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How Are Interest Rates Affecting Household Consumption and Savings?

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by

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Abstract

This paper explores the optimal interest rates that could potentially maximize overall consumption and savings. I attempt to determine whether artificially low interest rates are positively or negatively affecting consumption. There has been speculation on whether the United States needs to raise the effective federal funds rate to provide financial institutions the incentive to lend money and increase household consumption. The Federal Reserve is currently keeping the effective funds rate between 0 and .25 in hopes of increasing consumption levels. This paper uses fifty years of interest rate data to narrow in on an optimal interest rate that leads to increased consumption levels, while taking into account numerous market factors. The empirical data suggests that the Federal Reserve is correct in keeping interest rates low, when attempting to increase consumption. There has been much research on this topic and on closely related subjects to consumption, savings and the real interest rate.

Introduction

The effective federal funds rate has changed greatly over the last fifty years, ranging from 0 percent all the way to 18 percent. Judging from this information, it is difficult to believe that the Federal Reserve has had perfect foresight of what the optimal interest rate should be that maximizes consumption. I attempt to find the optimal effective federal funds rate that maximizes consumption, while taking into account numerous explanatory variables; namely: the consumer price index, disposable income, the rates for 1, 3, 5, and 10 year treasuries, GDP, and sentiment.

This is an extremely important topic because there are innumerous differing opinions on the optimal value of the effective federal funds rate. Historically, lower interest rates have led to increased consumption levels; however, is there a point at which lowering interest rates becomes detrimental to society? There has been mixed opinions saying that when interest rates are too low banks do not have enough motivation to participate in lending activities, which results in even lower consumption levels. The main hypothesis of this paper is testing whether or not there is an optimal interest rate that increases overall consumption in the United States, and if so, can that rate be approximated. After finding this interest rate level, I investigate rates of household savings. I would like to provide a way to find a more stable interest rate that would increase consumption, while retaining a modest savings rate. The Fed's current plan is to keep interest rates low, between 0 and .25 until 2014, and I test to determine whether or not this is a sound strategy.

I run multiple regressions involving several independent variables to test the significance of each variable on savings. Using a savings rate equal to one divided by consumption as the dependent variable and interest rate and interest rate squared as the explanatory variables, I test for statistical and economic significance. Using the following regression model:

$$\text{Savings rate (1/consumption)} = \alpha + \beta_1 Ir + \beta_2 IR^2 + \underline{B}_X \qquad (1)$$

- Unemployment
- Consumer Price Index
- Interest Rate
- Disposable income
- 1-year, 3-year, 5-year, and 10-year treasuries
- Gross Domestic Product
- Consumption
- Sentiment
- Inverse Consumption

Where α is the intercept, $\beta 1$ is the coefficient for interest rate, $\beta 2$ is the coefficient for interest rate-squared and $\underline{B}$ is a matrix of other independent variables that could possibly have explanatory power on the savings rate. Running this regression 10 times, once for each additional 9 control variables, I am able to see the significance of each variable when regressed on savings and continue on to solve for an optimal interest rate.

With this data, I am able to compute the means, maxima, minima, and standard deviations for each variable and compare them with the optimal rates (see table 1). I create a correlation matrix to test the amount of correlation that exists between each of the variables (see table 2). I then create a table (see table 3) to display the results from the regression analyses which include the estimated coefficients, t-statistics, and adjusted R-squared values. Also, I create a table displaying the derivative of savings with respect to interest rate for all ten regressions, and the optimal values with the mean of all optimal values calculated at the bottom (see table 4).

After running these regressions, I take the partial derivative of savings with respect to interest rate for each regression, set them equal to zero, and find the optimal savings rates. Then taking the mean of all ten savings rate values, I find the optimal savings rate. I then use this value to solve for the optimal interest rate that maximizes consumption.

Literature Review

The motivation for my project came from speculation in the market saying that these low interest rates were not providing financial institutions with the motivation to lend and that this would decrease consumption. Along with these views came many more that were arguing in the opposite direction, that although that could be the case if financial institutions did stop lending, it didn't seem to be the case because financial institutions were lending plenty with these incredibly low rates.

There has been a great deal of research done on this topic and closely related topics. Some literature discusses the problems with low interest rates and its effect on the life cycle. How are these rates affecting spending now and the people who need to live off investments in the future. Are these low interest rates stimulating the economy now but hurting a different generation? It is difficult to predict all of the elements affected by the interest rate, but one that seems to be heavily discussed is that of consumption and savings. It may be in people's best interests to spend now while interest rates are so low, but if they stay low, then where will that leave personal investments and their ability to sustain in the future? Using the lifecycle, this particular question can be more closely examined.

