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### A Backward Bending Supply of Loanable Funds: An Examination of the Interest Rate Elasticity of Saving

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## A Backward Bending Supply of Loanable Funds: An Examination of the Interest Rate Elasticity of Saving

### Abstract

The market for loanable funds is presented as either a market with an upward sloping supply curve, or as one with a perfectly inelastic supply. This paper relates the supply of loanable funds to the supply curve in the labor market: backward bending. Once interest rates are high enough, people start to save less, creating the "backward bend." This explains the discrepancies in previous literature that attempted to put a single value on the interest rate elasticity saving. The reason for the variation in values could be because the elasticity actually depends on the point on the curve.

### Keywords

loanable funds market, interest rate elasticity of saving, target saving, saving rate, backward bending supply curve

### Cover Page Footnote

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The model of the loanable funds market is commonly taught as one of two situations: a standard supply and demand case where the supply curve is upward sloping and demand is downward sloping, or a perfectly inelastic supply curve paired with a negatively sloped demand curve. Occasionally, as in Gregory Mankiw’s textbook, *Economics*, the two models are presented side by side as an “either-or” situation. The supply of loanable funds either has a positive slope, or is perfectly inelastic. However, the truth may lie somewhere in between, and could even mimic the shape of the labor supply curve. The model of the backward-bending labor supply curve is commonly accepted as a phenomenon that occurs when wages reach a high enough level. As wages start to increase, workers follow the law of supply and choose to work more hours. However, the backward bending labor supply model proposes that, once wages reach a high enough level, workers start working less even though their salaries keep increasing. This causes the supply curve to look like a backward “C.” This idea can be applied to the market of loanable funds to explain the difficulties economists have faced trying to determine the slope of the supply curve. Instead of being an “either-or” situation, the supply curve may start out positively sloped, but once interest rates reach a certain level, the curve becomes inelastic and may even start to bend backward, as with the labor supply model.

In an attempt to determine if the supply curve is actually perfectly inelastic, previous researchers have used various econometric techniques to put a single numerical value on the elasticity (slope) of the supply curve. This has proved to be a difficult task, as seen in the following figure:

<u>Author(s)</u>	<u>Interest Elasticity of Saving</u>
Alan Binder (1975).....	0.03
Michael Boskin (1978).....	0.4
Gerald Carlino (1982).....	0
Gerald Carlino and Robert DeFina (1983).....	0
Thorvaldu Gylfason (1981).....	0.3
Dale Heien (1972).....	1.8
E. Philip Howrey and Saul Hymans (1978).....	0
Charles Steindel (1980).....	5.8
Lawrence Summers (1982).....	1.3

Lester Taylor (1971).....	0.8
Colin Wright (1967).....	0.2

The values of the interest rate elasticity of savings range from zero all the way to 5.8 (a clear positive relationship). All of these models attempted to put a single number on the elasticity of the supply curve when, in reality, the elasticity may vary on different sections of the curve, as in the case of the backward bending supply of labor. The remainder of this paper is organized as follows: the next section explores the theory behind the relationship of interest rates on saving as shown in the lifecycle model, the second section looks at an underlying concept that helps determine the interest rate elasticity of saving, and the third section examines target saving. The fourth section expands upon the idea of target saving by applying it to Carroll's buffer stock model. We then turn toward empirical evidence in the fifth and sixth sections, using two different kinds of regressions on historical datasets, and the seventh section briefly examines our residuals. We conclude with our eighth section that uses information from our regressions to generate point elasticities which show how savings responds differently to changes in interest rates differently at higher interest rates than lower ones.

### *I. The Relationship Between Interest Rates and Savings in the Lifecycle Model*

The lifecycle model of saving implies that households chose their consumption and savings behavior today based on their plans for the long-term, hoping to even out their consumption as much as possible over their entire lifetime. An individual chooses their current level of consumption while trying to maximize lifetime utility, subject to the intertemporal budget constraint that results from their lifetime income. The decision to save in the lifecycle hypothesis is subject to three effects: the income effect, the substitution effect, and the wealth effect. These three interact to determine the actual interest rate elasticity of substitution. At different points along the curve, however, the magnitude of each may change, resulting in a varying elasticity of saving.

The substitution effect is the change in the relative price of consumption today that results from a change in the interest rate. If we assume the interest rate rises, this creates incentive for households to save more and consume less, as today's consumption is relatively more costly than tomorrow's. The second effect, the income effect, is the lowering of a household's present value of their future lifetime consumption: if the interest rate rises, this means that an individual needs fewer of today's dollars to finance their future consumption spending. Therefore, the household would be able to lower their current level of saving, instead

consuming more. This income effect works in the opposite direction of the substitution effect. Finally, the wealth effect is the discounting of a household's present value of their wealth, both financial (future capital income) and human (future labor and pension income). In this case, a rise in the interest rate would cause a decline in the present value of an individual's wealth, making them worse off over their lifetime and cause them to lower their consumption and increase their saving. It should be mentioned that discounting resulting from a change in the interest rate does not affect all types of financial wealth. For example, an financial asset in the form of an annuity will provide constant future cash flows for a household. An increase in the interest rate would not affect the actual coupon payments from the bond; however, the present value of these future cash flows is affected (changing the price of the bond). This is a reevaluation of the value of financial wealth that *is* affected by changes in the interest rate. A financial asset such as the balance in a simple bank account, on the other hand, is not changed. For simplicity purposes, when looking at the wealth effect we will assume that all financial wealth is reevaluated in response to a change in interest rates.

