

# A Harming Hand: The Predatory Implications of Government Backed Student Loans

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September 15, 2017

## Abstract

Using the Department of Education's College Scorecard, I provide evidence that over 30% of undergraduates should expect to realize a negative financial return on their investment in higher education. To explain these findings, I construct a model of informed lending in which student loan providers know more about their students' likelihood for success. Reversing traditional lending information asymmetries has no adverse impacts in a laissez-faire environment as borrowers are able to perfectly infer their type from lenders' loan offers. When all loans, however, are required to be issued at the same interest rate (as is the case with student loans) borrowers are no longer able to learn their true type. In this environment, borrowers may be induced to accept a predatory loan. In spite of the possibility for predatory lending, the socially optimal lending program, may still mandate that all loans be issued at the same interest rate. In effect, the socially optimal lending program can encourage predatory lending.

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# 1 Introduction

*“College remains an excellent investment overall[funding] investments with large returns to student borrowers and the economy”*

–Council of Economic Advisers, 2016

*“In 2016 alone, nearly 1.2 million borrowers defaulted on a federal Direct Loan-more than two borrowers every minute.*

–Seth Frotman (Student Loan Ombudsman, CFPB), 2017

Since 2010, student loans have been the second largest source of consumer debt in the United States. Currently, over 1.4 trillion dollars in student loans are outstanding, the vast majority of which is backed by the US government. The current debate on student loans presents a particular challenge for economic theory and analysis. On the one hand, a vast literature exists arguing that a college education produces a substantial wage premium resulting in substantial economic returns for most students (Avery & Turner, 2012; Oreopoulous & Petronijevic, 2013). In contrast, rhetoric and anecdotal evidence on the negative impacts of student loans suggests that not everyone is benefiting from their education loans. Preliminary research has also found that student loans may be having real effects on consumer behavior (Rothstein & Rouse, 2011; Thompson & Bricker, 2014; Sieg & Wang, 2017).

How do we reconcile these competing views on the impact of student loans on consumer welfare? If students always realized positive returns to higher education, the low interest rates students are charged on their federally backed loans should not harm many students. Further, we would expect far fewer student loan defaults than the 1.2 million we see annually.

In our paper, we examine the downside risk of college attendance and then consider how the structure of the student loan market might contribute to negative outcomes associated with student loans. Student loan programs let potential students access credit at a lower interest rate than would otherwise prevail in the market in two ways. First, student loan programs restrict the interest rate that students will get on their loans. Unlike most credit markets, all borrowers are charged the same interest rate regardless of borrower characteristics, college attended, or field of study. Second, student loan programs reduce the lenders risk by providing large guarantees that cover the lenders losses in cases of default. These loan programs promote access to higher education; without these programs, some students might not be able to undertake a (potentially) valuable investment in their education. The government’s intervention allows all students access to credit on the same terms. For some

students, cheap credit may just burden them with the high costs associated with attempting higher education; students could be taking out loans for what, even ex-ante, appears to be a poor investment.

We attempt to reconcile the contradiction between the view that the returns to higher education are, on average, positive with the observation that many students are struggling to service the debt on their loans. We begin by providing new evidence regarding the downside risk of attending college. Using the Department of Education's College Scorecard, we construct a school level score to calculate the percent of students receiving an education that will be negative NPV. Our calculations show that the majority of students will make substantial gains by furthering their education. Substantial downside risk, however, exists. Approximately one-third of all students will realize a negative NPV for having attended college. While closing some poor performing colleges could lower this proportion, in and of itself heightened standards seem unlikely to substantially reduce the number of students realizing negative returns<sup>1</sup>.

To analyze the downside risk to higher education we consider both the direct cost (net tuition) and the opportunity cost (wages from entering the labor force immediately after high school graduation). As over 90% of the cost of higher education is in the form of opportunity costs, we must consider both components to accurately gauge the cost to attending college. We then use the College Scorecard's data on post-attendance earnings by college to construct a school level wage distribution. Finally, we can determine where on a given school's wage distribution a student would need to fall in order to make his/her investment attending that school "pay-off." The higher a student would need to fall on his/her school's wage distribution to break-even, the more students at that school realize a negative return. Unsurprisingly, private for-profit colleges have a large percent of their students realizing a negative return; however, there are still many public colleges where a student would need to be in at least the 40th percentile of the wage distribution to break even.

We then construct a model to show how the organization of the student loan market contributes to the high number of students realizing negative returns. In contrast to traditional credit markets, all students from a given year receive the exact same interest rate on their loan regardless of the school they are attending or any personal characteristics. If students are relatively uninformed about their personal prospects, interest rates will serve as a signal of loan quality. With all students pooling at the same interest rate students will be unable to learn their true prospects. Thus, some weaker students may be induced to take out a

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<sup>1</sup>only 5% of students attend colleges where half of students realize a negative return.

loan with a negative private value. Since lenders know that for borrowers these loans have a negative private value, we will call such loans “predatory.”

Even though pooling results in predatory lending, such loan programs may still be socially optimal. With interest rate pooling, the cost of subsidizing loans is lower. Holding fixed the marginal student, a high level of government support is necessary if she knows she is the marginal student. In contrast, if she does not know she is the marginal student, then she would be willing to take out a loan even when the government offers a much lower level of support on her loan.

Under our lending model, a borrower is looking to finance a risky project, where the distribution of possible payoffs varies across borrowers. In contrast to traditional lending models, we assume that the lender can observe the distribution of possible payoffs at the project level; borrowers, however, are uninformed. Time is discrete with two periods. At time 0, lenders simultaneously choose a contract to offer the borrower. After observing the offered contracts, the borrower either accepts or rejects the best offer. At time 1, the project generates some cash flow, and the borrower repays the loan to the extent possible. In addition to the project’s private value, the project will also generate positive spillovers. These positive spillovers allow us to capture the positive externality associated with college attendance.

In the *laissez-faire* environment, the lenders’ information advantages has no negative consequences. Competition between the lenders ensures that borrowers are offered a risk-adjusted interest rate. Since interest rates vary with borrower risk, the borrower can infer her true type.

The *laissez-faire* environment, however, is not socially efficient. As neither the borrower nor the lender price in the societal benefits of education, some socially valuable projects are foregone. In order to reduce the societal loss, a social planner can create lending guarantees which alter the interest rate lenders will charge. The social planner can also restrict the interest rate lenders can charge forcing all loans to be issued at some fixed interest rate. With lower interest rates, more projects will receive investment dollars. When all accepted borrowers receive the same interest rate, borrowers are unable to learn much from their loan offer as all acceptable borrowers pool at the same interest rate.