A project conducted in India went through this same thought process and tried to see if there was a change in consumption and savings for just the elderly population when they were able to save at a higher rate than the average person. Due to some legislation, persons over 50 were able to save at a higher rate. This resulted in a lower consumption by those persons affected by this legislation. This is one example of higher interest rates reducing consumption.

All of these papers discuss the significance and vast research on consumption and the real interest rate. This is perhaps because these two factors are so closely related to each other and to substitution. Although it is difficult to determine how these two precisely affect each other and how best to factor in other variables, it does prove to be an interesting research question with countless other possibilities. Some have also claimed that consumption should not be used at all in the study of interest rates with the claim that they have no effect.

Some thought has also been put into studying consumption in more than one category. Some believe that consumption should be studied just as consumption, some as a function related to income, and some as a function related to future savings and consumption in the life cycle. All of these are valid points and great areas of research to pursue.

Data/Methodology

I obtained the data for this project from the Federal Reserve Economic Data from January 1962 through January 2012, excluding sentiment which only contained information dating back to January 1978. The data came in different formats including daily, monthly and quarterly. I gathered all of the data and then used SAS to compute quarterly statistics for each variable before running regressions. In total, there are 200 observations for each variable that I use, except for the case of sentiment, where 135 observations were gathered.

To make use of these variables, I sort them by date and then calculated the mean, maximum, minimum, and standard deviation for each variable. I create a correlation matrix between all the variables and then ran ten regressions to determine which variables are significant, at what level, and what optimal rates I might find.

To find an optimal value I used the partial derivatives of my regression function with respect to interest rates for each of the regressions that I ran. I used each of the intercept, alpha values, and beta values in each partial derivative, then set it equal to zero and solved for the interest rate. After obtaining the intercepts for each regression and using them in these partial

derivatives, I was able to systematically choose inputs from the set that I had chosen with the variables, and therefore produce an optimal value for this project. This type of optimization helps find the best value for this function.

Although this is more theoretical than an actual practice, I found that by using this method of optimization, I was able to then predict an accurate interest rate consistent with common belief and also with my hypothesis. Also, using partial derivatives in economics is a good way to make sense of all of the independent variables that can go in to a regression. The variables that I have chosen are highly correlated one with another, which we will see later.

Results

First, I will be discussing the variable correlation matrix (table 2) to show which variables are most highly correlated with one another. Starting with unemployment, I can see that it is most highly correlated with interest rates with a p-value of (.597), the 1 year bond rate (.224) and GDP (.1466). Unemployment was not significantly correlated to any additional variables. Sentiment was the only variable that was significantly correlated to all variables. Consumpinv, my variable for savings, was also highly correlated to GDP with a p-value of (.3733).

Using the regression analyses (table 3) I find that there are many highly significant variables. The consumer price index (inflation) is most negatively correlated with savings, with a t-statistic of -48.18, implying that as inflation increases savings decreases significantly. In the same category of significance as the consumer price index, disposable income (-46.65) and GDP (-

44.74) are both significantly adversely related with savings. Other negatively correlated variables include: sentiment, with a t-statistic of -4.95, the rate for the ten year treasuries, with a t-statistic of -3.36, the rate for the five year treasuries, with a t-statistic of -2.09, and the unemployment rate, with a t-statistic of -2.43. Using the R-squared values to judge whether or not these variables are good fits for the regression model, I see that consumer price index, disposable income and GDP are all incredibly good fits with percents all above 90. Also, sentiment is a good fit with an R-squared value of .7575.

Using the optimal values for each variable (table 4) found by taking the partial derivative of the regression equations with respect to interest rate, I find that the mean of all the optimal rates is 13.069 for savings, which implies a .07 percent optimal rate for consumption. The lowest optimal value I found for savings is from the regression of one over consumption on interest rates, interest rates-squared, and the 1 year treasury rate. This rate was approximately 8.05%, which results in a .124% rate for optimal consumption (Table 5). The highest optimal value for savings is from the regression of savings on interest rates, interest rates-squared and sentiment. These results provide an optimal savings rate of 17.468%, which calculates a .057% rate for optimal consumption.

