to 2016 and demonstrates a fairly steady increase in operating return on assets from 2011 to 2016. The increase in Swedish bank profitability, they believe, is credited mainly to their rise in bank operating incomes, while the increase in Denmark, is credited to the fall in operating expenses (Madaschi & Nuevo 2017). Sweden’s operating income has increased due to “realized and unrealized gains” on securities, the economic recovery, and Riksbank’s government bond purchase programs. Denmark’s operating expenses have fallen due to cutting costs, such as layoffs, as well as improvements in impairments ((Madaschi & Nuevo 2017).

Additional studies support Madashci and Nuevo’s findings. Researchers from Oesterreichische Nationalbank, the Central Bank of Austria, also looked into bank profitability of Denmark, Sweden, and also Switzerland post NIRP (Scheiber, Silgoner, & Stern (2016). They found that “in the countries under observation, ultra-low and negative interest rates have so far not resulted in a significant slump of bank profitability and especially of net interest income,” (Scheiber, Silgoner, & Stern 2016). This is because if the cost of funds is -100 bp, then banks are getting paid to take money and can lend it out at zero, still gaining from the transaction. Many banks have avoided lost

profits due to constantly changing their business models to reflect the economic environment. Trying different methods, “large banks are able to mitigate the negative effect of NIRP on NIMs and ROAs through hedging, lending diversification and by switching from interest to non-interest oriented business models,” (Molyneux, Reghezza, & Xie 2019). Other ways banks have hedged themselves against negative interest rates has been through raising lending volumes and by gains in non-interest income (Madaschi & Nuevo 2017).

Another likely reasoning for banks remaining fairly stable is because my data and results look at returns from 2017-2019. By this point, the Danish, Swedish, and Swiss banks have had three or more years of experimenting with these low and ultra low negative interest rates. They have been able to test different methodologies and figure out exactly how to maintain their profitability. While banks have been able to maintain stable profitability in recent years, bank profitability may not have been as high in the years immediately following the implementation of NIRP. This factor may have also played a role in bank volatility.

Switching over to look at the results of bank volatility, banks did not prove to be more volatile under NIRP. In understanding these results, I looked at further research to try and comprehend this outcome. I think the fact, mentioned above, that my data collected was from the three most recent years, contributed to the more stable returns. Banks and citizens have had time to adjust to the policy and have been able to arrange for better consistency. Supporting this idea, past research indicates that bank net income in Denmark was volatile in the years between 2010 and 2015, but since 2015, have been able to level out and become more balanced (Scheiber, Silgoner, & Stern

2016). This also stands true for Switzerland as well. If I had compared returns from early years, the data might have given different results.

Other factors that tend to play a role in volatility are extreme political events, the GDP growth rate, bank hedging activities, their asset and liability structures, and banks' varying fixed, floating, and exchange rates. Thinking politically, a possible reason for the decreased volatility today, rather than in the months between 2006 and 2008, is the aftermath of the Financial crisis of 2007-2008 and the collapse of big banks. After observing how the central government bailed out so many large banks and enacted policies to ensure bank security, people may feel more confident today depositing their money in banks, and leaving it there, decreasing volatility. People's confidence in the government backing them up may outweigh the risks involved with negative interest rates.