We hypothesize that the magnitude and subsequent interplay between these three effects is dependent on the initial level of the interest rate as well as other parameters dependent on the interest rate, leading to a nonlinear supply curve. At lower interest rates, as the interest rate rises, the substitution effect and wealth effect are greater than the income effect, so that the quantity supplied of loanable funds increases. However, once interest rates rise high enough, the income effect begins to overpower the substitution and wealth effects, and the curve starts to bend backward on itself. To cause such a shift in the magnitude of these effects, there would have to be a corresponding change in an underlying parameter of the lifecycle model, the intertemporal elasticity of substitution, which we examine in the second section.

Of course, the lifecycle of saving model does not present a complete picture of our economy's households. There are always "rule-of-thumb" individuals, who repeatedly consume their entire income and save none. Clearly such households do not follow the forward-looking assumptions made in the lifecycle hypothesis. And the flip side of this coin is income uncertainty: people do have a precautionary motive for saving. Households can chose to allocate more of their income toward saving today to hedge against future negative windfalls, or even to protect against living an unexpectedly long amount of time. All of these behaviors deviate from the idea of simple consumption smoothing that underlies the lifecycle of saving model. These deviations from the lifecycle model are looked at more closely in following sections. From here we more closely examine

what could cause the magnitude of the substitution, income, and wealth to shift in such a way that would cause the supply of loanable funds to bend back on itself.

## *II. The Intertemporal Elasticity of Substitution and Its Effect on the Interest Elasticity of Saving*

This discussion of a backward bending supply of loanable funds can be deepened by viewing a household's decision of whether to save or consume as the decision of whether to consume *now*, or consume *later*. In order to do this, we must look at the intertemporal elasticity of substitution. In this scenario, the household is looking at the decision of how much of their current consumption they are willing to substitute in order to get a higher future level of consumption: their budget constraint is a tradeoff between  $C_t$  and  $C_{t+1}$ . When the intertemporal elasticity of substitution is greater than one, an increase in interest rates lowers current consumption in favor of an increase in future consumption,  $C_{t+1}$ , (increases saving), as the substitution effect outweighs the income effect. Households are willing to tolerate a drop in their current level of consumption with the expectation of a higher future level. Conversely, when the intertemporal elasticity of substitution is less than one, an increase in interest rates causes an increase in current consumption and a fall in future consumption,  $C_{t+1}$ , (decreases saving), as the income effect outweighs the substitution effect. As with the interest rate elasticity of saving, there have been many attempts to put a single numerical value on the intertemporal elasticity of substitution, with results ranging from zero to slightly above one. This is integral to the examination of the supply of loanable funds, as a household's decision of whether to save or consume is inherently tied to their level of patience in tolerating a drop in current consumption in exchange for an increased future consumption (by definition, the intertemporal elasticity of substitution). And as seen in the discussion above, the intertemporal elasticity of substitution is subject to the same forces we are looking at in our examination of the supply of loanable funds: the interplay between the income and substitution effects. The difficulty previous economists have encountered in trying to put a single value on the intertemporal elasticity of substitution is the opposite side of the coin we are looking at in trying to put a value on the interest rate elasticity of saving.

We can use the mathematical formulas that describe lifecycle consumers' behavior to more clearly tie our discussion of the intertemporal elasticity of substitution in with the theory of a varying interest rate elasticity of saving. Following the lifecycle hypothesis, we model a consumer's utility over their lifetime as:

$$U = \int_{\tau}^{T2} 1 / \left( 1 - \left( \frac{1}{\sigma} \right) \right) C^{(1-\frac{1}{\sigma})} e^{-\delta(t-\tau)} dt$$

where  $U$  is utility,  $C$  is consumption in time  $t$ ,  $\sigma$  is the intertemporal elasticity of substitution,  $\delta$  is the rate of time preference, and  $\tau$  is the person's current age and  $T2$  is the person's age at death. In a survey published by the Federal Reserve Board, Douglas Elmendorf (1996) shows that this utility function can be combined with the intertemporal budget constraint and solved for the income and substitution effects. Elmendorf uses the fact that the substitution effect is a change in the slope of the consumption path while the income effect is based on a change in the present value of future consumption to solve for the two effects to find that the income and substitution effects are modeled by, respectively:

