THE VEGAN SHARK: DOES LOAN-SHARKING REALLY HURT THE POOR?

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This paper will attempt to add data and results from a new perspective to the debate surrounding high interest microloans to low income households in America. Legislation on payday lenders, pawn brokers, and rent-to-own stores is left up to state governments and many are split on how to regulate the industry. Case studies and models have been used to support both sides of the argument, but this paper will use a new medium: a multi-agent system.

1. INTRODUCTION: SUBPRIME BORROWERS

Some 7.7% of American households, equivalent to 17 million people, don't have bank accounts (Ellis, 2009). In Manhattan, the banking capital of the world, 12% of households are "unbanked" (Haughney, 2009). These households are inclined to buy goods and pay bills with cash. They tend to be from the poor and uneducated segment of the population: 20% of households earning $30,000 or less and 25% of households led by someone who didn't finish high school didn't have bank accounts (Ellis, 2009). This limits their access to traditional forms of credit such as loans from banks and credit cards. Thus they turn to alternative "fringe banking" sources: pawn shops, payday lenders, check-cashing businesses, car-title loans and rent-to-own stores (Lewison, 1999, p. 328). Many poor people who *do* have bank accounts also turn to "fringe banking" for their credit needs. They may not have a high enough credit score to apply for a credit card and banks won't make them small cash loans.

"Fringe banking" has moved out of the fringes and become big business in the United States. Nationwide payday lenders such as Advance America and Dollar Financial Corporation are traded publicly and have billions of dollars in revenue. In the state of Wisconsin, with a population 5.6 million, payday lenders made 1.7 million loans for a total of $625 million. The "fringe banking" system is known for taking advantage of the often desperate and unknowledgeable borrowers. They routinely charge very high interest rates. Pawn shops and rent-to-own stores can charge up to 200% interest annually while payday loan establishments have been known to charge up to 3000%[1] (Lewison, 1999, 328). In a study done in Albuquerque, it was found that nearly half of used cars financed to subprime borrowers were repossessed because the debt was too much for the individual to handle (Epstein, 2007). A payday loan is the most applicable form of "fringe banking" to this paper. In a typical payday loan transaction, the borrower will receive a small sum of cash from the lender with a promise to pay back the money and interest on his next payday. Typically the lenders will require a pay stub or some form of proof that the borrower has a job. If the borrower has a bank account, he will write a postdated check to the payday lender. If he does not return to make his payment, the lender will cash the check. In a more modern technique, borrowers will apply for a loan online and the lender will directly deposit the funds into his bank account.

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[1] This is an EAR. The huge difference between APR (Annual Percentage Rate) and EAR (Effective Percentage Rate) must be noted. For a $30 charge on a loan of $200 for two weeks, the APR is 26 x 15% = 390% and the EAR is $(1.11^{26} - 1) \times 100\% = 3{,}685\%$. This paper will be using EAR unless otherwise noted.

Proponents of payday lenders state that the rates are high by necessity. First, there are the high transaction costs that accompany loans of such a short time frame and for such small amounts. Second there is the high default risk that comes from lending to poorer borrowers. It is estimated that payday loans have a 10-20% default rate (McArdle, 2009). Even nonprofit microloan facilities charge high rates. Goodmoney, a nonprofit payday lender, charges APR of 252% on its loans. They say that nearly half of the interest goes to cover bad loans (Leland, 2007).

As the "fringe banking" industry has grown, governments have begun to enact regulations to protect the consumers. In the United States, the legislation has been left up to the states. As of 2007, thirteen states had strict usury laws or banned the practice altogether. Northeastern states have tended to be stricter with their regulation. One way to regulate the lenders is to impose interest-rate ceilings. This forces many of the businesses to shut down, especially ones with low volume in less populated areas. Meanwhile the South has generally stayed away from or been lenient with regulating the industry which explains the huge numbers of payday lenders one sees on Main Streets south of the Mason-Dixon Line (Lewison, 1999, p. 329). For example, in 1991, Pennsylvania had a ceiling of 2% per month on pawnshops while Georgia's ceiling was 25%[2] (Brown, 1991, p. 105).

Regulation brings about the question: are the people who use "fringe banking" as a means of credit better off being protected from it? If the answer is yes then legislation should try to shut down the industry or force it to lower interest rates. If no, then the industry should be allowed to continue its service. Currently this question is being debated in many states and there are strong statistics, facts and arguments that back up both sides. This paper will attempt to add data from a new perspective into the discussion and show that low-income borrowers need to have the safety-net of high-interest credit at their disposal.

