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Bachelor thesis Finance

The influence of the interest rate on bank profitability

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Abstract

In this paper the influence of the market interest rate on bank profitability in the United States is investigated. Using fixed effects models with demeaned variables, I find that a lower interest rate results in lower bank profitability. Further, a low interest rate gives a lower total amount of savings at commercial banks. Lastly, the total amount of investment by commercial banks in the United States decrease in a low interest rate environment.

1. Introduction

The Covid-19 pandemic has led to severe discussions on monetary policy, bank profitability and interest rates. Banks and companies are worried about their profits and there is not one economist who can say with absolute certainty what will happen in the next few years. The past has shown that a poorly running economy leads to low interest rates. To what extent will this influence the bank profitability?

There are written plenty of papers about the interest rate and bank profitability separately. For example, Evans (1987) wrote about the relationship between interest rates and larger budget deficits, while Demirgüç-Kunt and Huizinga (1999) discussed bank profitability in countries with an undeveloped financial system. However, papers about these two concepts combined are scarce. There are some studies in which the topics are both mentioned, but these papers mainly focus on the amount of risk banks take during low interest rates and not on the profitability (Bikker & Vervliet, 2017). The purpose of this thesis is therefore to give a better insight in what happens with the profit if the interest rate drops, so that banks can prevent unexpected setbacks.

After analyzing papers about low interest rates and bank profitability, some questions remained unanswered. The reactions of the amount of savings and investment to a low interest rate are crucial for a bank's profitability, but not yet defined in the existing literature. To get a better view on these reactions and the profitability, I have divided this thesis into a research question and two sub-questions. The most important question, and therefore the research question of this paper is:

'Does a low interest rate result in lower bank profits in the United States?'

To answer the main research question, this paper will also contain a few sub-questions:

1. 'Do United States citizens save less during a low interest rate?'
> The behavior of the inhabitants of the United States is very important for the profitability of banks. With a low interest rate, the assumption is that people will save

less. But is it this straightforward, or are there other interpretations that should be considered?'

2. 'What happens to the amount of investment in a low interest rate environment?'
With this sub-question I want to investigate what characterizes banks when there is a low interest rate. This will allow for greater understanding of the decisions that banks make in these times.

With answering these questions, banks will have a clearer understanding of their profitability during a low interest rate environment. This research will help them making difficult decisions about investing, borrowing, lending, and saving.

Looking for answers on what happens to bank profitability in a low interest rate environment, a panel data study is assembled. A fixed effects model is made, and all the variables are demeaned. This way, variables that do not change over time can be left out of this study. The data is obtained from Global Financial Data (GFD) and the Federal Reserve Economic Data (FRED). The dataset contains multiple variables during the period 1961-1987. With the data, the influence of interest on bank profitability will be examined. To zoom in on the effect of a low interest rate on savings and the total amount of investment, two extra regressions will be constructed.

This thesis contains seven chapters in which different sections are discussed. In the upcoming chapter, the already published literature on this topic are summed up and criticized. The next chapter covers the data and formulation of the hypotheses. Predictions are made, and the variables are defined. Chapter 4 consists of the methodology. The regressions are explained, and the use of the fixed effects model substantiated. Thereupon the STATA output is examined and claims about, among other things, the effect of a low interest rate on bank profitability are made. Next, all findings are summed up in the concluding chapter. Lastly, the predictions and outcomes of this study are compared and the limitations and recommendations of this research are named.

2. Literature review

In this paper it is important to determine what affects the interest rate and bank profitability. If this is properly done, the right variables can be used in the regressions so that the findings will be as unbiased as possible. In the following sections the concepts that influence the interest rate and bank profitability will be discussed. Furthermore, I have named and compared the existing literature on bank profitability in a low interest rate environment.

2.1 What affects the interest rate?

It is relevant to know what influences the interest rate, because this could (indirectly) affect the bank profitability. The interest rate discussed in this paper is the market interest rate. This is the applicable interest rate on cash deposits. Banks are the entities which establish this type of interest rate. It is the task of the United States banks to choose the right interest rate at the right time. There are multiple factors that should be considered when determining the amount of interest.