$$\alpha_t * W_t$$

$$-\sigma * \alpha_t * W_t$$

where  $W_t$  is the present value of all income,  $\sigma$  is the intertemporal elasticity of substitution, and  $\alpha_t$  is a complex formula modeling an individual's decision making process about lifetime consumption and saving as a response to the interest rate and other parameters. This mathematical model shows what changes the magnitude of the income and substitution effects, which ultimately determine the shape of the supply of loanable funds. As we can see in the above equations, the substitution and income effects perfectly cancel each other out when  $\sigma$  equals one. If  $\sigma$  is greater than one, the substitution effect overpowers the income effect, meaning we must be operating on the upward sloping portion of the supply curve. And if  $\sigma$  is less than one, the income effect outweighs the substitution effect, and the curve bends back on itself. We see here that, according to the lifecycle hypothesis, the intertemporal elasticity of substitution is what directly changes the relative strength of the two competing effects. Other factors may change  $W_t$  and  $\alpha_t$ ; however, these affect the absolute value of both the income effect and the substitution effect by the same magnitude. The only way for the relative strength of one to the other to change is via changes in  $\sigma$ : at lower interest rates, an increase in the interest rate causes households to increase their level of saving, as here  $\sigma$  is greater than one and thus the substitution effect outweighs the income effect. As interest rates rise high enough,  $\sigma$  falls below one, and the relationship between interest rates and savings flips. As with the backward bending labor supply model, the magnitude of the substitution and income effects resulting from the intertemporal elasticity of substitution could change in this way due to a shift in consumer preferences: at high interest rates, the marginal utility to be gained from an increase in current consumption is now greater than the utility to be

gained from extra return on savings that could be earned by allocating more of their budget toward future consumption.

### *III. Target Saving*

The other force that, combined with consumer theory, provides the theoretical framework for a backward bending supply of loanable funds is target saving and the idea of a buffer stock. Target savers are people who are motivated to save to meet a specific goal: be it retirement, their children's education, or a vacation (Defina 1984). These target savers will respond to a decrease in the rate of return on their investments, the interest rate, by increasing their savings rate to compensate, and decreasing their current level of consumption today. These households will try to make up for any reduction in future interest earnings by increasing their actual amount of saving, and vice versa for an increase in the interest rate. This phenomenon of responding to fluctuations in the interest rate by adjusting a household's allocation in a way that would move opposite the way the interest rate moved is not unique to these specific target savers: it can be applied to a more general model of Christopher Carroll's idea of a buffer stock.

### *IV. The Buffer Stock Model*

The underlying idea behind Carroll's buffer stock is that consumers have an ideal wealth to income ratio that they try to reach to smooth their consumption and prepare for any adverse shocks to their income, and they constantly adjust their budget accordingly. Carroll shows that the ratio of wealth to income,  $x$ , as the following:

$$x_{t+1} = R[x_t - c_t](1/G * N_{t+1}) + V_{t+1}$$

where  $c_t = C_t/P_t$ ,  $G$  is the growth rate of income,  $R$  is 1 plus the interest rate, and  $N_{t+1}$  and  $V_{t+1}$  are i.i.d shocks with a mean equal to one. We can see that, assuming a household is starting at their ideal wealth to permanent income ratio,  $x^*$ , then if  $R$ , the interest rate factor, increases, this would lead their future wealth to income ratio to also increase. Now  $x_{t+1} > x^*$ , so the household will decrease their levels of savings accordingly, until they reach their ideal level,  $x^*$ , again. The reverse is true as well. If interest rates fall, then  $x_{t+1}$  falls as well- below the ideal level,  $x^*$ . Households increase their current level of saving to make up for this. This is a reiteration of the idea of target saving, with a new rationale for the target.

One more force at play here that should be brought into the discussion is that of habit formation. Habit formation is essentially the idea that once households have decided a certain portion of their income to allocate toward savings, they are reluctant to revisit that decision and revise it given current



economic conditions. This puts a “stickiness” factor that applies to a movement of interest rates in either direction. If interest rates rise *or* fall, savings would tend to stay at the level it was originally given households reluctance to reallocate their budget. This would imply an interest rate elasticity of close to zero, or a perfectly inelastic supply curve. However, this is clearly not the only factor in play in determining the interest rate elasticity of saving, although it could dampen any force that is pushing the elasticity in one direction or the other.

How do these forces play against each other to determine the effect interest rates have on saving? We propose that one does not simply dominate over the others; in fact, at different points along the curve the elasticity varies. At any point along the curve, each of the forces we spoke about is in play (substitution and income effects as they relate to both saving and the intertemporal elasticity of substitution, target saving, and saving toward an ideal buffer stock), but at different sections along the curve different forces overpower each other. At lower interest rates (the lower section of the supply curve), in looking at the interest rate elasticity of saving, we see that the substitution effect is greater than the income effect, as consumption spending is relatively more expensive than saving today. This pushes the supply curve in the upward direction. This is bolstered by the fact that along this section of the curve the intertemporal elasticity of substitution is greater than one, meaning that as interest rates increase, households decrease current consumption in favor of future consumption, as the substitution effect is greater than the income effect (opposite side of the same coin, here we are simply looking at the tradeoff between current consumption and future consumption rather than current consumption and current saving). Undoubtedly at these low interest rates –along the lower section of the supply curve- there are still target savers and households that act in the way we demonstrated using Carroll’s idea of saving toward an ideal buffer stock: decreasing their level of saving when interest rates rise. However, the effect these households generate on the elasticity of saving combined with the relatively small income effect is still not enough to outweigh the largely positive substitution effect here. Thus, the supply curve starts out upward sloping.