2. THE MODEL

A new way to look at payday lending in America is through the lens of a multi-agent system. Multi-agent systems take in assumptions and variables and allow the user to easily measure the outcomes that apply to the study. The user can hold some variables constant while examining the effects that come from manipulating the others. These models harness the power of contemporary computers to allow for stochastic processes that can't be simulated in a purely mathematical model. This makes the system more authentic.

2.1 The Wealth Distribution Model. The platform on which this project is based is the "Wealth Distribution" model created by Wilensky (1998). It is located in the "Models Library" of Netlogo. It represents a prehistoric economy based on one good with no trade and seeks to replicate and better understand what creates distribution in wealth.

In "Wealth Distribution" a user-specified number of agents compete to harvest grain from a fifty by fifty grid. Each patch is given a random starting amount of grain and constraints on the amount of grain it can grow. All patches are limited by the same growth time period.

Agents are assigned five parameters: age, wealth, metabolism, life-expectancy, and vision. When the model is setup, **age** is set randomly between two user-specified numbers. When age reaches **life-expectancy**, the agent dies. Life-expectancy is also assigned randomly between the

[2] Interestingly, by 2004 Georgia had banned payday lenders. A new bill is in the works that would reallow the practice with a maximum APR of 390%

two age constraints. **Wealth** is the quantity of grain the agent owns. **Metabolism** represents the amount of grain an agent eats each turn. If wealth dips below metabolism, the agent dies. Metabolism can be viewed as the converse of savings rate. **Vision** is the length, in patches, that the agent can see ahead. The agent looks for grain, so a higher vision means the agent is a more effective harvester. Wealth, metabolism, and vision are all assigned randomly.

When an agent dies, a new one is born. This makes the model a closed system in which there is always the same number of agents in existence. Excepting age, the newborn agent is assigned its characteristics in the ways described above. Age is started at zero. Wealth is not closed since new agents start with a given amount of grain determined independently from the dying agent's wealth.

To understand the model, look at it through the eyes of one agent. At the start of the turn, the agent harvests the grain on the patch he is on. This removes all the grain from the patch and the patch must regrow. If the agent is accompanied on the patch by other agents, they split the grain equally. He adds the grain into his wealth. Next, he looks at all the patches in his given field of vision. He then moves one patch-length towards the patch with the highest amount of grain. Finally he eats (subtracts his metabolism from his wealth) and ages (adds one to his age). If his wealth goes below zero or his age reaches his life-expectancy, he dies.

2.2 Modifications to the Model. To tailor the model to the question at hand, loaning was introduced to the agents. It was programmed in such a way that if an agent's wealth fell below two times his metabolism, he would begin asking his neighbors for a loan. A neighbor would choose to grant a loan if two constraints were met. The first is that the debtor not be too old (calculated as the midpoint between the minimum and maximum life expectancy set by the user). The second is that the potential creditor be wealthy enough in terms of wealth divided by metabolism. This can be set by the user as the same for all agents or the agents can randomly be assigned this level. The latter simulates different appetites for risk. If the constraints are met, the creditor grants the debtor a loan of two times the creditor's metabolism.

The user sets an interest rate between zero and two hundred percent. All agents who borrow are required to pay back their loans over three turns at this interest rate. Rearranging the formula

$$P = X\,\frac{1 - v^n}{i}, \qquad v = \frac{1}{1+i}$$

where P is the size of the loan, X is payment size, n is turns, and i is interest rate, yields the formula for the payment size:

$$X = P\,\frac{i}{1 - v^n}$$

The agent is bounded to make payments of size X for three years excepting the case of death. If he dies, the creditor agent suffers a loss of the remaining payments. An agent dying can be viewed in this model as a person defaulting.

2.3 Measurements. Several variables included in the original "Wealth Distribution" model and added in the modification process are used to collect data and make inferences on the agents and their economy. These will be used to make comparisons of agents' well-being when loans are allowed and when they are disallowed.