Firstly, the policy of the Federal Reserve System (hereafter: Fed). If the Fed wants citizens of the United States to consume more, they will lower the funds target rate. This is the interest at which commercial banks can loan and borrow their reserves to each other. The banks will follow by decreasing the market interest rate. Saving will be less attractive, which will automatically lead to higher consumption. A low market interest rate is often set during a poorly running economy. This is one of the most well-known rules of thumb in the economy, but essential to mention since it has a major effect on the interest rate. Cochrane and Piazzesi (2002) investigated this reaction of the market interest rate to the Fed's interest decisions and vice-versa. According to these two economists, the Fed only responds to long term interest rates and has control over the funds target rate. Cochrane and Piazzesi claim that if the Fed increases the funds target rate with 1%, the market interest rate increases with 0.8%. This means that the Fed, indirectly, can influence the market interest rate. A logical conclusion, as a higher fund rate results in more costs for commercial banks. These banks want to compensate this high-cost item and will increase the market interest rate.

Another determinant that affects the interest rate is inflation. Both the Fed and ECB aim for a maximum inflation of 2% per year. Crowder and Hoffman (1996) found that a 1% inflation increase results in a 1.34 increase of the nominal interest rate. If inflation occurs, the outstanding loans will be worth less once paid back by the borrower. To compensate for this loss, banks will raise the interest rate. Crowder and Hoffman also found that the short-term interest rates are no good predictors for inflation. It could take a few periods before the inflation is correctly implanted in the nominal interest rate. This assertion is slightly different from Fama's conclusion about short-term interest rates from 1975. He investigated the short-term interest rate as a predictor of future inflation as well and concluded that it is not possible to reject the fact that it is not a good predictor. Looking at the above, one may assume that inflation affects the long-term interest rate, yet the effect on the short-term interest rate is still debatable.

2.2 What affects bank profitability?

Bourke (1988) has clarified and examined the determinations of profitability. He explained that there are internal and external factors which affect bank profits. Internal factors are the bank characteristics. Examples are capital, risk management and expenses management (Almazari, 2014). External factors affect the bank's profitability from the outside. Think of the macroeconomic environment, such as inflation and interest rates. To clarify these two factors, I will elaborate on them in the following sections.

2.2.1 Internal factors

As already mentioned, internal factors are the bank characteristics. Capital is an important factor for explaining bank profitability. An increase in capital leads to higher profits. It is crucial for banks to make a good trade-off between labor productivity and operating expenses. Labor productivity growth results in a higher profitability. However, this increase in productivity must be financed and will be allocated in operating expenses. A rise of operating expenses is (logically) negatively related to bank profitability. Size is not a valid internal factor, because economies of scale play a small role in the banking sector. Furthermore, it does not matter if a bank is privately owned or owned by the government. Privately owned banks do not make significant higher profits (Athanasoglou, Brissimis and Delis; 2008).

2.2.2 external factors

Macroeconomic control variables like inflation and interest rates (as explained in detail above) certainly affect the profitability. The rule of thumb that can be used is that when the business cycle is above the trend, the profitability rises. When the business cycle is located underneath the trend, the profitability of banks decreases (Athanasoglou et al., 2008). There is still some debate about whether GDP growth is an external factor. Arpa, Giulini, Ittner & Pauer (2001) argue that the net interest income has no relationship with GDP growth, unless a very low interest rate is occurring. Liu & Wilson (2010) claim that the impact of GDP growth on profitability depends on the ownership type of the bank. When there is more competition, a growing GDP will result in lower profitability. Privately owned banks will suffer from this the most. In this study, I will zoom in on the effect of the interest rate on the bank profitability and use other macroeconomic concepts which affect bank profitability as control variables.

2.3 Existing papers on bank profitability and interest rates

Looking at papers that are already published, one can try to predict the outcome of this thesis. Unfortunately, this is not that simple since there are many different findings about the correlation between interest rate and bank profitability. Altavilla, Boucinha and Peydró (2017) claim that, at first, there is no correlation between interest rate and bank profitability once there is: "control for the endogeneity of the policy measures to expected macroeconomic and financial conditions". However, if the interest rate stays low for a long time, profits will decline.