As we move along the supply curve, however, the net effect these forces have on the elasticity changes. Once interest rates are high enough, the income effect starts to outweigh the substitution effect, as savers earn higher future income on their savings, making them more comfortable allocating more of their budget toward consumption spending today, and less toward saving. In the same way, here the intertemporal elasticity of substitution is less than one, meaning that as the interest rate rises, current consumption rises and future consumption falls, as the income effect overpowers the substitution effect in the tradeoff between current and future consumption spending. Preferences have shifted so that, at

these high interest rates, the additional utility of an increase in current consumption is greater than what extra utility could be derived from an increased allocation toward and return on their savings (future consumption). Now the net direction of the income and substitution effects is working in the same direction as that of target saving and those households saving toward an ideal buffer stock. Therefore, at higher interest rates, the supply curve first becomes perfectly inelastic, then starts to bend backward on itself, and the interest rate elasticity of saving becomes slightly negative.

#### *V. Empirical Analysis: Local Linear Smoothing*

This theoretical background provides the framework for our econometric analysis. In order to more closely examine the possibility of a backward bending supply of loanable funds, we used a non-linear piecewise regression to find if there was an optimal “breakpoint” in the relationship between interest rates and saving, and if, once interest rates became high enough, the slope of the supply curve changed from a clear positive value to zero or even a slightly negative number. The historical data for interest rates in the initial regression was the yield on the three month treasury note, beginning in the year 1965 and continuing through 2013 at quarterly intervals. In later regressions, we utilized the historical yield on the five year treasury note, also beginning in 1965 and continuing through present day at quarterly intervals. These datasets were both obtained from the Federal Reserve Bank of St. Louis. The data for the loanable funds was taken from the Bureau of Economic Analysis: to find a clearer picture and confirm our results, we used two datasets, one for the historical domestic net savings and one for the historical domestic net savings as a percentage of national income (the savings rate).

Before running the piecewise defined function between the interest rate and savings, to confirm that there was a non-linear relationship between the two that would be better modeled by a parametric regression, we first used a local linear smooth plot. Figures 1 and 2 display the results of a LOWESS smoother with a bandwidth of .3. In each curve there does appear to be a clear breaking point where the relationship between interest rates and savings changes. The typical model of the loanable funds market graphs the reverse of the above figures; however, in order to emphasize the causal relationship between interest rates and savings, our regressions were done such that interest rates were on the x-axis and savings and the savings rate were on the y-axis. One can easily visualize how the best-fit line would be transposed to generate the “supply curve” in the market for loanable funds.

## VI. Empirical Analysis: Piecewise Defined Function

In order to find the optimal piecewise defined function that will model the supply curve, we perform a segmented regression. By doing this we are able to generate actual values for the slope of the supply curve and determine if the slope switches from a positive value to zero, or even goes negative. Using the following form:

$$S = \begin{cases} ci + (ak+b) & \text{if } i \geq k \\ ai+b & \text{if } i < k \end{cases}$$

We ran the piecewise regression with an initial estimate of “k” at 5. *Figure 3* is the regression table that resulted from regressing net savings on the interest rate, and *Figure 4* is the table that corresponds with regressing the savings rate on the interest rate. The estimated break points are 3.97% and 5.37%, respectively. The coefficients “a” and “c” also behaved in the same way- a positive and statistically significant correlation when  $x < k$ , and a statistically insignificant negative coefficient once  $k > x$ .

The econometric analysis confirms the original hypothesis of a nonlinear supply of loanable funds. At lower interest rates, there is a clear positive elasticity of saving; however, once interest rates are high enough (the data points to around 4 - 5%), the relationship changes to a perfectly inelastic curve, even bending backward on itself slightly. In order to determine if this relationship existed as the horizon on the treasury notes lengthened, to bring future expectations into the model, we then ran the same piecewise defined regression on the relationship between net savings and the five year and ten year treasury notes: both exhibited the same behavior. At lower interest rates, there is a clear positive slope, but after a certain point, the supply curve slopes directly upward and backward (see *Figures 7 and 8*).

## VII. Examining the Residuals

Finally, we looked at our residuals. Upon graphing both models' residuals over the time horizon, we found autocorrelation, as exists in much macroeconomic time series data, as well as heteroscedacity in the residuals resulting from the piecewise regression of net saving on the yield on the three month treasury bill (the graphs of residuals are found in the Appendix). To correct for this, we added a lag coefficient, “d,” in our regression. In the regression of

savings rate on the interest rate, this resulted in a value of 0.936, and upon graphing the new residuals over time, corrected for autocorrelation. The new break point was 6.4%, and the slope of the best fit line behaved in the same way as previous regressions: a statistically significant positive correlation when  $i < k$ , and a coefficient of nearly zero when  $i > k$ . The lag term did not, however, correct for autocorrelation in the regression of net savings on the interest rate (see regression tables and graph of new residuals).