According to the data I obtained from FRED, the Fed has kept the effective federal funds rate between .07 and .08 since September of 2011. Using the data I gathered, I can see that the mean interest rate is 5.77225, the minimum is .0733, and the maximum is 17.78. The most

recent months are consistent with my findings of the optimal rate for consumption being equal to one divided by the optimal rate for savings (13.0693), which is .077.

Conclusion

The rate at which financial institutions can lend to one another directly impacts consumption at the household level. The Federal Reserve can better control for consumption levels by identifying the optimal interest rate. This study suggests that lower interest rates lead to higher consumption levels. The Federal Open Market Committee suggested that interests stay low until the year 2014 which is consistent with the empirical findings in this report.

At times it is difficult to understand the intuition behind keeping interest rates low because of the adverse effect it has on bank lending. Future studies would need to be conducted to view the effects of bank holding companies lending when interest rates are altered. It would be interesting to see if consumption levels are directly impacted by bank lending and if the findings are consistent with what was found in this research data.

Historically, the effective federal funds rate has been inconsistent; however, over the past twenty years the rate has been conserved to below 5.0%. By exploring annual data over the past 100 years, I was able to narrow in on an interest rate that maximizes U.S. consumption. It appears that government officials have reviewed historical data to better understand how to implement policies that directly impact household consumption.

Appendix

Table 1: Univariate tests on all variables included in the regressions

Variable	N	Mean	Std Dev	Min	Max
unemploy	200	6.04133	1.63218	3.4	10.66667
cpi	200	114.1847	63.00726	30.06667	226.452
ir	200	5.77225	3.47605	0.07333	17.78
dispincome	200	5727	2485	2101	10288
yr1bond	200	5.77928	3.13917	0.11393	16.31063
yr3bond	200	6.20241	2.97055	0.41672	15.78
yr5bond	200	6.44834	2.82389	0.95262	15.41797
yr10bond	200	6.73806	2.63071	2.04672	14.83844
gdp	200	7738	3248	3029	13430
consumption	200	5201	2362	1879	9484
sentiment	135	85.75136	12.95102	54.36667	110.13333
consumpinv	200	0.0002398	0.0001152	0.0001054	0.0005323

Table 2: Correlation Matrix between all variables

	unemploy	cpi	ir	dispincome	yr1bond	yr3bond	yr5bond	yr10bond	gdp	consumption	sentiment	consumpinv
unemploy	1	0.18627	0.0376	0.14227	0.08636	0.17378	0.23955	0.33472	0.10302	0.11729	-0.57093	-0.21802
		(0.0083)	(0.5970)	(0.0445)	(0.2240)	(0.0139)	(0.0006)	(<.0001)	(0.1466)	(0.0981)	(<.0001)	(0.0019)
cpi		1	-0.40085	0.98764	-0.42181	-0.39815	-0.36591	-0.30231	0.98754	0.9849	0.06526	-0.9337
			(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(0.4520)	(<.0001)
Ir			1	-0.43899	0.97897	0.94485	0.92192	0.88308	-0.43792	-0.45378	-0.10382	0.18997
				(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(0.2308)	(0.0071)
dispincome				1	-0.46828	-0.45518	-0.42725	-0.36834	0.99857	0.99919	0.0424	-0.92091
					(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(0.6253)	(<.0001)
yr1bond					1	0.98582	0.96841	0.93508	-0.46783	-0.48404	-0.06536	0.20168
						(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(0.4514)	(0.0042)
yr3bond						1	0.99555	0.97634	-0.45732	-0.47341	-0.04138	0.16658
							(<.0001)	(<.0001)	(<.0001)	(<.0001)	(0.6337)	(0.0184)
yr5bond							1	0.99174	-0.43181	-0.44726	-0.06199	0.12971
								(<.0001)	(<.0001)	(<.0001)	(0.4751)	(0.0672)
yr10bond								1	-0.37659	-0.39086	-0.10393	0.06329
									(<.0001)	(<.0001)	(0.2303)	(0.3733)
gdp									1	0.99922	0.08946	-0.92083
										(<.0001)	(0.3021)	(<.0001)
consumption										1	0.06188	-0.91258
											(0.4758)	(<.0001)
sentiment											1	-0.8371
												(<.0001)
consumpinv												1