Bikker & Vervliet came to a slightly different finding in 2017. The conclusion that banks profitability suffers from a low interest rate is, according to these two economists, only partly correct. One of the main earning models of banks is being compressed by the low interest rates, which could lead to a lower profitability. However, the United States banks managed to preserve their overall level of profits. This could have been achieved by the banks cutting in their provisions. Because of the low interest rate, most of the borrowers will not have trouble with paying interest as scheduled. The downside of this approach is that banks will have a smaller buffer for unexpected credit losses. The financial stability will therefore decline. United States banks therefore have the option to lose profit or financial stability.

Looking at the above, the profits will either decline during low interest rates or they will remain the because of a cut in provisions. However, it is still not entirely clear what happens with the profitability of banks during low interest rates. All the more reason for this research.

3. Data and hypothesis formulation

3.1 Data

This thesis contains a quantitative research. Using the Erasmus University credentials data is collected. Data for this study is collected from GFD and FRED. Combining all variables into one dataset, the aim is to investigate what happens with the profitability of banks in a low interest environment. This is done by running regressions in STATA. I gathered panel data between 1961 and 1987, which means there is a total of 27 observations. The 12 variables that are used will be defined later in this chapter. The key figures of these variables are summed up in table 4.

3.2 Research question

The most important and therefore research question of this thesis is: '*Does a low interest rate result in lower bank profits in the United States?*' As already mentioned, there are not many papers that give a precise answer to this question. Altavilla, Bouchinha and Peydró (2017) argue that there is no correlation of these two concepts on the short term and a positive correlation on the long term. This means that if the interest rate decreases, the probability will be lower too. Bikker & Vervliet (2017) claimed that there are two possibilities in a low interest rate environment. The profitability could stay the same if banks decide to cut in their provisions (which will lead in less financial stability) or the profitability itself will decline.

With this study I want to clarify the effect of a low interest rate on bank profitability in the United States. Looking at the papers above, I predict that the answer to the research question will be that the profitability of the banks in the United States will fall. Not every bank will cut in their provisions and the other assumption is that bank profitability declines during a low interest rate. The hypotheses are therefore:

Null hypothesis: *In a low interest rate environment, bank profitability will stay the same.*
Alternative hypothesis: *In a low interest rate environment, bank profitability will decline.*

3.3 Sub-questions

This thesis contains three sub-questions to explain concepts regarding interest rates and bank profitability. The first sub-question is: '*Do United States citizens save less during a low interest rate?*' If this is the case, United State banks have less capital to invest or lend. This could be a huge disadvantage for the profitability. A German study about demographic changes and bank profitability explains that the current aging population could result in a lower total of savings, since less people will be alive in the near future. However, elderly people generally have more money, which could lead to a higher amount of total savings. In the short-term, banks could achieve higher profitability, but looking far ahead, an aging population will probably lead to less bank profitability (Berlemann, Oestmann & Thum; 2013). Since there is an aging population in the United States, according to Ortman, Velkoff & Hogan (2014), this could also be the case in the United States. Hence, the hypothesis of the first question is:

Null hypothesis: *United States citizens total savings stay the same in a low interest rate environment.*
Alternative hypothesis*: United States citizens save less in a low interest rate environment.*

The second sub-question is as follows: '*What happens to the amount of investment in a low interest rate environment?*' In this sub-question I will use a different approach. The regression will not have the market interest rate as variable of interest, but the federal funds rate. This is the rate at which banks can borrow and loan money to each other overnight. In my opinion, it is more interesting to look at the relationship between the federal funds rate and investment since there is no research on this topic so far. During times of a low federal funds rate, it is more attractive for commercial banks to loan money. This could result in a higher amount of investment since more money will be available. To examine if this is true, the hypotheses are:

Null hypothesis: *the amount of investment will stay the same during low interest rate times.*
Alternative hypothesis: *the amount of investment will decrease during low interest rate times.*

3.4 Dependent variables

In this study three regressions have been constructed. All dependent variables are demeaned. The dependent variable of the first regression is $BANK_{profit}$. This variable stands for the bank profitability of all commercial banks in the United States in millions of dollars. The second regression contains $SAVINGS$ as dependent variable. The definition of this variable is the total amount of savings at commercial banks in the United States in billions of dollars. The dependent variable of the last regression is $INVESTMENT$. This is the total amount of investments at commercial banks in the United States in billions of dollars.