### *VIII. Using a T-Test to Show the Elasticity of Saving Varies as the Interest Rate Rises*

From our piecewise regressions we know that there is an optimal “break point” when the interest rate reaches 4%, where the relationship between savings and interest rates changes. Using this information, we can directly calculate the own elasticity of saving at every point along the curve and test if the elasticity is significantly different below this optimal break point than above it. The formula for calculating a point elasticity is as follows:

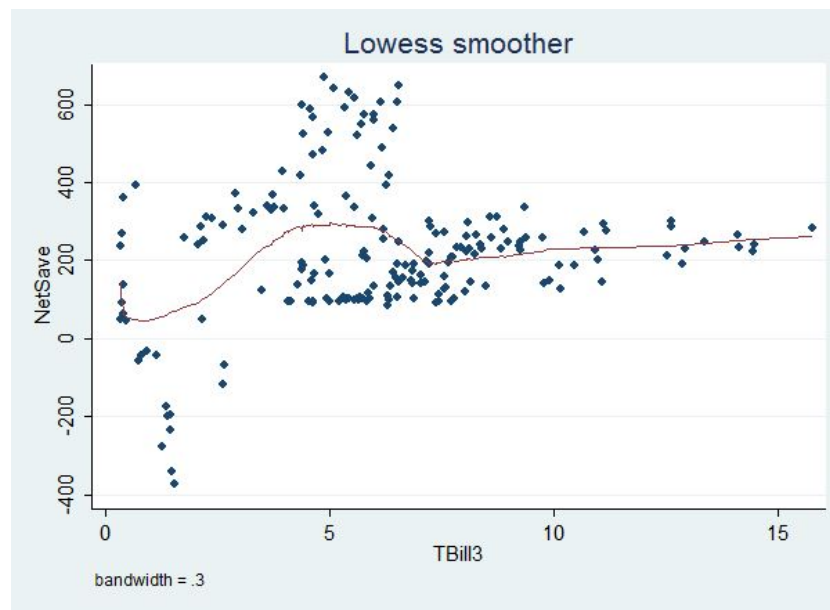
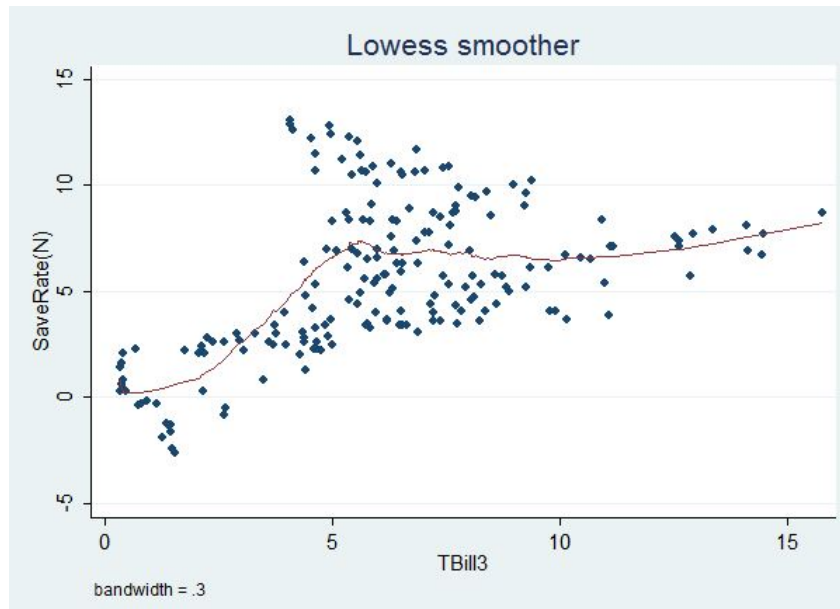
$$\mathcal{E}_s = \left| \frac{r}{s} * \frac{\partial s}{\partial r} \right|$$

In other words, the elasticity of saving is given by the absolute value of the ratio of the current interest rate to net savings multiplied by the derivative of net saving with respect to the interest rate at that point. Knowing this, we calculated the point interest rate elasticity of saving for every data point in our set. Then, given that our piecewise regression generated a break point where the relationship between interest rates and net savings changes at 3.97%, we separated our data into two groups: point elasticities found when the interest rate was below 4%, and point elasticities when the interest rate was at or greater than 4%. In order to test if these two groups were significantly different from each other, we then ran a two-tailed, unpaired sample t-test at the ninety-five percent confidence level assuming unequal variances. The t-test rejected the null hypothesis, that the means of the two groups were equal, with a t-statistic of -5.9967 and a p-value of 0.000 (see Figure 14). This statistical test tells us that, given that our p-value was below the significance level ( $0 < 0.05$ ), we can reject the hypothesis that the mean elasticities of these two groups are equal. The point elasticity of saving is different at lower interest rates than higher ones, supporting the theory that there is a nonlinear relationship between interest rates and savings: a given percentage change in the interest rate generates a significantly different

percentage change in savings when the initial interest rate is below the optimal break point than when it is above it.