Restricting the borrower’s ability to learn from interest rates is not without cost. In the *laissez-faire* benchmark, no borrower accepts a loan that leaves her worse off. With limited information, however, some borrowers may accept a predatory loan (i.e. a loan with a negative private value). To see how this can arise, consider the case of a borrower who receives a loan offer of  $R$  such that in expectation the borrower is indifferent between accepting and

rejecting the loan. When multiple borrowers with different payoff distributions pool at  $R$ , the only way that the borrower can be indifferent in expectation is if at least some borrowers at  $R$  are strictly worse off. At least some rational borrowers will then accept a bad loan. Since lenders know these weak borrowers are being harmed by their loans, we can call these loans predatory. Of course, given the limited information available to the borrower, the borrower doesn't know ex-ante that the loan is predatory.

Although a uniform rate loan program results in predatory lending, such a policy may still be socially optimal. Loan guarantees are costly, the social planner faces a trade-off. High guarantees allow more borrowers to borrow at lower interest rates; however, higher guarantees increase the overall cost of the program. Suppose, the social planner would like to convince some weak borrower to accept a loan. If that borrower knows she is unlikely to repay her loan, she will need a very low interest rate and by extension a high guarantee to accept the loan. In contrast, the same borrower, if she were uninformed, would be willing to accept the same loan at a much higher interest rate implying lower guarantees. Varying rate programs rule out predatory lending but are much more costly to implement.

The remainder of the paper is organized as follows: section 2 reviews the relevant literature. Section 3 analyzes the returns to higher education. Section 4 considers the laissez-faire benchmark, section 5 discusses how government intervention can impact lenders' and borrowers' equilibrium behaviors. Section 6 considers the welfare implications from the borrower's perspective. Section 7 explores the construction of the optimal lending program. In section 8, we add a publicly observable variable that is semi-informative showing that predatory lending arises as long as the lenders possess an information advantage. Section 9 concludes. All proofs are contained in Appendix B.

## 2 Literature Review

Our research connects to two broad strands of the literature. First, we provide new evidence regarding the returns to higher education. While our results confirm, as most other papers have, that there are positive returns to higher education we show substantial downside risk exists that has not been extensively documented previously. Second, we extend the theoretical literature on informed lending and multidimensional signaling.

## 2.1 Returns to Education

Recent surveys have found that over 70% of students rated employment concerns as a “very important” factor in their decision to attend college (Fishman, 2015). Students also seem well aware that a college education can command a significant wage premium (Rouse, 2004). According to the Bureau of Labor Statistics, by 2016 the median wage of a bachelor’s degree holder was 67% higher than the median wage of a high school graduate (\$ 60,112 vs. 35,984). Proving that the education itself, however, is the driver of this wage gap is not straight forward.

Ability is natural confounding variable that can contaminate simple comparisons between college and no-college individuals. Taber (2001) suggests that much of the growth in the college-no college wage gap in the 1980s may have been driven by increased demand for high ability workers. Increased sorting along ability may also explain the increasing wage gap (Hendricks & Schoellman, 2014). Castex and Dechter (2014) have found that while there seemed to be a substantial wage premium on ability in the 1980s and 1990s, that by the 2000s much of this ability premium may have dissipated.

To control for ability, numerous studies have adopted an instrumental variable approach to estimate the returns to an additional year of education (Card, 1999; Card, 2001). For example, early studies instrumented on the distance to the nearest college to isolate the returns to education (Kane & Rouse 1995; Card, 1995). Implicitly, such an approach requires that students living near colleges must be similar to those who live further away, an assumption that may not always hold. More recent studies have adopted a regression discontinuity approach around enrollment cutoffs comparing students just below and above these publicly stated thresholds, again finding a statistically and economically significant wage premium (Zimmerman, 2014; Ost et al., 2016). Using these various methods returns on the order of 5%-15% per year of higher education have been documented. Such estimates are similar to the observed wage gap.

The positive returns to education, however, can vary significantly among various subgroups. Zimmerman (2014) found overall attending a 4-year college resulted in a 22% increase in earnings for the marginal student. These findings, however, were driven almost entirely by an increase in the expected earnings of male students suggesting that not all students realize significant private benefits from college attendance.

Differences in the returns of education have also been found to depend on the type of college a student is attending. Generally selective colleges produce large and positive returns (Hoekstra, 2009). In contrast, the evidence for 2-year and community colleges is much more

mixed. Early studies found that the returns to credits at 2-year and 4-year colleges were similar (Kane & Rouse, 1995). More recent studies, however, have suggested that there is a substantial decrease in wages for attending a 2-year college, although this may be partially offset by the decreased costs of attendance (Reynolds, 2012). For-profit colleges have also been identified as schools that may produce substantially worse outcomes than comparable public or non-profit schools (Deming et al., 2012). Even if college is generally a good investment for students which school a student attends appears to have a significant impact on the value of their education.

One difficulty in making policy recommendations based on these findings, however, is the various marginal dimensions of the college entry decision. Some potential students might decide against college due to financial constraints whereas others might decide against college due to their inability to get accepted to a school of their choice. In evaluating any policy proposals, it is important to consider the dimension of marginality. When changing the dimension of marginality, the marginal return may be substantially positive or negative (Carneiro et al., 2011). Hence, when evaluating changes to policy it is important to consider exactly which students the change would impact.

For example, current US policy is to provide financial aid without regard to what school a student is attending (so long as it has been regionally accredited). Financial aid can have a significant impact on student enrollment (Kane, 2003), especially among minority students (Arcidiacono, 2005). Although financial aid may help improve attendance, it isn't obvious that this aid is always being used to help reduce costs (Bennett, 1987). Among public college, it does appear that increased federal financial aid has helped to keep out-of-pocket costs low (Singell & Stone, 2007). At for-profit colleges, however, a 1 dollar increase in federal aid has translated into a 78 cents increase in cost suggesting that increasing financial aid can, but doesn't always, lower costs (Cellini & Goldin, 2014).

Altonji (1993) suggests that it is important to consider the uncertainty that students face when they make the costly decision to attend college. As attending college is not a risk-free investment, acknowledging downside risk is an important next step in understanding the returns to higher education. From an empirical standpoint, I examine how likely it is that a student will realize a negative return. Even if the average return to college is positive, understanding how large the downside risk is has important implications from both the students' perspective and the government's. If certain students face significant downside risk then student aid policies should be designed in such a way to help mitigate such risk.

## 2.2 Informed Lending and Predatory Lending

From a theory perspective, there is a long literature studying the interactions between informed and uninformed agents. In fact, early research on signaling used education as a motivating example (Spence, 1973), although from the perspective of a student signaling a potential employer. When information asymmetries exist various market distortions may occur. In extreme cases, complete market failure may even occur (Akerlof, 1970). The problem of information asymmetries may be mitigated in one of two ways.