Since the original model focused on the distribution of wealth, the built-in monitors generally pertain to measuring the inequality and variance in wealth among the agents over time. The first measurement, used in the "Class Plot", divides the agents into three categories: rich, poor, and middle class. This is accomplished by finding the richest agent, dividing his wealth by three. All the agents are then sorted into either poor (less than 1/3 the wealth of the richest), middle class (less than 2/3 the wealth of the richest), and rich. The totals in each are displayed in a plot on the main interface. The other important statistic included in the model is the calculation of the Gini coefficient. The Gini coefficient is a measure of inequality bounded by zero and one in which zero represents perfectly distributed wealth and one perfect inequality. The Gini coefficient is calculated as

$$G = \frac{n+1}{n-1} - \frac{2}{n(n-1)\mu}\sum_{i=0}^{n} P_i X_i$$

where n is the number of agents, μ is the mean wealth of all agents, and and X_i and P_i are the wealth and wealth rank respectively of agent i (Deaton, 1997, p. 139).

The following tools to track the agents were added during the modification process. "Life-exp" measures the average age at death of each agents. This differs vastly from the user input values of minimum and maximum life expectancy because of the number of agents who die of starvation. There is also a monitor called "Life-exp-poor" which measures the average age at death of agents who die of starvation. This is an important distinction and gives another snapshot of the inequality in the "Wealth Distribution" society. "Loans-made" measures the total amount of grain loaned and "Loans-repaid" is the sum of all payments made back. Finally, "GDP" is a count of the total grain harvested.

3. RESULTS

The goal of the paper is to determine if the working poor are better off or not having access to high interest lines of credit. In the real world this can be hard to measure. A researcher can look at happiness levels, average income, default-rates and many other statistics. They may be misleading and may not agree with each other. However, in the "Wealth Distribution" model, determining if an agent is better off can is simple: does he live longer? This is the case because the only goal of an agent in this society is to maximize his life-span.

3.1 Hypotheses. With this in mind, the first hypothesis is that agents—the poor in particular—will live longer due to the safety net provided by loans. This may seem an obvious conclusion, but there is the possibility that agents unnecessarily take out loans when they might have survived otherwise and then get weighed down by the debt.

The second hypothesis is that the creditors make a positive average return on investment from the loans they originate. This is a reality check on the system. If the first hypothesis is true, but the creditors are losing money, it is not an accurate depiction of the real world. It would mean the gains of the poor agents were at the expense of the rich agents. This would represent a tax on the rich as opposed to a depiction of the subprime loan industry.

If the first two hypotheses are correct, then the distribution of wealth will be investigated. The third hypothesis is that the distribution of wealth will shift in some direction, thus warranting a two-tailed test. It is probably more likely that the rich would experience more gains in wealth due to the collected interest. However, a case could be made that the poor could see more gains due to longer lives and more potential harvesting.

3.2 Simulation and Results. The simulation was run sixty times each with loans on and off. Other than the variables in the loan function, the initial values of the variables remained the same. Population was set at 500, max-vision 5, metabolism-max 12, life-expectancy-min and life-expectancy-max at 25 and 80, percent-best-land 10, grain-growth-interval 2, num-grain-growth 4, interest-rate 100, tick-stop 1000, and random-limits "on". The statistics pertaining to the three hypotheses are summarized in Table 1 of the Appendix.

Two measurements, explained in the measurements section of the paper, were used to investigate the change in life-spans of the agents. The first was the "Life-exp" measurement. Figure 1 shows the density plots of average age at death with loans on and loans off. As evidenced by the distinct distributions, a significant difference was found when loans were allowed compared to loans were not allowed (p-value < 0.0001). When loans are turned on, the agents live an average of 5.9% longer than when the loans are turned off.