3.5 Independent variables

With the first regression, I want to create an answer to the research question: measuring the effect of a low interest rate on the bank profitability. Again, all variables are demeaned. The following independent variables are important:

a. $INTEREST_{rate}$: this is the 1-year secondary market interest rate in the United States. The reason for choosing this variable is that in banking, both saving and lending are important. The secondary market interest rate consists of both equity as debt markets and is therefore the best option.

b. CPI_{growth} : this variable stands for the yearly change of the Consumer Price Index and covers the growth/shrinkage of all items in the United States. The variable is a tool to measure inflation.

c. GDP : the Gross Domestic Product is a synonym for national income. In this study $demGDP$ covers the real Gross Domestic Product of the United States in billions of dollars. The reason for choosing real GDP over nominal GDP is that the real GDP take inflation into account, which results in a more accurately measure.

d. $CONFIDENCE_{index}$: with this variable, the confidence of the United States citizens is measured. It is an indicator with a normal value of 100.

e. $TREASURY_{10year}$: the definition of this variable is the 10-year treasury constant maturity. This is the rate that United States citizens get when they buy a treasury bond.

The second regression is a function where the interest rate explains the total amount of savings. The independent variables: $INTEREST_{rate}$, GDP and $CONFIDENCE_{index}$ are already discussed. The remaining variables are described below.

a. POP_{growth} : the definition is the population growth for the United States in percentage.

b. $WEALTH_{level}$: this variable stands for the wealth level of citizens in the United States in millions of dollars.

The third and last regression explains the effect of the funds rate on the amount of investment of banks. The variable GDP is already defined above. The other two variables are:

a. $FUNDS_{rate}$: The federal funds rate is the rate at which banks can borrow and lend their reserves to each other. In this study, $FUNDS_{rate}$ is the effective federal funds rate.

b. SP : this is the S&P 500 index. With this index one can see the financial situation regarding stocks. This index contains the 500 biggest American companies and is therefore useful to gain a good insight in the stock market returns.

3.6 Key figures of all variables

Table 1

Key figures of all variables

Variable	Obs	Mean	Std. Dev	Min	Max
$BANK_{profit}$	27	-0.000434	13634.36	-13696.26	32997.74
$INTEREST_{rate}$	27	8.83E-08	2.635576	-3.805926	6.544074
POP_{growth}	27	1.55E-08	0.2099092	-0.2210479	0.570865
$SAVINGS$	27	3.39E-06	259.8601	-565.3074	276.9926
GDP	27	0	1363.036	-1468.255	2824.751
CPI_{growth}	27	-3.31E-09	0.2814847	-0.3633682	0.6262518
$INVESTMENT$	27	0.0000164	121.9602	-128.6934	290.87
$WEALTH_{level}$	27	0.037037	4957262	-5170140	1.10E+07
$CONFIDENCE_{index}$	27	-2.83E-06	1.59125	-2.8601	2.421295
$TREASURY_{10year}$	27	-2.65E-08	2.812965	-3.871111	6.098889
$FUNDS_{rate}$	27	-1.32E-07	3.500627	-5.171111	9.248888
SP	27	-1.13E-06	53.83596	-51.31647	163.0139

Note. This table contains the number of observations, mean, standard deviation, minimum and maximum of all variables in this thesis. The mean of every variable is zero or close to zero, because every variable is demeaned.

4. Methodology

4.1 Fixed effects model

As already mentioned, fixed effects models will be used in this study. A pooled OLS model could also be used. However, this method has two problems: heteroskedasticity and a possible violation of zero conditional means. All variables are demeaned. Demeaning is subtracting the mean of a variable from all values. The advantage of this method is that variables that stay constant over time can be left out of this study. In table 4 all means of the variables are listed. The number of observations is 27, which means that every variable has 27 values. I used STATA to generate the new, demeaned variables. With these demeaned variables I ran multiple regressions.

While running the regressions, I noticed that all p-values of the constant term were 1.000. This happens when the data is perfectly described by the restricted model. The probability that worse data will be obtained described is 1. Since the findings in this study are mainly about the coefficients of the independent variables, I decided to remove the constant term.