Traditional financing models of information asymmetry assume that borrowers possess more information than lenders (Jaffee & Russell, 1976; Stiglitz & Weiss, 1981). In many cases, however, this traditional assumption may not hold. The implications of informed lending is well studied in models of entrepreneurial financing. As entrepreneurs specialize in coming up with an idea they may not have the expertise or time to properly evaluate the quality of the idea; instead the entrepreneur can outsource this evaluation to better informed investors (Habib & Johnsen, 2000). When working with venture capitalists it would be natural to think that a VC, who has made a career picking “winners,” will be able to better evaluate a potential firm’s chances of succeeding in a competitive market (Axelson, 2007). Given the nature of generating new ideas, an entrepreneur is unlikely to be an expert in all aspects of project evaluations; often some dimensions of project viability will need to be evaluated by outsiders (Biais & Perotti, 2008). Much of the work on informed finance has focused on its implications for security design finding that equity may actually be optimal (Garmaise, 2007; Casamatta & Haritchabalet, 2013). When banks have the ability to engage in costly screening, pure debt financing will result in an inefficient allocation of capital (Manove, Padilla, & Pagano, 2001).

One market where informed lending seems particularly likely involve student loans; students often seem to poorly estimate, ex-ante, the final results of their investments in education. Students who enter school seeking a science degree have been found to significantly overestimate the probability that they will actually receive a degree in a science major (Stinebrickner & Stinebrickner, 2013). As they progress through college students also learn about their ability; this type of learning may account for high attrition rates (Stinebrickner & Stinebrickner, 2012). Large disconnects between actual and perceived returns of education have also been documented (Jensen, 2010; Wiswall & Zafar, 2015) casting further doubt on the ability of students at all levels to accurately assess the value and riskiness of education. Increasing information available to students does seem to improve their ability to estimate the value of education (Fryer, 2016). The misvaluation of important financial variables, which seems

common amongst many students, makes informed finance models particularly well suited for analyzing the market for student loans. The implications of informed lending, however, has seen less study in consumer finance markets despite the clear applicability.

The reversed information asymmetries captured by informed finance models have significant implications for borrower welfare. Depending on the specifics of the environment, investors may be either too aggressive or too conservative in their provision of capital (Inderst & Mueller, 2006). When lenders are too aggressive, we will say that they are engaging in “predatory” practices. Explicitly, some borrowers are receiving credit even though they would’ve been better off ex-ante if credit were not available.

The common explanation for predatory lending practices is done via appeals to behavioral biases (e.g Morgan, 2007; Della Vigna & Malmendier, 2004). Most policy prescriptions have also tried to tackle predatory lending from a behavioral perspective (Stango & Zinman, 2011; Fritzdixon et al., 2014). A study of an anti-predatory loan program in Chicago has shown that credit counseling reduces both default rates and loan activity (Agarwal et al., 2014). Such programs, however, may not be enough to eliminate all predatory lending, especially if predatory lending can arise in a rational environment.

Recent work has started to explore rational explanations for predatory lending. A key requirement of such models is that the lender has an information advantage over the borrower. Without a less informed borrower it would be impossible to induce a rational borrower to agree to a bad loan. In the mortgage market, borrowers may refinance their loan even when entering into bankruptcy would be a better option (Bond et al., 2009). As banks know the borrower’s ability to repay both the current loan and the refinanced loan, banks are able to structure a refinanced loan in such a way that the borrower pays the bank more even if bankruptcy is an eventual certainty.

Most closely related to our theoretical model is Inderst (2008). In his model, a monopolistic lender observes the repayment probability of potential borrowers and chooses whether to offer a loan, and if so what interest rate to charge. In equilibrium, all borrowers who are offered a loan pool at the same interest rate. This pooling induces some borrowers to agree to a predatory loan. Since borrowers don’t know how strong they are, the borrowers must rely on the loan offer as a signal. The pooling behavior, however, limits the ability of the borrower to differentiate her type. With the introduction of a second, less-informed lender, however, competition attenuates most of the negative effects that arise from predatory lending.

Our model differs from the Inderst (2008) model in two key respects. First, we generalize the model to a continuum of possible payoffs. Second and more significantly, in our model

predatory lending can still be socially optimal. In fact, under our model a social planner’s optimal intervention drives the creation of predatory lending practices. To generate such a model of rational predatory lending we introduce government lending subsidies that distort the lenders’ profit functions. To our knowledge, this is the first model that explores how distortions to the lenders’ profit functions can induce rational predatory lending even when the government is constructing the socially optimal lending program.

### 3 The Empirical NPV of a College Education

#### 3.1 Data

We use publicly available data from the U.S. Department of Education’s College Scorecard, which contains data collected from all colleges with students receive federal financial aid including costs, student demographics, and degree programs. In addition, the College Scorecard also provides a wage distribution at a school level for students 6 and 10 years after initial enrollment<sup>2</sup>. To construct the wage distribution, the College Scorecard matches students who received federal financial aid with administrative tax records. Wage data is then aggregated to the school level where the mean and standard deviation of wages is reported. The College Scorecard also reports various wage quantiles for almost all schools.

The administrative wage data only captures students who at sometime during the enrollment received Title IV aid (federal financial aid). Hence, a school’s complete distribution of post-enrollment wages may differ from that reported in the College Scorecard. Although the complete distribution may not exactly match what we calculate, this is not a major limitation for our specific analysis. Since we are concerned with the impact of student loan policies on student outcomes, limiting the data to only those students receiving federal financial aid may in fact allow us to better focus our analysis on our targeted population.

Our unit of observation will be individual schools. In total, there are 5,328 observations in our data set. Due to privacy concerns, the College Scorecard censor data from . After removing these schools, we have wage data for 4,978 schools. Table 1 provides summary statistics, and Table 2 provides cross-correlations of our sample.

[Insert Table 1 Here]

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<sup>2</sup>For a 4-year university, this would correspond to the 2nd and 6th year after graduation for students graduating on-time.

Panel A reports the summary statistics unweighted, whereas panel B weights the results by the number of students at each school. There is a substantial difference in the make-up of the sample when we weight the results. When allowing each school to be weighted equally, for-profit colleges comprise over 40% of our sample. When we weight the sample, however, the ratio of for-profit private colleges drops to 7%. Although there are a handful of massive for-profit colleges, most tend to be quite small. As it is plausible that the outcomes from for-profit colleges will differ substantially from other institutions, we will report our results both unweighted and weighted by student enrollment. In most cases our results will be qualitatively similar.

[Insert Table 2 Here]

In addition, we supplement the data with information from the American Community Survey to construct an estimate of how much students could have earned if they entered the workforce immediately after high school<sup>3</sup>. We also use the Quarterly Census of Employment and Wages to approximate long-term wage growth, both for high school graduates and college educated individuals.