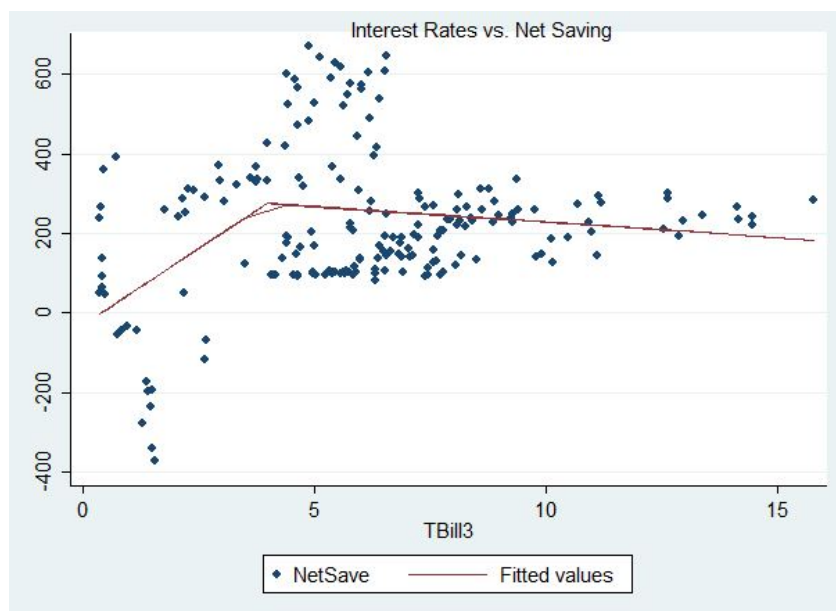
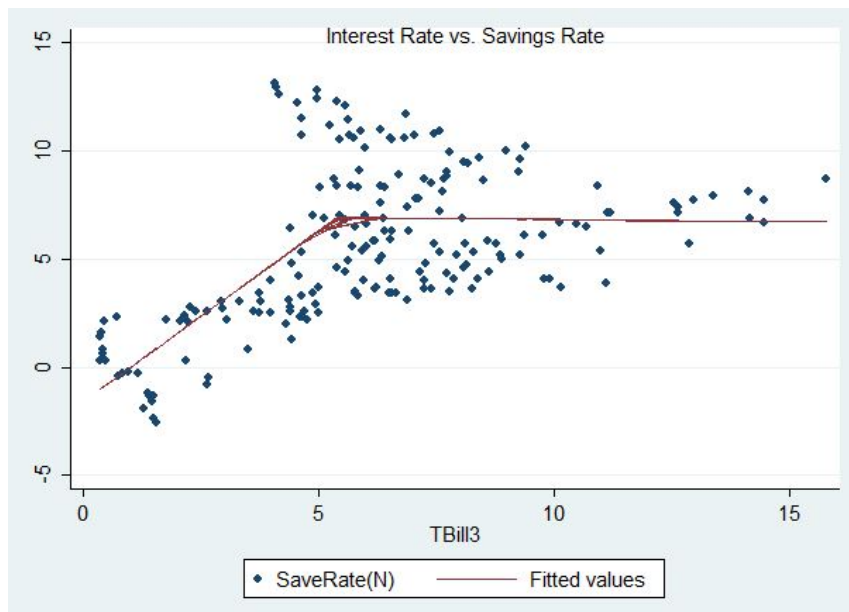
*IX. Concluding Remarks*

The backward bending supply of loanable funds could explain the difficulties economists have faced in trying to put a single value on the interest rate elasticity of saving. One possible next step from here is to examine the econometric methods used in previously trying to put this single number on the elasticity of saving. We have shown here that consumer theory, applied to the decision between saving and consuming, as well as between consumption today or consumption tomorrow, paired with target savers and households that save toward an ideal wealth to permanent income ratio, can provide the theoretical framework that explains what our econometric model shows us: there is a nonlinear relationship between interest rates and saving. Future research opportunities this paper presents are the possibility of running a triple segmented regression, where there are two “break points” in the supply curve, to more carefully examine how the slope changes at different points along the supply function. Although this study undoubtedly leaves room for more research to be done to expand upon our results, our empirical results provide strong support for the theoretical framework behind the idea of a nonlinear, backward bending supply of loanable funds, answering the question of why there have been so many discrepancies in valuing the interest rate elasticity of saving.



*Figure 1 (top):* A local linear smooth plot of the historical savings rate versus the yield on the three month treasury bill using a bandwidth of .3.

*Figure 2 (bottom):* A local linear smooth plot of the historical net savings versus the yield on the three month treasury bill using a bandwidth of .3.



*Figure 3 (top):* A piecewise defined regression of the historical savings rate on the yield on the three month treasury bill.

*Figure 4 (bottom):* A piecewise defined regression of the historical net savings on the yield on the three month treasury bill.

Table I: Piecewise defined regression of savings data on 3 month treasury bill yields

Variable	N	Breakpoint "k"	Coefficient "a"	Coefficient "c"	Intercept "b"
(1) Savings Rate	195	5.39***	1.575**	-0.0192	-1.572*
p value		(0.000)	(0.000)	(0.857)	(0.021)
(2) Net Savings	195	3.97***	76.71**	-7.709	-29.33
p value		(0.000)	(0.000)	(0.154)	(0.568)

Notes: \*p<0.05, \*\*p<0.01, \*\*\*p<0.001

Figure 5 (above): Regression table for the piecewise defined regressions of savings data on yield on the three month treasury bill.