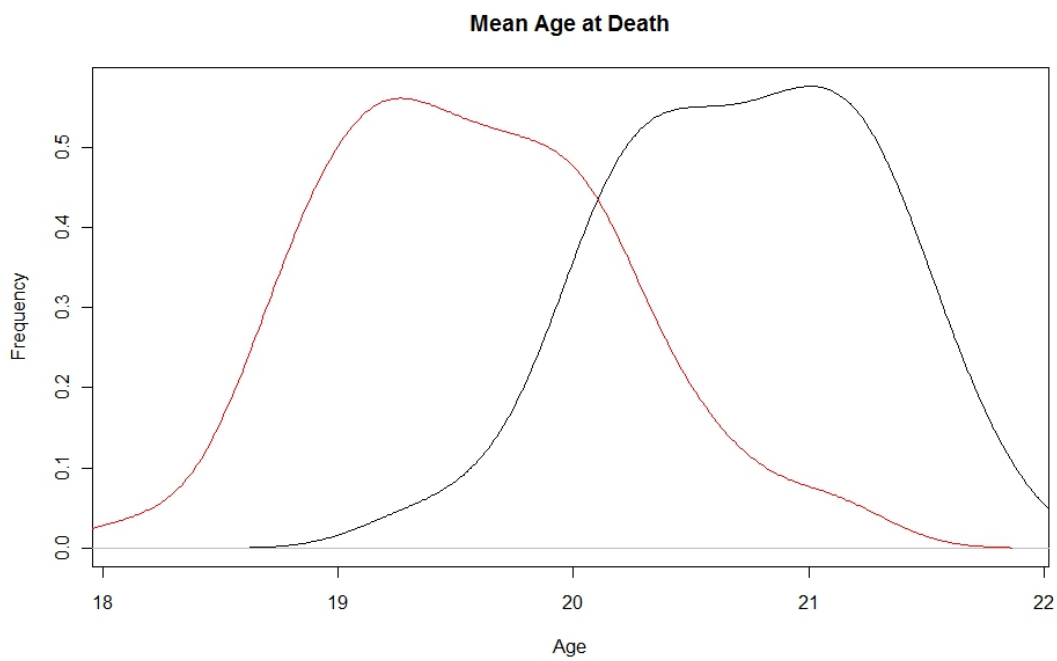

FIGURE 1: Density plot of mean age of death when loans are off (red) and on (black)

However, of more interest is Figure 2, which compares the densities of the average age of death of the poor when loans are on and off. Recall that the deaths of the poor is measured as any agent who died of starvation and not because he reached his life expectancy. The difference is again strongly significant (p-value < 0.0001). In fact, the results are even stronger as demonstrated by the sharper peaks and smaller overlap region of the densities. The poorer agents see their lifespans increase by 6.9% when they are extended loans. These two findings give clear evidence that agents do live longer, and thus are better off, when they are given the opportunity to take out loans.

The average return on investment was 24.6%. This was measured by looking at the total loans extended compared with the total payments made[3]. When tested against zero, it was very significant (p-value < 0.0001). This proves that the creditor agents are making average positive

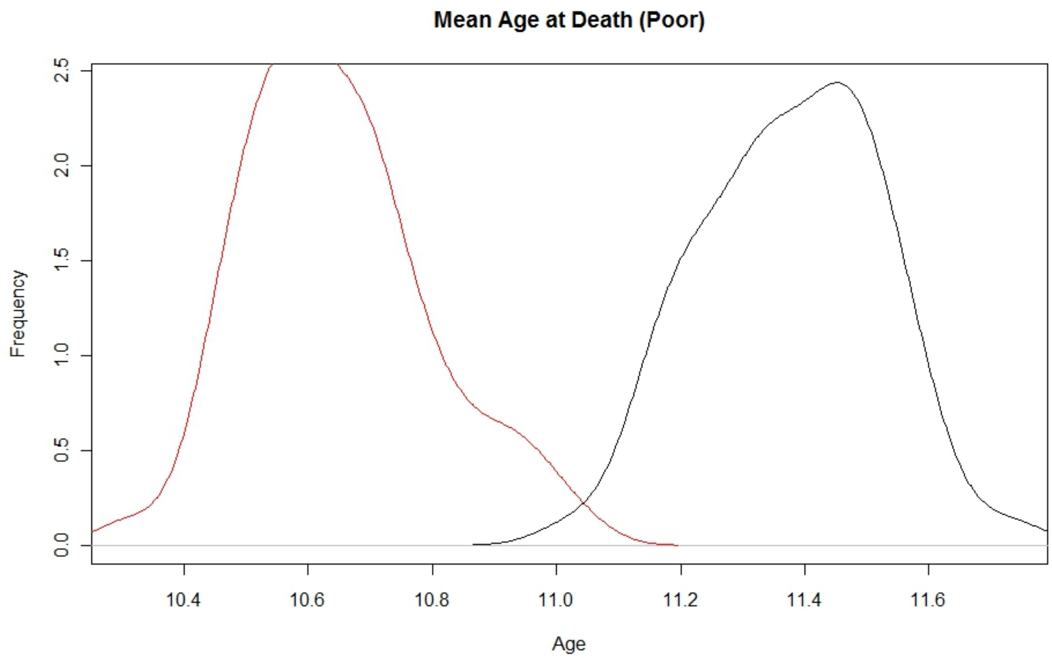

FIGURE 2: Density plot of mean age of death of poor agents when loans are off (red) and on (black)

returns and thus are incentivized to continue giving out loans. This also sheds light on the arguments mentioned in the intro about why the payday lenders had to charge such high interest rates. Though no transaction costs are factored into the "Wealth Distribution" model default rates are. Even though the lenders charge a rate of 100%, they only realize a return of 25%. Thus they are justified in charging a high rate.