### 3.2 Estimating the Value of College

Consider the case of a student graduating high school with the choice of either attending college or entering the workforce directly. The benefits of college are higher expected wages. The costs of higher education are both direct, tuition and fees, as well as indirect, the opportunity cost of delaying entry to the workforce. The NPV of a given student's choice to enter college should be given by

$$NPV(\text{College}) = PV(\text{Post-College Earnings}) - PV(\text{Tuition and Fees}) - PV(\text{No-College Earnings}).$$

The College Scorecard provides the data necessary to estimate the cost and post-college earnings for a school's students. In order to calculate the NPV, however, we will need two other key estimates: the discount rate and the no-college earnings. We will make conservative assumptions for the discount rate and the no-college wage that will be biased towards making college more beneficial<sup>4</sup>. Even with our conservative assumptions, we find that for a substantial fraction of students college is a negative NPV financial investment.

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<sup>3</sup>In 2014, 72% of students attending traditional 4-year colleges remained in-state and very few students at 2-year colleges would be classified as out-of-state students.

<sup>4</sup>In traditional papers studying the return to educations, assumptions are usually made conservative by biasing the results against positive returns to education. In our paper, however, we argue that too many

For the discount rate, we will assume that student's discount the future at the historically low 2016-17 Stafford loan rate of 3.76%. In our case a low discount rate will bias our results against finding positive returns to education. Since the benefits are realized in future years while the costs are realized today, low interest rates would increase the present value of the benefits while holding the costs constant. Recent research on the returns to higher education has used much higher discount rates on the order of 6% (Zimmerman, 2014).

To calculate the no-college wage, we will use the American Community Survey to calculate, by state, the average wage for adults age 18-22 who graduated high school but have not attended college. Hence, the opportunity cost will be constant for every school located in a given state. On average, this translates to a no-college wage of \$17,544 per year.

We suspect the counter-factual we construct is lower than the true opportunity wage for two reasons. First, selection effects would mean the pool of no-college wage earners will be weaker than the pool of potential college students. Hence, the marginal student who went to college likely would have been able to receive a wage higher than the no-college average had they foregone college attendance. Second, not attending college today would not preclude future investments in higher education. If it becomes clear that as an employee, the individual needs further education he/she can still pursue that education. In contrast, once the student has spent time in college he/she can never recover those sunk costs.

Our estimate for the no-college wage is also substantially lower than the \$25,000 annual earnings for high-school only, young adults the Department of Education publicizes on the College Scorecard's public facing interface. Since higher no-college wages will increase the opportunity cost of attending college, our deliberately low estimate will bias us away from finding negative economic benefits to education.

Once we have established the direct and opportunity costs of post-secondary education, we can then determine what wage a student at each college would need to earn to break even<sup>5</sup>. We then match this break even estimate to that college's wage distribution to determine what percent of students from each particular school earn a negative return on their investment in higher education. This *NegativeReturnPercent* will be our primary measure of the aggregate performance of each college.

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students are choosing to go to college. Hence, the conservative assumptions in our paper will bias the results towards finding a positive value in further education.

<sup>5</sup>We model the total lifetime earnings as a growing annuity using the annual wage growth rate between Earnings (6-Years) and Earnings (10-Years) in order to estimate the early career wage growth. The Quarterly Census of Employment and Wages is then used to estimate later career wage growth.

### 3.3 Results

Overall, we find that approximately 32% of students will fall below their school's break even threshold. This translates to approximately 5 million students currently in college who are likely to realize a negative return on their investment in higher education. While well more than half of students will be better off having attended college, a surprisingly high proportion of students will realize a negative financial return.

[Insert Table 3 Here]

Only 5% of students are enrolled in schools where over half of the students will realize a negative return. Nearly twice that number are enrolled in schools where fewer than 20% of students realize a negative return. The bulk of students, however, seem to be concentrated in schools where approximately a third of students realize a negative return. When we look at what type of schools have a high *NegativeReturnRate* value, we find clear differences.

[Insert Table 4 Here]

As schools become more selective, the percent of students realizing a negative return on their investment declines dramatically. While this result may not be surprising, we should caution that our estimate of the opportunity cost was made at a state level. If students attending more selective institutions had higher outside options, then our *NegativeReturnRate* variable would be biased downward. Also, note that within each classification category the for-profit schools tend to perform worse than their public or non-profit counterparts (as only 3 for-profits were classified as selective or most selective, we cannot draw conclusions regarding selective or most selective for-profits). Even within the public and non-profits, however, a high number of students will still realize a negative return from their education.

[Insert Figure 1 Here]

In figure 1 we estimate the empirical PDF of our outcome measure *NegativeReturnPercent*. We also break out the empirical PDF by ownership type (public, private non-profit, and private for-profit). We find that there are substantial differences in the outcomes between different ownership structures. On average for-profits exhibit much worse outcomes than either public colleges or non-profits. The average *NegativeReturnRate* for private for-profits is over 44% indicating that nearly half of all for-profit students will realize a negative return from their education. In contrast, for public schools the mean *NegativeReturnRate* value is 32%; private non-profits are even lower with a mean *NegativeReturnRate* of only 26%.

As over two-thirds of students are enrolled in public schools, when we weight our results for school size the overall empirical PDF closely matches the public school PDF. The for-profits schools also appear marginally better when we weight for school size. It appears that some of the very worst performing schools are very small. Even when we exclude the smallest schools, however, for-profit colleges have significantly higher *NegativeReturnRate* values than either the public or non-profit colleges.

[Insert Table 5 Here]

In table 5, we consider various school level variables that might, plausibly predict *NegativeReturnRate*. We conduct a multivariate regression of various school characteristics on *NegativeReturnRate*. The first set of characteristics look at school type (public vs. private and whether the school awards four-year degrees). The second set looks at student characteristics (e.g. percent in STEM fields, log of family income, percent first generation, etc.). The final set of predictors looks at admissions criteria (SAT scores and admission rates).

In most cases our coefficients appear, at least intuitively, directionally correct and highly significant. For example, an increase of 1 standard deviation in  $\text{Log}(\text{Income})$  corresponds to a 5 point decrease in the school's *NegativeReturnRate*. Similarly, a 1 standard deviation increase in the percent of first generation students predicts a 1 percent increase in *NegativeReturnRate*.

Our findings suggest that approximately a third of students would have been better off if they had foregone college. With so many students, in the aggregate, worse off, the question becomes what drives these negative returns. Part of the answer is that most for-profit colleges perform significantly worse than their public peers. Even if all for-profits were to shutdown, however, over 30% of students would realize a negative return. Our results suggest that a select number of poor performing schools is not the sole explanation for negative returns. Instead, there might be something about the choices students are making that is driving many students to appear worse off after attending college.