4.2 Regressions

For the research question, the following regression has been constructed:

$$BANK_{profit} = \beta_1 * INTEREST_{rate} + \beta_2 * CPI_{growth} + \beta_3 * GDP + \beta_4 * CONFIDENCE_{index} + \beta_5 * TREASURY_{10year} + \varepsilon \qquad (1)$$

As mentioned above, there is no constant in this regression. This makes sense because the mean of every variable is subtracted from all values, which results in a mean of 0. What I wanted to investigate is the influence of the market interest rate on bank profitability. The other variables are control variables. As already discussed, all variables are demeaned. The first is CPI_{growth}. The reason for using CPI_{growth} as variable is that inflation makes money worth less, what could affect the bank profitability. Secondly, GDP has been considered. If the national income of the United States rises, I think bank profitability increases too. With $CONFIDENCE_{index}$, I added an index which measures United States citizens' confidence in their economy. This could lead to a change in the spending pattern. The last variable I use in

this regression is $TREASURY_{10year}$. This is another interest rate than the market interest rate. Citizens of the United States could choose to invest in other institutes instead of saving. This could affect the bank profitability as well.

With the first sub-question I want to examine if the citizens of the United States save less in a low interest rate environment. The following regression has been made to check whether this is the case:

$$SAVINGS = \beta_1 * INTEREST_{rate} + \beta_2 * GDP + \beta_3 * POP_{growth} + \beta_4 * WEALTH_{level} + \beta_5 * CONFIDENCE_{index} + \varepsilon \tag{2}$$

The total amount of savings in the United States is the dependent variable in this regression. Again, interest rate is the independent variable, and the other four variables are control variables. The reason for choosing GDP as a control variable is that when the GDP rises, there will be more money available to save. This could affect the total savings. POP_{growth} could influence the total amount of savings as well. When there are more citizens, more people could save their money. $WEALTH_{level}$ is a variable which measures the wealth of the United States and is therefore also a control variable. $CONFIDENCE_{index}$ is already discussed and could lead to a change in the saving pattern.

The second sub-question explains the influence of the interest rate on the amount of investment. This time, the funds rate of the FED will be examined. I want to investigate if a lower funds rate results in higher investments. The regression also uses demeaned variables and is as follows:

$$INVESTMENT = \beta_1 * FUNDS_{rate} + \beta_2 * GDP + \beta_3 * SP + \varepsilon \tag{3}$$

The funds rate could influence the investments of banks because it is cheaper to borrow when the funds rate is low. If the banks have a higher return on investment than the level of the funds rate, it is financially attractive to borrow and invest. The GDP could be a determinant of the investments too. If the national income of the United States is higher, more money will

be circulating, what could affect the amount of investment. The S&P 500 is also important to consider. If these returns are relatively high, it is more attractive for banks to invest.

5. Results

The regression below is the first regression of this study. I used STATA to calculate the coefficients and other relevant statistics. I demeaned every variable by generating the means of the variables and subtracting these from all values. In table 2, the statistics from this regression are summed up. $BANK_{profit}$ is the dependent variable and $INTEREST_{rate}$ is the independent variable.

$$BANK_{profit} = \beta_1 * INTEREST_{rate} + \beta_2 * CPI_{growth} + \beta_3 * GDP + \beta_4 \\ * CONFIDENCE_{index} + \beta_5 * TREASURY_{10year} + \varepsilon$$

The control variable CPI_{growth} is negatively correlated to bank profitability. This differs with the findings of Tan & Floros (2012), who wrote that inflation and bank profitability have a positive relationship. However, they observed Chinese banks, what could lead to this difference. GDP is positively related to bank profitability. If the GDP rises with 1 billion dollars, the bank profitability rises with 9,159,799 dollars. This is logical since there will be more money circulating in the United States economy. If $CONFIDENCE_{index}$ increases with 1, bank profitability declines with 3203.036 million dollars. An explanation for this could be: if there is more confidence in the economy, citizens consume more and therefore save less. All three variables above have a p-value of 0.000, which means that the results are significant at a 1% significance level. The last control variable is $TREASURY_{10year}$. If this rate increases with 1%, the profitability decreases with 1169.962 million dollars. Citizens of the United States will be more attracted to these treasury bonds, which leads to a cash outflow from banks to treasuries. Unfortunately, this finding is not as significant as the ones above, but still significant at a 10% level.