Finally, as measured by the Gini Coefficient, inequality was lowered when loans were turned off. The results were not as strong as the others, but were statistically significant. The densities of average Gini Coefficient is shown in figure three. On average, the Gini Coefficient was decreased 0.8% when loans were turned on.

[3] It must be kept in mind that the small standard deviation of the ROI is based on the ROI gathered at the end of each run. The actual variation in ROI between each loan made in the model is much larger.

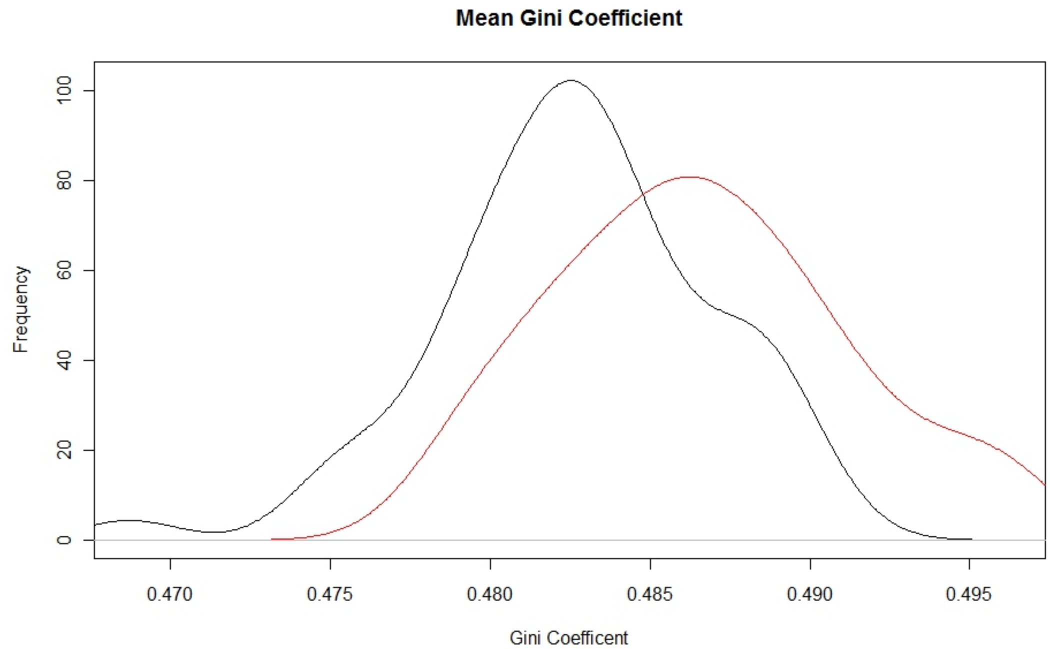

FIGURE 3: Density plot of mean Gini Coefficients when loans are off (red) and on (black)