## 4 Laissez-Fiare Benchmark

To help rationalize our evidence that a substantial number of students are realizing a negative return on their investment in college education, we consider a model of informed lending where lenders can observe borrowers' repayment probabilities better than the borrowers themselves. In and of itself, informed lending cannot rationalize the large number of negative

NPV investments we observe, when we introduce a social planner who mandates a constant interest rate across all borrowers some borrowers will be induced to accept a loan with a negative expected value.

In this section, we introduce the laissez-faire benchmark case where the government does not intervene in the credit market. Although much of the analysis in the benchmark case is standard, it will help provide intuition for why interest rate pooling can lead to adverse credit market outcomes.

## 4.1 The Model

A single borrower wants to finance a risky project. Multiple competitive and identical lenders exist who are willing to provide the necessary financing. Time is discrete with two periods:  $t \in \{0, 1\}$ . For simplicity, we will assume that all agents are risk-neutral and do not discount between periods. Neither of these assumptions have a qualitative impact on our results.

### 4.1.1 The Borrower

At  $t = 0$ , the borrower is faced with a potential risky investment opportunity, defined by its quality  $\theta$ , with a non-zero upfront investment cost. Project output is distributed according to  $F(w|\theta)$  with support over the interval  $[0, \bar{w}]$  where  $0 < \bar{w} \leq \infty$ . Without loss, let  $\theta \sim U(0, 1)$ . We make the following assumptions on  $F(\cdot|\theta)$ :

**Assumption 1.**  $F(\cdot|\theta)$  displays strict first-order stochastic dominance in  $\theta$

**Assumption 2.** The partial derivative  $f_\theta(w|\theta)$  exists and is continuous in  $\theta$

The first assumption ensures that  $\theta$  is a valid measure of project quality as agents with higher  $\theta$ 's will always generate a higher expected profit regardless of the interest rate charged. The second assumption is purely technical.

The payoff of any project is verifiable, and lenders can enforce repayment upto the project's total output.

Although the project's expected payoff is governed by  $\theta$ , the borrower is unable to observe her individual type,  $\theta$ . This is in contrast to traditional lending models where the borrower is privately informed. The distribution of types and  $F(w|\theta)$  is common knowledge.

The borrower has a reservation wage given by  $c > 0$ . The loan contract is a standard one period loan, with a required gross repayment  $R$  at  $t = 1$ . If a loan  $R$  is accepted by a

borrower of type  $\theta$ , the borrower's net expected payoff is given by,

$$V_B(R; \theta) = \int_R^{\bar{w}} (w - R) dF(w|\theta) - c. \quad (1)$$

In addition to the cash flow generated by the project, projects will also generate an externality  $e \geq 0$ . For example, successfully graduating from college can reduce the likelihood that a student will require future government assistance (e.g. unemployment benefits), which is costly to society at-large.

#### 4.1.2 Lenders

Multiple identical, competitive lenders exist in the market with the ability to extend the necessary credit to the borrower. All lenders are able to perfectly observe the borrower's type at  $t = 0$ . The lenders can then use this information to set the loan's interest rate. The ability of lenders to observe the borrower's type is common knowledge. Knowing that lenders observe her type, a borrower can use the offered contract to try to infer her type. After observing  $\theta$ , all lenders simultaneously choose whether to offer a loan to the borrower and if so the contract,  $R$ , to offer.

In order to provide the loan to the borrower, the chosen lender must pay a cost, which we will normalize to 1. The cost includes both the cost of funds to provide the necessary investment capital as well as any servicing and origination costs associated with the loan. This cost is paid regardless of whether the borrower repays the loan. For simplicity, we will assume that the loan cost is paid at  $t = 1$ . Although in the real world, much of this lending cost would likely be borne at the time of loan origination, the cost 1 could just represent the total cost of the loan, compounded at the lender's cost of capital.

We will also assume that the possible payoffs of the project is such that the lending and borrowing decisions are non-trivial from the lender and borrower's perspectives:

**Assumption 3.** *There exists some valuable projects: There exists  $\theta \in (0, 1)$  such that  $\mathbb{E}_w[w|\theta] = 1 + c$*

**Assumption 4.** *There exists some projects that will surely be useless:  $P(w < 1|\theta = 0) = 1$*

**Assumption 5.**  $\mathbb{E}[w|\theta] < \infty \forall \theta$

These assumptions guarantee that the information asymmetry problem matters to our agents. Under the first-best, we will have both loans accepted and rejected. Finally, assumption 5

is a standard technical assumption that the expected value of any loan is finite regardless of the borrower’s type.

If the borrower accepts the lender’s offer of  $R$ , the expected payoff to the lender is given by,

$$V_L(R; \theta) = \int_0^R w dF(w|\theta) + R[1 - F(R|\theta)] - 1. \quad (2)$$

[Insert Figure 2 Here]

## 4.2 Equilibrium Construction

As only lenders observe the borrower’s type, the borrower is at an information disadvantage compared to the lenders. Since, the borrower’s type affects the lenders’ expected profit, the loan offer,  $R$ , will be a function of  $\theta$ . Thus, the borrower is able to use  $R$  in order to rationally infer her strength. This inference will then determine whether the loan offer is accepted.

We will use a perfect Bayesian equilibrium concept with the minor refinement that the borrower must exhibit monotonicity of beliefs.

**Definition 1.** *A borrower is said to exhibit **monotonic beliefs** if for any  $R'_i < R_i$  sent by lender  $i$ , the borrower’s expected type conditional on  $R'_i$  is (weakly) higher than the expected type conditional on  $R_i$ :  $\mathbb{E}[\theta|(R'_i, R_{-i})] \geq \mathbb{E}[\theta|(R_i, R_{-i})] \forall R'_i < R_i$ .*

The imposition of monotonic beliefs is both minor and intuitive. Without monotonic beliefs, a great number of pooling equilibria could be constructed. These equilibrium, however, would have the unnatural property that upon observing a low, but off-equilibrium, interest rate the borrower assumes she must have a very poor repayment probability. Intuitively, interest rates should be at least non-increasing in the probability a loan is repaid.

We will now establish several standard but useful facts regarding the lending equilibrium. Since all the lenders have the same information set and move simultaneously, it must be that for any given borrower type,  $\theta$ , the lenders must, in expectation, make zero profit.

**Lemma 1.** *For any type  $\theta$ , all lenders must, in expectation, make zero profit.*

Since all lenders act the same, throughout the remainder of the paper we will refer to “the lender” bearing in mind that the lender is constrained to make zero profit by the presence of other potential lenders who could skim some types if the lender made a strictly positive profit.