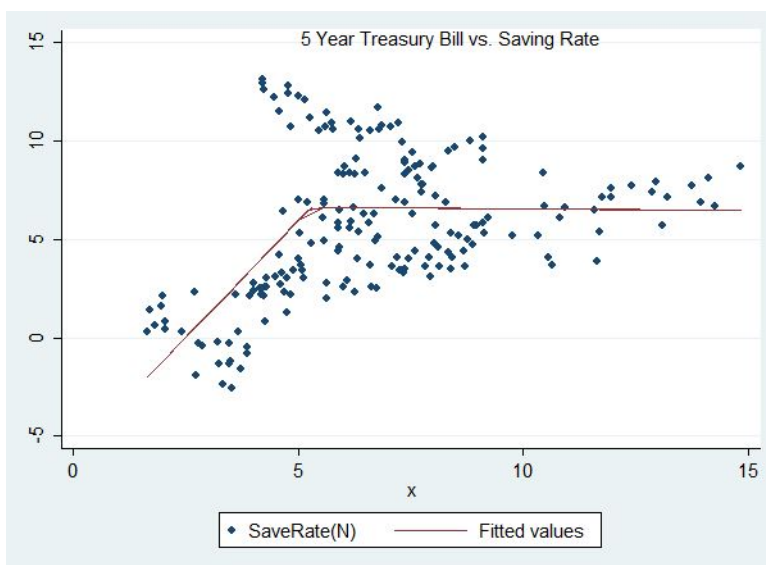
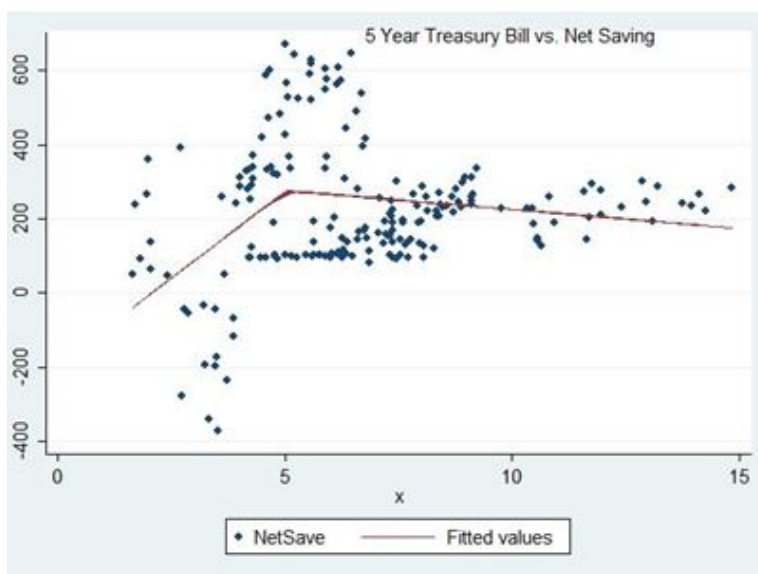




Figure 6 (previous page, top): A piecewise defined regression of the historical net savings on the yield on the five year treasury bill.

Figure 7 (previous page, bottom): A piecewise defined regression of the historical savings rate on the yield on the five year treasury bill.

Table II: Piecewise defined regression of savings data on 5 year treasury bill yields					
Variable	N	Breakpoint "k"	Coefficient "a"	Coefficient "c"	Intercept "b"
(1) Savings Rate	195	5.283***	2.372***	-0.0165	-5.903***
t statistic		(17.16)	(6.45)	(-0.14)	(0.021)
(2) Net Savings	195	5.022***	93.31***	-10.2	-192.3*
t statistic		(12.10)	(4.00)	(-1.61)	(-2.10)
Notes: *p<0.05, **p<0.01, ***p<0.001					

Figure 8: Regression table for the piecewise defined regression of historical savings data on the yield on the five year treasury bill.