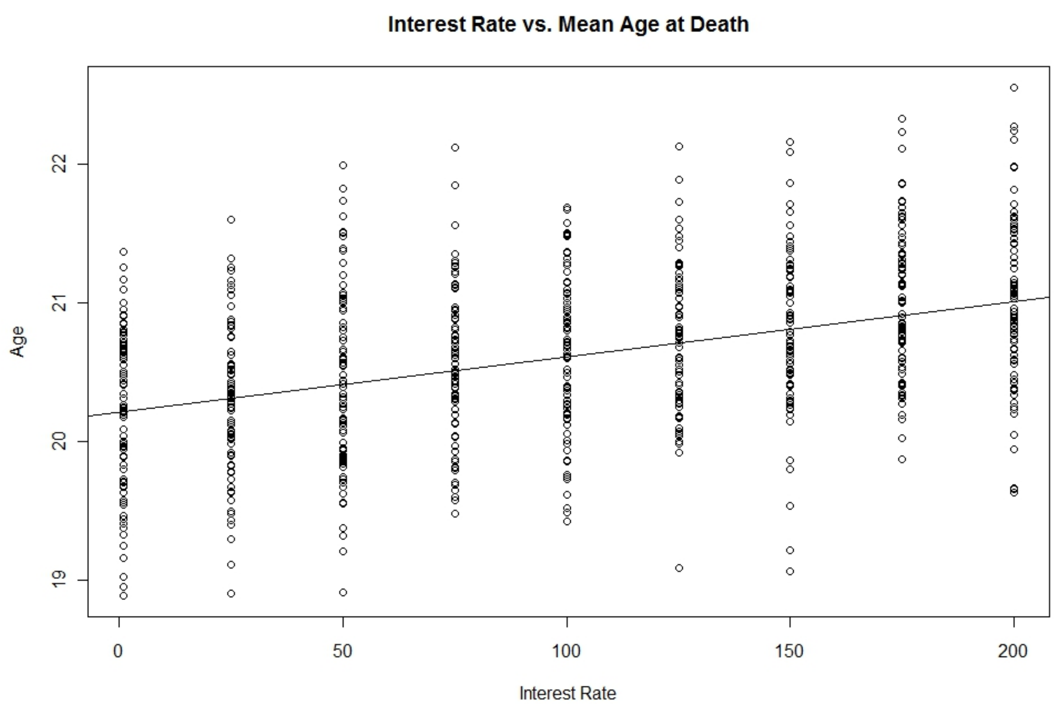

FIGURE 4: Plot of mean age of death vs. interest rate with regression line

3.3 Other Results. In order to gain more understanding of the system, three simple regressions were run[4]. The first compares the interest rate and the average age of death. The expectation

[4] A summary of the statistics from the regressions can be found in Table 2 of the appendix.

was that average age would fall as the interest rate went up since the poorer agents would default on their loans sooner. It was assumed that the poor agents were the main drivers of the change of life expectancy. The surprising results are presented in Figure 4. The model is very significant (p-value < 0.0001). Contradicting the prediction, average age goes up slightly as interest rate climbs. This means that the benefits the rich gained from higher interest outweighed the losses that the poor suffered.

The second regression compares the interest rate and the average age of death of the poor. This was also expected to be negatively correlated, but with a steeper slope. The data and regression line are presented in Figure 5. As expected, there was a very strong negative correlation between the variables (p-value < 0.0001). The slope of the regression line was -0.008 which signifies a drop in life expectancy by 0.008 for each 1% the interest rate goes up. The y-intercept was 12.2. In Table 1 of the appendix, it is seen that poor agents' life spans were 10.65 when loans were disallowed. Setting up the regression equation and substituting 10.65 for the mean age of death of poor yields:

$$10.65 = 12.2 - 0.008\ (\textit{interest rate})$$

Solving for interest rate gives a value of 193.75%. This means that, in the model, agents are better off with loans until the interest rate reaches nearly 200%.