**Proposition 1.** *There exists a threshold  $\underline{\theta} \in (0, 1)$  such that only types  $\theta \geq \underline{\theta}$  receive a loan offer.*

Since some projects will surely fail to even cover the lender's cost, these projects will never be funded. If no loan is offered, the borrower has no choice to make. Hence, we can restrict our attention to the interval of borrower types  $[\underline{\theta}, 1]$  as only these borrowers will even be able to accept a loan.

For projects with types above  $\underline{\theta}$ , the lender will be willing to extend credit at some interest rate. To find this break-even interest rate, we can set the lender's expected profit, equation (4.1.2), to zero and determine the equilibrium loan contract.

**Lemma 2.**  *$R(\theta)$  is a strictly decreasing function*

Since the probability of low output is lower when the lender faces higher types, the lender is able to offer lower interest rates to these types. As  $R(\theta)$  is strictly monotonic,  $R(\theta)$  must be an invertible function. In the laissez-faire environment, interest rates provide enough information for an uninformed borrower to perfectly infer her type.

As  $R(\theta)$  is a decreasing function in  $\theta$ , lower interest rates correspond to higher repayment probabilities. In this environment, low interest rates are good for the borrower for two reasons. One, lower interest rates mean the borrower can keep more of the project's surplus. Two, lower interest rates imply that the borrower is "stronger." Since a high  $\theta$  means the borrower is more likely to generate a positive surplus, the borrower is better off with high  $\theta$  values. Since both these effects move in the same direction, the borrower's expected utility will be strictly decreasing in  $R$ .

**Lemma 3.** *The borrower's expected utility is strictly decreasing in  $R$ .*

Since the borrower's expected utility is strictly decreasing in  $R$ , she can use a cutoff rule to determine whether or not to accept a loan, accepting only those loans where the interest rate is at or below the cutoff. To find the cutoff, the borrower need only set her expected utility to zero and solve for  $R$ .

**Proposition 2.** *In equilibrium, there exists some  $\hat{R}$  such that the borrower will accept the loan offer if and only if  $R \geq \hat{R}$*

**Corollary 1.** *There exists  $\hat{\theta} > 0$  such that the borrower accepts the loan if and only if  $\theta \geq \hat{\theta}$*

Although the borrower doesn't directly observe her type, only types above  $\hat{\theta}$  will receive an offer that is sufficient to induce lending. In equilibrium, three regions will exist which determine the observed behavior:

1. If  $\theta < \underline{\theta}$ , then no loan will be offered.
2. If  $\underline{\theta} \leq \theta < \hat{\theta}$ , the lender will offer a loan,  $R(\theta)$ , but that offer will be rejected.
3. If  $\hat{\theta} \leq \theta$ , then the lender will offer loan  $R(\theta)$ , and the borrower will accept that offer.

[Insert Figure 3 Here]

Although the borrower is uninformed, the lenders' equilibrium behavior reveals the borrower's type. Thus, the information disadvantage has no adverse consequences in the benchmark model. All privately beneficial projects will be undertaken, and no project that has a negative expected, private value will receive investment dollars.

In the laissez-faire benchmark, equilibrium behavior does not depend on a project's externality. Hence, some projects that are socially beneficial might not be funded. So long as some subset of projects generate an externality, the laissez-faire environment will generate a socially inefficient level of lending.

**Proposition 3.** *Assume that  $e > 0$ . Then some projects with a positive social value will be rejected.*

The existence of positive externalities, however, results in a socially sub-optimal level of lending. Some projects that are socially beneficial aren't undertaken as neither the borrower nor the lenders adjust their behavior to account for externalities. Even though, the laissez-faire environment is good in the sense that projects will be undertaken if and only if the private value is positive, society suffers since some projects that generated positive externalities are foregone.

## 5 The Intervention

In the previous section, we showed that in the laissez-faire benchmark some projects with a positive social value will be foregone. We now introduce a social planner who can intervene in the credit market encouraging a greater level of lending than may prevail in the private market. We assume that the social planner has a technology that allows for intervention in two ways:

1. The social planner may introduce loan subsidies or credit guarantees,  $s$ , that compensate the lender in cases where the borrower defaults. We also allow the social planner to

impose additional costs on the lender if the borrower defaults <sup>6</sup>. Hence, the guarantee need not be positive.

2. The social planner can restrict the interest rate that lenders can charge for a given loan so that all borrowers must receive the same interest rate. Although we allow for the government to fix an interest rate for all loans, the government cannot compel lenders to issue any loans at that interest rate.

In this section we will consider the two different policies the social planner can use. First, the social planner can simply provide credit guarantees, while allowing the lenders to set the interest rate. Second, the social planner will engage in a policy of mandating a constant interest rate for all offered loans. For now, we will let the form of the intervention be exogenous. In section 7, we will endogenize the social planner's choice of the optimal guarantee program.

These tools see much use in various government policies. Many programs exist that cover lenders in case of default such as student loans, FHA loans, and SBA loans. Further, some programs, most notably student loans, require that all borrowers in a given cohort receive the exact same interest rate.

In setting the optimal social policy, we assume that the social planner cannot observe  $\theta$ , the borrower's strength. To motivate this assumption, consider that lenders' long-term survival depends on their ability to assess and screen potential borrowers; they will need to invest in superior models and data in order to analyze the chances of success of a given project. The government, however, does not depend on assessing individual investments to prosper; hence a social planner would have little incentive to invest in the costly capabilities necessary to evaluate the exact riskiness of inherently risky projects.

Since the planner cannot observe  $\theta$ , the guarantees must be constant for all borrowers. Let  $s$  be the guarantee rate that the government provides. The guarantee will cover any  $s\%$  of the losses incurred by the lender. A guarantee payment will only be made if the project fails to produce an output of at least 1. Figure 5 plots the lender's actual profit and the guarantee paid out as a function of  $w$ .

[Insert Figure 5 Here]

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<sup>6</sup>For example, if too many borrowers default the government may restrict a given lender's ability to access the program

We will assume that the social planner can always perfectly observe ex-post the project's output implying that the guarantee is paid out if and only if the project fails to cover the lender's cost.

A positive guarantee, when it is paid out, represents a transfer from the social planner to the lender. This changes the lenders' expected profits to,

$$V_L(R, s; \theta) = \int_0^1 s(1 - w)dF(w|\theta) + \int_0^R wdF(w|\theta) + R[1 - F(R|\theta)]. \quad (3)$$

The subsidy has the effect of decreasing potential losses in cases of default reducing the lenders' downside risk. Reducing the lenders' risk should increase their willingness to extend credit to weaker agents.