The coefficient of $INTEREST_{rate}$ is 1685.374, what means that if the interest rate rises with 1%, the bank profitability rises with $1,685,000. This means that there is a positive relation between bank profitability and the interest rate. If the interest rate decreases, bank profitability will decline as well. There is a 95% chance that the population mean is within 518.264 and 2852.11 since the standard error is 583.555. The null and alternative hypotheses of the research question are:

Null hypothesis: *In a low interest rate environment, bank profitability will stay the same*

Alternative hypothesis: *In a low interest rate environment, bank profitability will decline.*

Since the p-value of $INTEREST_{rate}$ is 0.009, the null hypotheses can be rejected at a 1% percent significance level. The adjusted R-squared has a value of 0.9585, which represents a high correlation. I tried to add more variables to this regression, for example the total amount of loans in the United States and the S&P 500. However, every variable I added, resulted in an insignificancy and a lower adjusted R-squared. The regression of the effect of interest rate on bank profitability is therefore:

$$BANK_{profit} = 1685.374 * INTEREST_{rate} - 20909.87 * CPI_{growth} + 9.159799 * GDP$$
$$- 3203.036 * CONFIDENCE_{index} - 1169.962 * TREASURY_{10year} + \varepsilon$$

Table 2

Effect of a low interest rate on bank profitability

					Number of observations	= 27
					F (5, 22)	= 125.87
					Prob > F	= 0.0000
					R-squared	= 0.9662
					Adjusted R-squared	= 0.9585
					Root MSE	= 2724.1

$BANK_{profit}$	Coef.	Std. Err.	t	P>|t|	[95%	Conf. Interval]
$INTEREST_{rate}$	1685.374	583.555	2.89	0.009	475.1544	2895.594
CPI_{growth}	-20909.87	3786.975	-5.52	0.000	-28763.57	-13056.16
GDP	9.159799	0.6746473	13.58	0.000	7.760667	10.55893
$CONFIDENCE_{index}$	-3203.036	674.227	-4.75	0.000	-4601.297	-1804.775
$TREASURY_{10year}$	-1169.962	604.011	-1.94	0.066	-2422.604	82.68043

Note. This table contains the output of a fixed effects model with bank profitability as the dependent and interest rate as the independent variable. The control variables are the Gross Domestic Product, the confidence index of the United States citizens and the 10-year treasury constant maturity.

The results of the first sub-questions can be seen in table 3. With this regression, I want to investigate the effect of the interest rate on the total amount of savings at commercial banks in the United States. $SAVINGS$ is the dependent variable, $INTEREST_{rate}$ is the independent variable and the GDP, POP_{growth}, $WEALTH_{level}$ and $CONFIDENCE_{index}$ are the control variables.

GDP and $CONFIDENCE_{index}$ are negatively related to the total amount of savings. If the real GDP rises with 1 billion dollars, the total savings decline with 0.261 billion dollars. If the expenditures go up, the GDP goes up. Citizens consume more and save less, what results in a lower amount of savings. Regarding the $CONFIDENCE_{index}$, more confidence leads to more expenditures and less savings. GDP and $CONFIDENCE_{index}$ are respectively significant on a 1% and 10% level. POP_{growth} has a positive relation with savings. Hence, more citizens result in higher savings on a 1% significance level. The last control variable, $WEALTH_{level}$, is positively related to the total amount of savings on a 5% significance level. However, this effect is very small.

$INTEREST_{rate}$ is the explanatory variable in this regression. As expected, this variable has a positive relation with the total amount of savings. It is logical that if the interest rate rises, more citizens want to save due to the higher returns. If the interest rate increases with 1%, the total amount of savings will rise with 12.751 billion dollars. There is a 95% chance that the population mean is within 9.577 and 15.926, since the standard error is 1.587. This result is significant on a 1% level. The adjusted R-squared is 0.9983, which is high. Just like the regression before, I tried to add more variables, but this lowered the adjusted R-squared and these regressions gave insignificant variables. The hypotheses of this sub-question are described below. Since the findings are significant with a high adjusted R-squared, there is enough evidence to reject the null hypothesis.