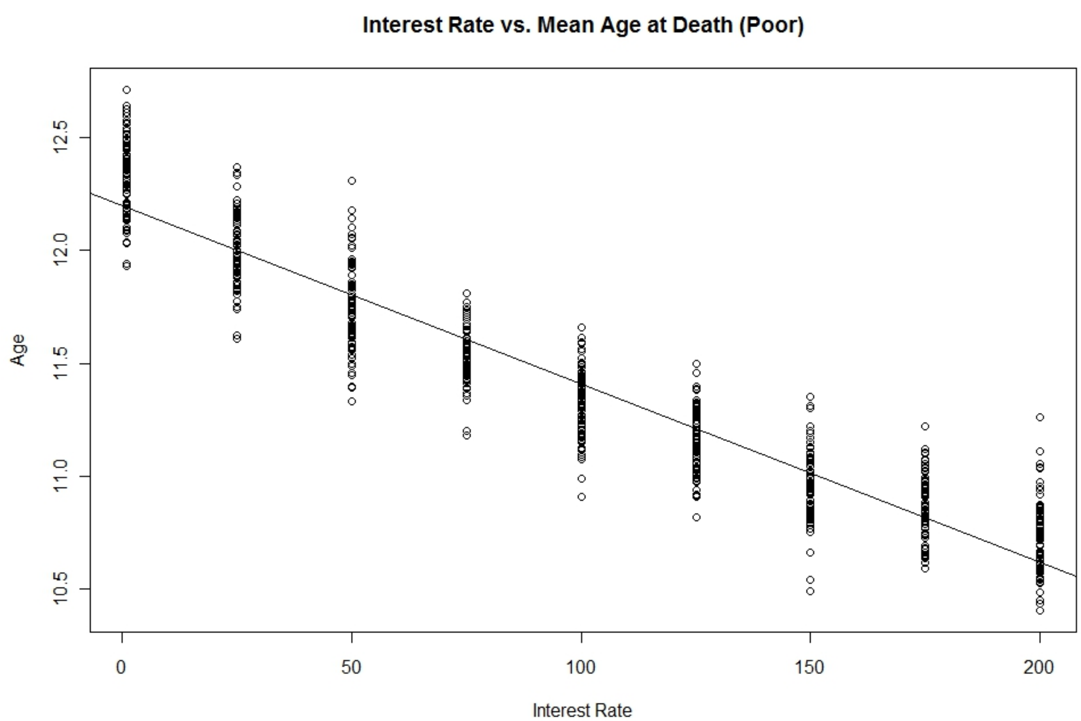

FIGURE 5: Plot of mean age of death of poor vs. interest rate with regression line

The final comparison regressed the return on investment against the interest rate. This was an obvious prediction: ROI goes up when interest rates are hiked. However, the exact relationship was a mystery and it was unknown if perhaps the curve would start leveling out after a certain interest rate level (a square root function). Figure 6 shows the strictly linear relationship and very strong correlation between interest rate and return on investment. There was very little variation in ROI between runs when interest rates and all other variables were held constant.

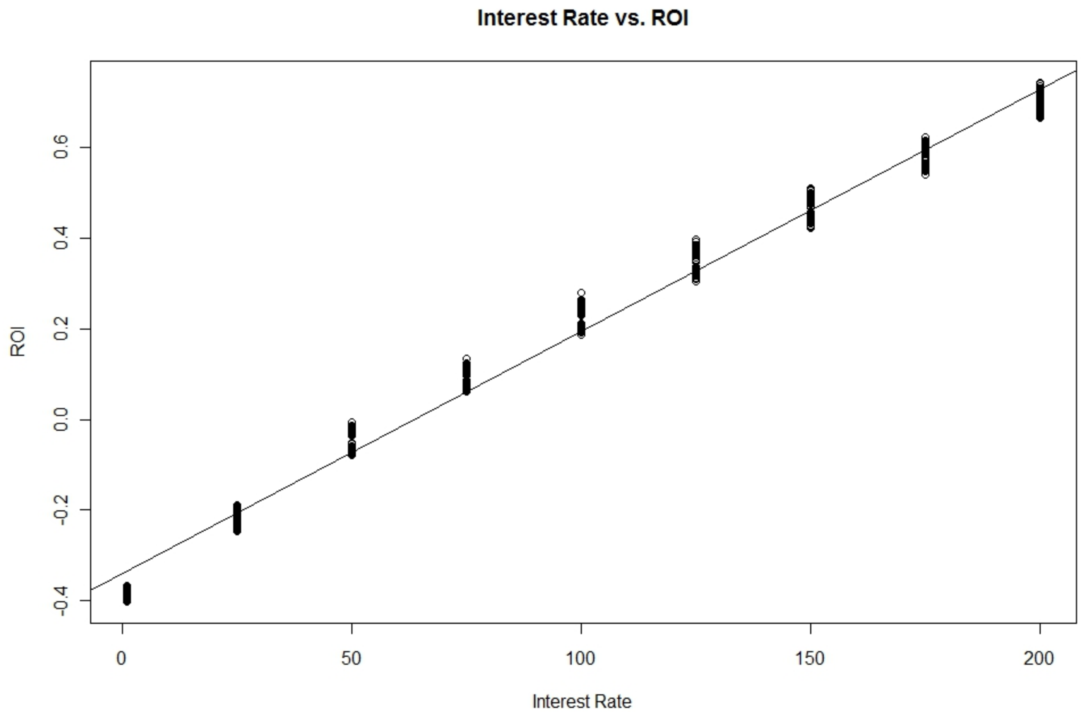

FIGURE 6: Plot of mean ROI vs. interest rate with regression line

4. CONCLUSIONS

The results obtained from this analysis provide useful, new results to the debate over if, and how, to regulate payday lenders and other "fringe banking" institutions. The data obtained from the "Wealth Distribution" model clearly point out that the low-income households need a source of credit, even if the interest rate is quite high.