If the subsidy were too large, however, the social planner could destroy any incentive for the lenders to engage in screening of credit applicants. Suppose the social planner set a credit guarantee such that  $s > 1$ . In this case for the zero-profit condition to hold, competitive lenders would have to set negative interest rates. This would make lenders strictly prefer the case where borrower's default. Such a scenario would create moral hazard problems with lenders encouraging borrowers to default. Further if the subsidy was more than enough to cover losses should the borrower default, no lender would invest in screening capabilities as it would be profitable to finance projects that are certain to fail. To prevent this, we will impose the condition that credit guarantees can't be "too" large to completely subvert the lenders' incentives to engage in screening and provide credit to stronger borrowers.

**Assumption 6.** *No credit guarantees are larger than the lenders' costs:  $s < 1$*

This is a relatively mild restriction as it doesn't prevent the government from providing very large credit guarantees. It also prevents a severe moral hazard problem where the lenders purposely give loans to borrowers with no chance of repayment in order to receive the high guarantee payment when the borrower defaults, thereby making a positive profit.

While credit guarantees change the lenders' downside risk, from the borrower's perspective, her utility does not change directly by the introduction of credit guarantees. Any impact on the borrower must enter through the interest rate channel. Since borrowers prefer lower interest rates, borrowers should benefit from the lower interest rates induced by positive credit guarantees.

We will now proceed to consider the two forms of intervention we discussed earlier: varying interest rates and fixed interest rates.

## 5.1 Varying Interest Rates

As in the laissez-faire benchmark, the lender must make zero profit on each borrower type. Using the lender's zero profit condition, we can set (5) to zero to find the equilibrium interest rate that must be offered, if any, for each borrower type.

Since larger subsidies reduce the lender's potential losses, the lender is willing to both extend credit to weaker borrowers as well as lower the interest rate for each borrower relative to the benchmark case.

**Lemma 4.** *Both the threshold type  $\underline{\theta}_s$  and the interest rate,  $R$ , are strictly decreasing functions of  $s$*

With the introduction of credit guarantees, the lender's offer will be a function of both  $\theta$  and  $s$ . Since  $s$  is constant across all borrowers, however, an individual borrower will still be able to infer her type as  $R$  will still be a strictly monotonic function of  $\theta$ .

**Lemma 5.**  *$R(\theta, s)$  is a strictly decreasing function of  $\theta$ .*

While guarantees will change interest rates, they have limited impact on the underlying mechanics of how the borrower evaluates potential loans when compared to the benchmark case. At each level of subsidization, there will exist a cutoff type such that only those borrowers at or above the cutoff will accept the loan offer.

**Proposition 4.** *There exists a borrower threshold,  $\theta^* \in (\underline{\theta}_s, 1)$  such that only borrowers at or above the threshold type will accept the loan. Further, a loan will be accepted if and only if it's privately beneficial to the borrower*

In the varying interest rate environment the only market distortions are distortions in the interest rate and not in the information borrowers receive. The intervention does not cause the borrower to face any added uncertainty even though initially the borrower was at an information disadvantage. The borrower knows her strength and will only take out a loan that is privately valuable,  $V_B(R; \theta) \geq 0$ .

## 5.2 Fixed Interest Rates

We now turn our attention to a program where the social planner imposes a fixed interest rate on all loans. Lenders can choose whether or not to offer a loan, but if they do they are required to offer the externally imposed rate. To help encourage lending, the social planner will continue to offer credit guarantees as before. In this case we can characterize the social

planner's decision as an ordered pair  $(R, s)$  that specifies the mandated interest rate and the guarantee rate.

Unlike in the case of varying interest rates, the lenders know only have one decision to make: whether to offer a loan at interest rate  $R$ . Even though the actions the lenders can take have been substantially reduced, a mandated interest rate does not alter the lenders' profit function. The value of an individual loan will still be given by (5).

Individual rationality dictates that no lender will offer a loan with a negative expected profit. As the lenders' profit function is strictly increasing in the borrower's repayment probability, the lenders will want to use a cutoff rule to determine whether a borrower is offered a loan.

Let  $\tilde{\theta}$  be the lender's cutoff types. As the lender will want to offer a loan if and only if their expected profit is non-negative, we can set (5) to zero to solve for the cutoff type. This cutoff type will create an interval  $\tilde{\Theta} = [\tilde{\theta}, 1]$ , such that the borrower is offered a loan, at rate  $R$ , if and only if the borrower's type is in  $\tilde{\Theta}$ .

[Insert Figure 6 Here]

In the fixed interest rate environment, the offered interest rate will convey little information to the borrower. Either the borrower will receive an offer of  $R$ , or she will not be offered a loan. If the borrower doesn't get a loan, the game ends. If, however, the borrower gets a loan then the borrower must choose whether to accept the loan.

As the guarantee is public knowledge, a rational borrower will be able to calculate the lenders' cutoff types,  $\tilde{\theta}$ . Using this information, she can calculate her expected type conditional on receiving a loan offer:

$$\mathbb{E}[\theta | \text{Offered Loan}] = \mathbb{E}[\theta | \theta \geq \tilde{\theta}]. \quad (4)$$

Knowing her expected type conditional on receiving the loan offer, the borrower can then determine whether or not in expectation to take the loan. Using (5.2), the borrower can calculate whether the expected NPV of her loan is non-negative. Since a loan offer carries the same information to every borrower offered a loan, either all borrowers will accept the loan or all borrowers will reject the loan.

**Proposition 5.** *If the government institutes a fixed interest rate policy conditional on being offered a loan, either all borrowers will accept the loan or all borrowers will reject the loan.*

With fixed interest rates less learning occurs; the borrower only knows that her type falls among a (potentially) large continuum of types. This lack of learning presents the possibility that borrowers who are actually quite weak will accept a loan because they are unable to

infer their true probability of success. Although fixed interest rates reduce price inequality, the fixed interest scheme prevents weaker borrowers from learning their true strength. Such a program will be costly for the weakest borrowers.

## 6 Welfare Implications

In the previous section, we considered how lenders and borrowers react to different credit guarantee schemes: varying interest rates with guarantees and fixed interest rates with guarantees. When interest rates are fixed, however, borrowers suffer an information disadvantage. This disadvantage may induce borrowers to take out a loan with a negative private value.

### 6.1 Predatory Lending

In the case of varying interest rates, no predatory lending can occur. The borrower is able to perfectly infer the probability of success. Knowing exactly the probability that she will repay the loan, the borrower will only accept the loan if the value of the loan is non-negative. Without the lenders maintaining some information advantage over the borrower, no predatory lending can occur.

Whenever a pooling equilibrium is mandated (i.e. with fixed interest rates), some borrowers may accept a predatory loan. The lender knows that negative NPV loans are being offered but has no incentive to alert the borrower to these predatory loans as the lender is not losing money on any loan they offer.

Suppose the social planner fixes the interest rate and guarantees such that the borrower's individual rationality condition holds with equality (i.e.  $\mathbb{E}[V_B|\text{Offered Loan}] = 0$ ). A continuum of types, all with different true values from the loan, will pool at the singular interest rate. Then for at least some of the pooled types, the loan value must be negative.