Table 3: Regression Analyses

	1	2	3	4	5	6	7	8	9	10
Intercept	0.00016048 (7.18)	.00025419 (5.71)	.00053895 (53.69)	.00061819 (52.67)	.00015881 (6.98)	.00017142 (7.11)	.00018817 (7.29)	.00022029 (7.84)	.00061764 (50.58)	.00017546 (10.27)
Ir	.00002245 (3.44)	.00001601 (2.30)	-.00001946 (-9.63)	-.00002224 (-10.55)	.00001707 (1.16)	.00003219 (3.09)	.00003544 (3.95)	.00003683 (4.81)	-.00001991 (-9.18)	.00001956 (10.26)
Ir2	-.00000111 (-2.65)	-6.51037E-7 (-1.43)	7.949087E-7 (6.42)	8.697545E-7 (6.79)	-0.00000106 (-2.43)	-.00000122 (-2.85)	-.00000122 (-2.92)	-.00000113 (-2.77)	7.252378E-7 (5.49)	-5.59889E-7 (-4.47)
unemploy		.00000527 (-2.43)								
cpi			-.00000195 (-48.18)							
dispincome				-5.05462E-8 (-46.65)						
yr1bond					.00000528 (.41)					
yr3bond						-.00000999 (-1.20)				
yr5bond							-.00001512 (-2.09)			
yr10bond								-.00002105 (-3.36)		
GDP									-3.82289E-8 (-44.74)	
sentiment										-.00000105 (-4.95)
adj r2	0.0597	0.0825	0.9264	0.9219	0.0557	0.0618	0.0755	0.1065	0.9157	0.7575

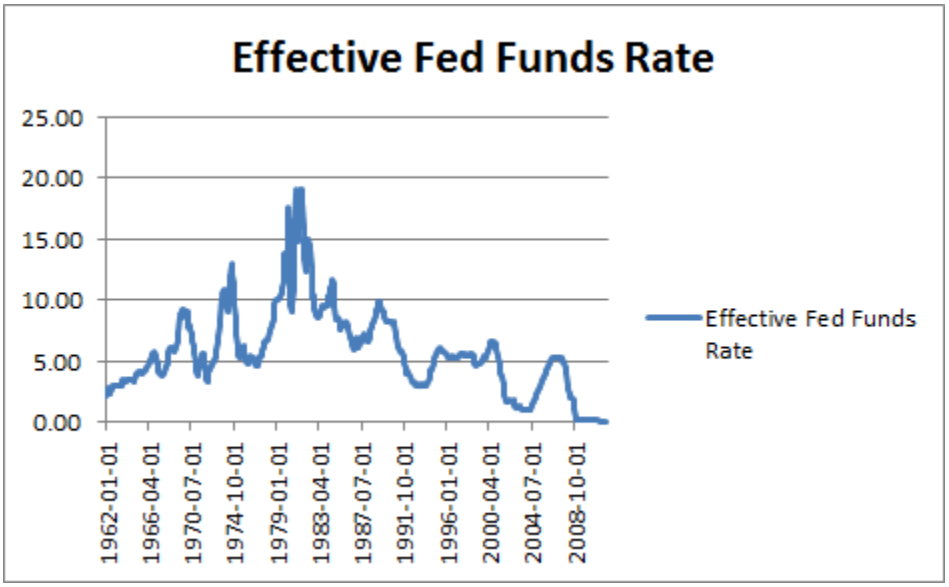
Table 4: Optimal interest rate values, according to the partial derivative of savings with respect to interest rate

Regression		Optimal Values
1	ir-ir2	10.11261261
2	ir-ir2-unemploy	12.29576814
3	ir-ir2-cpi	12.24039943
4	ir-ir2-dispincome	12.78521698
5	ir-ir2-yr1bond	8.051886792
6	ir-ir2-yr3bond	13.19262295
7	ir-ir2-yr5bond	14.52459016
8	ir-ir2-yr10bond	16.29646018
9	ir-ir2-GDP	13.72653218
10	ir-ir2-sentiment	17.46774807
mean		13.06938375

Table 5: The range of interest rates

	savings	consumption
Optimal value	13.069384	0.076514702
minimum	8.0518868	0.124194493
maximum	17.467748	0.057248364

Graph 1:


Effective Fed Funds Rate
25.00
20.00
15.00
10.00
5.00
0.00
1962-01-01
1966-04-01
1970-07-01
1974-10-01
1979-01-01
1983-04-01
1987-07-01
1991-10-01
1996-01-01
2000-04-01
2004-07-01
2008-10-01
Effective Fed Funds Rate

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