The model backs up the claim that creditors need to make the interest rate higher due to the rate of defaults. For instance, the regression determines that "Wealth Distribution" creditors don't break even on their loan investments until the interest rate hits 64%. Obviously this number can't be applied in the real world, but it does illustrate the high costs that defaults incur on a lending business.

The model also shows how much the poor benefit from having a quick line of credit. A real world example of this is if a worker's car breaks down. He has no money but needs $200 to fix the car. If he receives a payday loan, he has to pay high interest, but he is able to keep his job. It's the same in the model. If an agent has struggled for a few turns to have a good grain haul, he can take out a loan that gives him a few more turns to find a good patch. Also, if agents see a good patch of grain four spaces away, it takes them four turns to get there. For an agent with a high metabolism, four turns could be too long without a source of credit.

There are some agents who are doomed from the start due to very high metabolism and poor vision. These agents will take on too much credit and not be able to pay it off. This is the same in the real world. Some households get behind and start using more payday lenders to pay off the bills to other ones. These stories can often cloud the debate. However, for a person on the margins, "fringe banking" can be a positive fallback plan for his finances.

On top of this, there is evidence that suggests that income inequality is in fact lowered when agents are allowed to borrow from each other. Though a huge difference wasn't found, it was at least proven that income inequality doesn't grow due to loans.

These results show that states should allow the "fringe banking" industry to operate. They are justified in regulating excessive rates, as there is a certain rate at which borrowers are worse off than before. However, they owe it to their citizens to allow them access to some form of credit.

REFERENCES

Brown, C. "Pawnbrokers to the Stars." Forbes 148 (1991): 104-105.

Deaton, Angus. Analysis of Household Surveys. Baltimore: The Johns Hopkins University Press, 1997.

Ellis, David. "17 Million Americans Have No Bank Account." CNN.com. December 2009. Accessed 04/29/2011. http://money.cnn.com/2009/12/02/news/economy/fdic_survey/

Epstein, Keith and Brian Grow. "The Poverty Business." Businessweek. May 2007. Accessed 04/22/2011. http://www.businessweek.com/magazine/content/07_21/b4035001.htm

Haughney, Christine. "City's Poor Still Distrust Banks." NYTimes.com. August 2009. Accessed 05/02/2011. http://www.nytimes.com/2009/08/18/nyregion/18cash.html?_r=1&ref=nyregion

Leland, John. "Nonprofit Payday Loans? Yes, to Mixed Reviews." NYTimes.com. April 2007. Accessed 04/29/2011.http://query.nytimes.com/gst/fullpage.html?res=9E03EEDD123CF93BA1575BC0A9619C8B63&sec=&spon=&pagewanted=all

Lewison, Martin. "Conflicts of Interest? The Ethics of Usury." Journal of Business Ethics 22.4 (1999): 327-339.

McArdle, Megan. "On Poverty, Interest Rates, and Payday Loans." The Atlantic. November 2009. Accessed 05/02/2011. http://www.theatlantic.com/business/archive/2009/11/on-poverty-interest-rates-and-payday-loans/30431/

Wilenski, Uri, 2011, *Netlogo* http://ccl.northwestern.edu/netlogo/

5. APPENDIX:

Table 1

	Life Exp.	Life Exp. (Poor)	ROI	Gini Coeff.
Loans On - mean	20.72	11.38	24.59%	0.4827
Loans On - stdev	0.570	0.144	0.89%	0.0042
Loans Off - mean	19.57	10.65	N/A	0.4866
Loans Off - stdev	0.628	0.148	N/A	0.0046
% Diff	5.90	6.87	N/A	0.8
Test	$\mu_{On} > \mu_{Off}$	$\mu_{On} > \mu_{Off}$	$\mu_{On} > 0$	$\mu_{On} \neq \mu_{Off}$
t-stat	10.52	27.39	214.01	-4.90
p-value	< 0.0001	<< 0.0001	<<<0.0001	<0.0001

Table 2

Model	Intercept	Slope	P-value
$Life\ Exp = \beta_0 + \beta_1(Int\ Rate)$	20.21	0.00398	< 0.0001
$Poor\ Life\ Exp = \beta_0 + \beta_1(Int\ Rate)$	12.20	-0.0079	< 0.0001
$ROI = \beta_0 + \beta_1(Int\ Rate)$	-0.3399	0.0053	< 0.0001