Null hypothesis: *United States citizens total savings stay the same in a low interest rate environment.*
Alternative hypothesis*: United States citizens save less in a low interest rate environment.*

Implanting the results in the regression gives us:

$$SAVINGS = 12.75142 * INTEREST_{rate} - 0.2606935 * GDP + 71.64848 * POP_{growth}$$
$$+ 0.0000171 * WEALTH_{level} - 3.523676 * CONFIDENCE_{index} + \varepsilon$$

Table 3

The effect of a low interest rate on the total amount of savings in the United States

Number of obs	= 27
F (5, 22)	= 3218.84
Prob > F	= 0.0000
R-squared	= 0.9986
Adj R-squared	= 0.9983
Root MSE	= 10.437

SAVINGS	Coef.	Std. Err	t	P>|t|	[95% Conf. Interval]	
$INTEREST_{rate}$	12.75142	1.587318	8.03	0.000	9.459526	16.04332
GDP	-0.2606935	0.0297471	-8.76	0.000	-0.3223853	-0.1990017
POP_{growth}	71.64848	14.82963	4.83	0.000	40.89371	102.4032
$WEALTH_{level}$	0.0000171	8.01E-06	2.13	0.045	4.56E-07	0.0000337
$CONFIDENCE_{index}$	-3.523676	1.983981	-1.78	0.090	-7.638201	0.5908489

Note. This table contains information on the influence of the market interest rate on the total amount of savings at commercial banks. The control variables are the Gross Domestic Product, the population growth, the wealth level, and the confidence index in the United States.

The third and last regression gives us information about the effect of the federal funds rate on the amount of investment of commercial banks in the United States, where the amount of investment is the dependent and the funds rate is the independent variable. Table 4 in the page below covers all information needed to examine the results. The regression is as follows:

$$INVESTMENT = \beta_1 * FUNDS_{rate} + \beta_2 * GDP + \beta_3 * SP + \varepsilon$$

Looking at the results, both GDP and SP are positively related to the amount of investment at a 1% significance level. The effect of the real GDP is relatively small in comparison with the S%P 500. The S&P 500 is probably more important because this is the return banks get when they invest. The $FUNDS_{rate}$ is the explanatory variable. If the federal funds rate rises with 1%, the amount of investment will decline with 1.490 billion dollars. There is a 95% chance that the population mean is within -2.912 and -0.068 since the standard error is 0.711. This finding is significant at a 5% level and the R-squared has a value of 0.9947, which is very high. The hypotheses of this sub-question are described below. Due to the high significance and R-squared, the null hypothesis can be rejected.

Null hypothesis: *the amount of investment stays the same if the federal funds rate rises*
Alternative hypothesis: *the amount of investment declines if the federal funds rate rises*

Interpreting the results of the STATA output gives:

$$INVESTMENT = -1.490309 * FUNDS_{rate} + 0.0773528 * GDP + 0.3740044 * SP + \varepsilon$$

Table 4

The effect of the federal funds rate on the total amount of investments of commercial banks

				Number of obs	= 27	
				F (3, 24)	= 1701.65	
				Prob > F	= 0.0000	
				R-squared	= 0.9953	
				Adj R-squared	= 0.9947	
				Root MSE	= 8.6834	

$INVESTMENT$	Coef.	Std. Err.	t	P>|t|	[95%	Conf. Interval]
$FUNDS_{rate}$	-1.490309	0.7109667	-2.1	0.047	-2.957672	-0.022946
GDP	0.0773528	0.0047743	16.2	0.000	0.067499	0.0872065
SP	0.3740044	0.1068149	3.5	0.002	0.1535493	0.5944595

Note. This table contains information on the influence of the federal funds rate on the total amount of investment of commercial banks. The control variables are the Gross Domestic Product and the S&P 500.

6. Conclusions

In this thesis the research question is about the influence of a low interest rate on bank profitability was investigated. Two sub questions were created to clarify and strengthen my conclusions. With the first sub question I gave an answer to the question if United States citizens save less during a low interest rate. The second sub question covers what happens with the amount of investment of commercial banks in a low interest rate environment.