Implications section

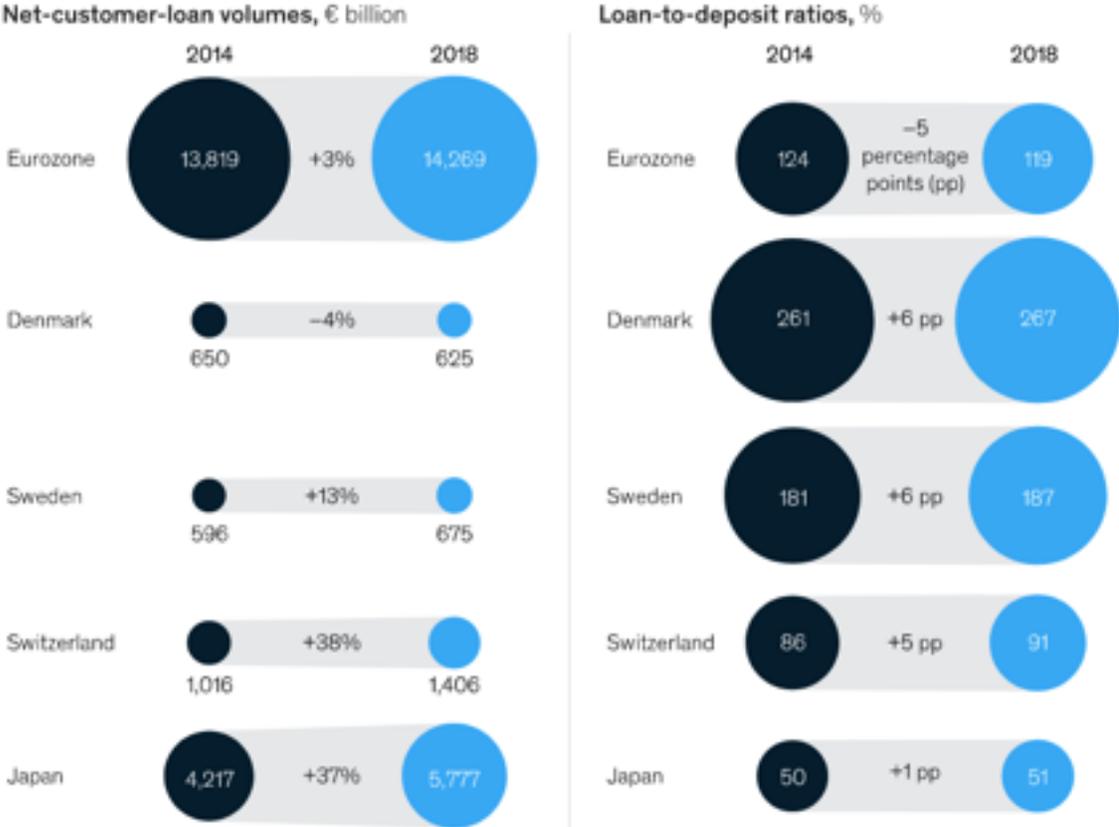
With banks still profiting, volatility remaining fairly stable, and beta giving somewhat inconclusive results, it appears as though negative interest rates are not as toxic for banks as they first sound. According to this paper's findings, the effect on bank profitability is much smaller, and the ability for banks to succeed under NIRP, is much greater than many economists had originally anticipated. These results of bank stock returns, volatility, and beta all suggest that banks have been able to hedge themselves from tremendous hits. Research has shown that, banks and business models are adapting to the economic changes, and "banks in countries with negative interest rates so far have not, on average, seen a fall in their profits as a result of them," (Blanke &

Krogstrup 2016). Banks have been able to avoid some of the downsides to negative interest rates by “increasing fees on deposit accounts to make up for the loss of interest income,” as well as “by having large parts of their money parked with the central bank exempted from the negative interest rate,” (Blanke & Krogstrup 2016). By increasing fees on deposits, the banks are in essence, able to pass the negative interest rates onto customers without necessarily referring to them as “negative rates,” making them appear less bleak, encouraging more deposits.

Despite the ability to adapt to lower rates, negative rates are by no means inconsequential. While my research suggests that negative interest rates may not have had as significant an impact on bank profitability as first thought, this does not mean they will not cause more problems in the future in banking as well as in other parts of the economy. For example, under NIRP, individuals will have to save a lot more for retirement. By definition, more saving equals less spending, and less spending may ultimately hurt the economy. It also does not mean that other measures should not be taken in addition to lowering interest rates. The initial NIRP implementation came with a whole array of other government measures and financial intermediation. Both the ECB and BOJ developed the “tiered” system to mitigate the side effects of negative interest rates in order to “reduce banks’ cost of holding excess reserves while still allowing for a strong pass-through to money markets” (Jobst & Lin 2016). This system was designed to ease the transition of this new policy to money markets. All of the steps taken to alleviate the side effects of NIRP, along with the fact that the results and success rates coming from Japan and across Europe are so mixed, demonstrates the complexity and intricacy of the economy. Governments should be wary of implementing NIRP and

should be prepared to enact other economic policies in order to alleviate some of the stronger effects of this monetary policy.