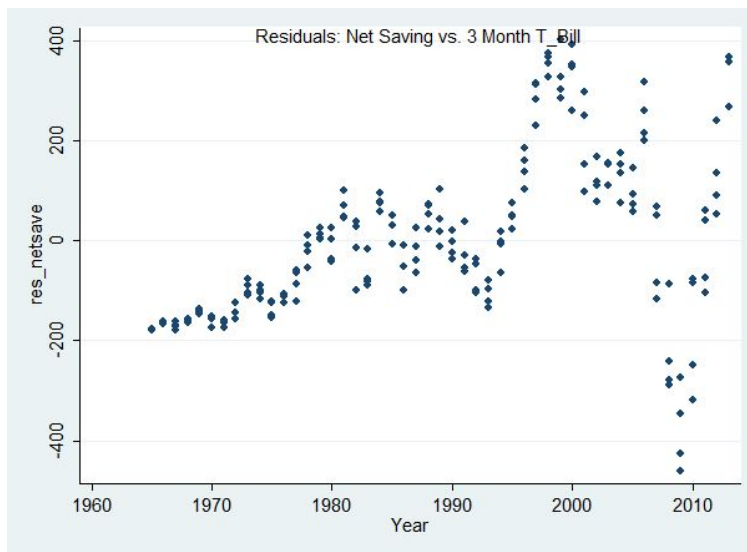
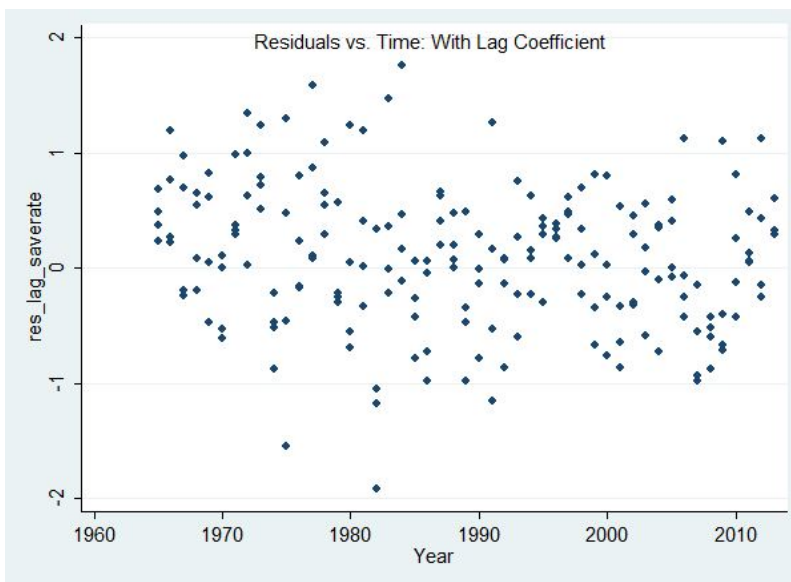




Figure 9 (left): Residuals over time resulting from the piecewise regression of historical net savings on the yield on the three month treasury bill.

Figure 10 (right): Residuals over time resulting from piecewise regression of historical savings rate on the yield on the three month treasury bill.



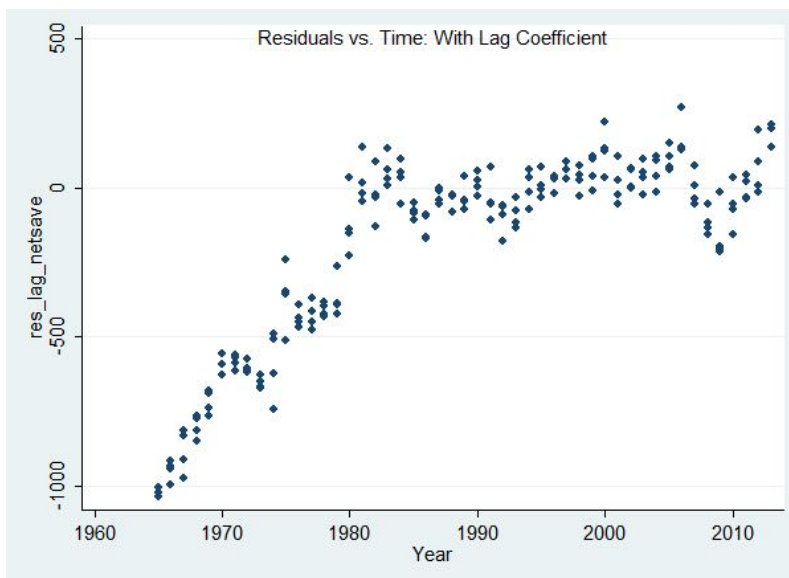


Figure 11 (left): Residuals over time resulting from piecewise regression of historical savings rate on the yield on the three month treasury bill with added lag term to account for autocorrelation.

Figure 12 (right): Residuals over time resulting from piecewise regression of historical net savings on the yield on the three month treasury bill with added lag term to account for autocorrelation.

Table III: Piecewise defined regression of savings data on 3 month treasury yields with lag coefficient

Variable	N	Breakpoint "k"	Coefficient "a"	Coefficient "c"	Intercept "b"	Lag Coefficient "d"
(1) Savings Rate	195	6.35***	0.0451***	0.00459	-0.0254	0.936***
t statistic		(8.21)	(5.70)	(156.38)	(0.70)	-156.38
(2) Net Savings	195	4.58***	11.0***	-48.91***	13.60**	82.00***
t statistic		(44.22)	(5.01)	(-52.75)	(2.59)	-67.64

Notes: \*p<0.05, \*\*p<0.01, \*\*\*p<0.001

Figure 13: Regression table for the piecewise defined regression of historical savings data on the yield on the three month treasury bill with the lag coefficient “d.”

T-Test for Equality of Means						95% Confidence Interval of the Dif.	
<i>Point Elasticity of Saving</i>	<i>t</i>	<i>df</i>	<i>Sig(2-tailed)</i>	<i>Mean Difference</i>	<i>Std. Error Difference</i>	<i>Lower</i>	<i>Upper</i>
(Equal Variances <i>not</i> assumed)	-5.9967	104.2	0.000	201.63	17.8	166.5	236.78

*Figure 14:* Results from two-tailed independent unpaired t-test with unequal variances, ran on the two groups of point elasticities calculated using formula for finding instantaneous elasticity and later separated into two groups based on the initial level of the interest rate at that point (greater than or less than 4%, the break point found in our regression).

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