In this study I used fixed effects models to answer the questions addressed in this thesis. I used STATA to generate demeaned variables. The advantage of using demeaning is that I can leave out variables that stay constant over time. Since the findings in this study are mainly about the coefficients of the independent variables, and the means of all variables are zero, I decided to remove the constant term.

The dependent variable of the first sub question is $SAVINGS$, the explanatory variable is $INTEREST_{rate}$ and the control variables are GDP, POP_{growth}, $WEALTH_{level}$ and $CONFIDENCE_{index}$. In table 2 one can see that all variables are significant at, at least a 10% significance level and the adjusted R-squared is high. The coefficient of $INTEREST_{rate}$ is positive, which means that if the interest rate drops, the total amount of savings drops as well. The null hypothesis: '*United States citizens total savings stay the same in a low interest rate environment'* can therefore be rejected.

With the second sub question I regressed $INVESTMENT$ on $FUNDS_{rate}$ with the control variables GDP and SP. The reason for using the federal funds rate instead of the market interest rate is that there is no research on the relationship of investments by commercial banks and this type of interest rate so far. Looking at table 3, all variables are significant at a 5% significance level and the adjusted R-squared is high as well. The coefficient of the federal funds rate is negative, which means that if the federal funds rate decreases, the total amount of investment will rise. The null hypothesis: '*the amount of investment stays the same if the federal funds rate rises'* can be rejected.

The dependent variable of the research question is $BANK_{profit}$, the explanatory variable is $INTEREST_{rate}$ and the control variables are GDP, CPI_{growth}, $CONFIDENCE_{index}$ and $TREASURY_{10year}$. All variables are significant at a 1% significance level, except for $TREASURY_{10year}$, which is significant at a 10% level. The adjusted R-squared is 0.9585, which means a high correlation. The coefficient of the interest rate is negative. If the interest rate decreases, bank profitability will decline as well. The null hypothesis: '*In a low interest rate environment, bank profitability will stay the same*' can be rejected. The conclusion of this study is therefore that if the market interest rate declines, bank profitability will decline as well.

7. Discussion

In this section, the predictions, limitations, and recommendations of this research will be discussed. Looking at papers already published, I tried to predict the outcome of the questions shown above. The prediction of the first sub question is that when the interest rate declines, the total amount of savings declines as well. United States citizens simply get less return on their savings and therefore consume more and save less. Regarding the second sub question, the prediction is that the amount of investment of commercial banks rises when the federal funds rate declines. When commercial banks can borrow money at a lower rate, it is attractive to invest the borrowed money to get a higher return. The prediction of the research question is as follows. When the interest decreases the bank profitability will decrease. The profitability could also stay at the same level if the commercial banks cut in their provisions. However, not every bank will do this, which results in a lower total bank profitability.

The prediction of the first sub question corresponds to the findings in this study. If the interest rate declines, the amount of savings at commercial banks declines as well. The second sub question is the only question which prediction was not based on published literature. Since there are no papers regarding this topic, I predicted the outcome myself using logical reasoning. The findings in this study are also in accordance with the prediction. Regarding the research question, the prediction is also in line with the findings. After all, a few economists have already done research on this topic. With this study, commercial banks have a better understanding of the events that take place during low interest rates.

Due to the lack of time and data, this study only counts 27 annual observations from 1961 until 1987. Since bank profitability is measured annually, it was hard to find a dataset with many observations. Other variables like $INTEREST_{rate}$ and GDP had more and daily observations, but since $BANK_{profit}$ was the dependent variable and the data on this is scarce, only 27 observations could be used.

Regarding the validity, there is still some room for improvement. Some of the variables are not normally distributed. One can use the logarithm of a variable to get a better distribution. However, I demeaned all variables, which means that some of the values are

negative. It is impossible to take the logarithm of a negative number. This resulted in missing values.

Recommendations for future research on this topic are using more observations and the logarithm of the not normally distributed variables. Concerning the observations, waiting some years will result in more available data. There could also be datasets with more information on bank profitability which I did not find. Using a more extensive dataset will result in more valid conclusions. The logarithm will create more normally distributed variables which would also improve the findings in this study.

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