Another policy that banks in Denmark, Japan, Sweden, and Switzerland have implemented in order to preserve their net-interest margins and protect their clients, has been to increase their loan-to-deposit ratios (Heider, Saidi, & Schepens 2018). This ensures that banks are able to payback their loans and withdrawals by customers, never going too far into debt. McKinsey & Company, a management consulting firm in America, obtained data from SNL Financial in order to visually display the increase in the loan-to-deposit ratios. Their data is shown in the image below:



Source: SNL Financial



These countries' banks have also tried to brace against these unknown effects through restructuring their balance sheets in order to optimize their liquidity reserve. Banks want to maintain an amount that minimizes their charges on excess reserves and allows them to fund more loans, while also having enough to cover any losses (Demiralp, Eisenschmidt, & Vlassopoulos (2017). They have also experimented with repricing their deposits and readjusting their assets and liabilities to avoid any mismatches and lower risks (Heider, Saidi, & Schepens 2018).

One of the biggest concerns with NIRP is that it is still a very new policy that has not been in place for many years. Seemingly unsustainable, down the road, "If negative interest rates are in place for a longer period of time, banks' room for maneuver may be constrained and this, in turn, may eventually curtail banks' profitability," (Scheiber, Silgoner, & Stern 2016).

While negative interest rates may be a good short term solution to stimulate the economy, there is no way of knowing how long they will be able to last until they result in diminishing returns. With the pressure on banks, as well as the uncertainty aspect, the longer negative rates remain in practice, the more likely they are to disrupt the natural economic flow, distorting financial markets and altering the system (Jobst & Lin 2016).

Going forward, it is important to learn from the countries that have already implemented negative rates and study what went well and what did not work so well. In the past few months, the President of the United States has even considered incorporating negative interest rates. Looking at the above findings, as well as all the research now available out there, it appears as though negative interest rates (for a

specified period of time) could be a temporary solution for struggling countries. On the other hand, while it is a good sign that countries with negative rates have not seen dramatic losses to their banking industry, the economies that have incorporated these policies, have not seen considerable recoveries, (Scheiber, Silgoner, & Stern 2016). Ultimately, the varied results and outcomes of negative interest rates are the reasons why choosing to enact this particular policy is such a risky venture. Especially now, in a time of so much global integration, there are so many different elements and moving parts in the economy that makes making accurate predictions so difficult.

Even though the United States has the advantage of looking to the countries that have already implemented these rates as examples, it is important to note that the U.S. government and economy is notably different than any of these other countries. The effects on the U.S. economy may be drastically different than what has previously been observed. If the U.S. were to utilize negative interest rates, economists and policy makers must carefully evaluate the progression of the economy on a regular, quarterly basis, paying special attention to how it affects banks, other lenders, and smaller financial services companies. They must introduce new systems to assess the impact and measure the risks by diligently communicating with top management and allowing for visibility and oversight. If the economy starts to show signs of breakdown, then economists need to reevaluate the new strategy and make adjustments accordingly.

Conclusion

This paper presents a compilation of research and data on the topic of negative interest rates. The data used was retrieved from Bloomberg Terminal. This included

monthly bank stock returns and market returns for all eight countries studied. The examination of the data revealed that a) after several years of implementation, bank stocks do not seem to suffer tremendously under negative interest rates b) bank stocks are able to remain fairly stable with NIRP and c) they do not seem to change positions in regards to how much they move with the market in this new environment.

The overall trend based on the presented evidence is that negative rates do not cause as much damage as many had believed. They are also extremely complex and result in many differing opinions. In many countries, negative interest rates may have actually helped to improve overall financial conditions in encouraging growth and spending in the short run. On the other hand, they have not helped revive economies as many had anticipated, and could create problems long term. The evidence found in this paper fails to support the original hypotheses that negative rates would dramatically hurt bank stock returns, increase overall volatility, and fluctuate more than the market.

Now with many more countries considering negative interest rates, including the United States, there may be much more information for further research with new scenarios to address. The new data will be helpful in understanding the many differing opinions regarding NIRP. The more data that can be analyzed, the more conclusions can be extracted, and the more able we are to determine the true effects. Gessel's century old idea is no longer hypothetical. Negative rates are here and their effects will be felt worldwide.

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