**Proposition 6.** *Assume the social planner uses a fixed interest scheme. If the social planner sets the interest rate such that the borrower is indifferent between accepting and rejecting the loan, then some borrowers will accept a predatory loan.*

In contrast to the varying interest rate environment, when interest rates are fixed some borrowers may be worse off as a result of the intervention. Fixed interest rates inhibit a borrower's ability to learn her true type. Even though in expectation the borrower may not

worse off, there will exist some borrowers who actually are made worse off by using a fixed interest rate scheme.

[Insert Figure 4 Here]

As can be seen from figure 4, under reasonable conditions, a significant percentage of potential borrowers will accept a predatory loan. In a full information environment (i.e. revealed subsidies with varying interest rates), no borrower with a negative utility would have accepted such loans. Fixed interest rates, however, results in a significant number of borrowers with bad loans.

Although fixed interest rates might induce a socially optimal level of lending, from the borrower's perspective too much credit is available. Borrowers know that on average they won't be worse off from the loan, but the weakest borrowers are worse off; they are able to get a loan even though such weak borrowers would have been better off if the lenders had rejected their applications. Without the government's intervention these borrowers would have had their applications rejected. It is only because of the intervention that they are able to get a predatory loan at all.

## 6.2 Surplus Transfer from Borrowers to Lenders

The predatory lending behavior is not the only way in which a fixed interest rate scheme may harm borrowers. When the social planner mandates fixed interest rates, borrowers are harmed in a second way; a fixed interest rate policy results in a transfer of surplus from borrowers to lenders. At the cutoff types, the lenders break even on the loan. For any borrower above the threshold types, lenders will make a strictly positive profit. When interest rates are allowed to vary this was not the case. Competition forced the interest rate down to a break even level for each type,  $\theta$ . In the competitive environment borrowers were able to capture the full surplus of their project. Now, lenders may capture some of the private surplus generated by the project.

**Proposition 7.** *With a fixed interest rate scheme, the lenders make a strictly positive profit on all borrowers (other than the threshold borrower).*

Fixed interest rates prevent lenders from competing with each other. Removing competition results in a transfer from the borrower to the lender. Under some conditions a fixed interest rates scheme may be socially beneficial. Borrowers, however, are not the beneficiaries of these policies. The best borrowers no longer get better interest rates.

Holding the social planner's guarantees constant, mandating fixed interest rates will hurt borrowers. Under a variable interest rate scheme, some borrowers would get lower interest rates to reflect their lower risk. Fixing interest rates, however, means that a borrower is no longer able to leverage competition between the lenders to increase her share of the project's surplus.

Even though the borrower is made worse off with a fixed interest rate scheme, the lenders have no incentive to encourage the implementation of a different policy. Without the government's intervention competition forces profits down to zero. A mandate that a fixed interest rate must be used, however, results in positive profits; no lender will ever want to return to the laissez-faire environment where he earned zero profits.

The fixed interest rate scheme may be good for lenders, but such a policy comes at a cost to borrower welfare. All borrowers who receive a loan would have been better off if rates had been allowed to vary across borrowers based on their repayment probability.

[Insert Figure 7 here]

This surprising result shows that when the government tries to induce a socially optimal level of lending by offering credit guarantees and fixing interest rates, the agents the government appears to help (i.e. weak borrowers) may have been better off with a more limited or different form of intervention. Fixed interest rates provide lenders an opportunity to profit off of borrowers. Further, they exacerbate information disadvantages, that can reduce borrower welfare. If borrowers knew as much as the lenders, they could have avoided the predatory loan and a transfer of project surplus from borrowers to lenders.

## 7 Optimal Guarantee Programs

If fixed interest rate schemes have the potential to induce negative borrower outcomes, some other factor must be at play that encourages a social planner to construct a program in such a manner. In this section, we will consider the relative costs of the different credit guarantee programs the social planner may institute showing that the fixed interest rate scheme costs less to implement. When the social planner's cost of funds is high, the social planner will want to institute a fixed interest rate scheme even though it results in predatory lending.

## 7.1 Social Planner's Problem

From the borrower's and lenders' perspective the government's guarantees represent an exogenous infusion of cash into the credit market. The social planner, however, will have to raise the costly funds necessary to provide such subsidies. Let  $\alpha > 0$  be the social planner's cost of funds to provide the credit guarantee.  $\alpha$  could represent the government's borrowing costs or the distortionary impact of taxes. Alternatively,  $\alpha$  can be viewed as the Pareto weighting the social planner places on taxpayers versus the private credit market.

The social planner's objective is to maximize the total expected utility that will occur in the credit market. The planner's expected value, for an accepted loan is given by

$$V_{SP}(R, s; \theta) = \underbrace{V_B(R; \theta) + V_L(R, s; \theta)}_{\text{Private Loan Value}} + \underbrace{e}_{\text{Externality Value}} - \alpha \underbrace{\int_0^1 s(1-w)dF(w|\theta)}_{\text{Guarantee Cost}}. \quad (5)$$

If the loan is rejected, we assume the social planner's utility is simply zero. The first two terms of (7.1) represent the value of the project to the borrower and the lender respectively. The third term captures the expected externality generated by the project (i.e. the reason for the intervention)<sup>7</sup>. The final term represents the social cost of the externality to the planner.

Using the definitions of  $V_B$  and  $V_L$  we can simplify (7.1) to

$$V_{SP}(R, s; \theta) = \underbrace{\mathbb{E}[w|\theta] + e}_{\text{Expected Social Value}} - \underbrace{\left[1 + c + (\alpha - 1) \int_0^1 s(1-w)dF(w|\theta)\right]}_{\text{Expected Social Cost}}. \quad (6)$$

The first term of (7.1) is the expected social value of the risky investment should it succeed. The remaining terms captures the expected social cost of the investment, both the lender's and the borrower's private cost as well as the net cost of any credit guarantees that may be paid out.

The social planner's objective is to set the guarantees in such a way as to maximize total social welfare. In addition the social planner is able to choose which type of guarantee scheme to implement: varying interest rates or fixed interest rates.

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<sup>7</sup>Note that we've implicitly assumed without loss that the externality is valued from the social planner's perspective.

## 7.2 Varying vs. Fixed Interest Rates

With varying interest rates, the subsidy must be set in such a way that the borrower is indifferent between accepting and rejecting the loan at the desired threshold<sup>8</sup>. Given that some projects, however, will never produce a positive profit for the lender, even with very high subsidies it is impossible to encourage some borrowers to accept a loan. The subsidy rate would have to be excessively high (greater than 1) in order to induce lending.

**Lemma 6.** *There exists a  $\underline{\theta} \in (0, 1)$  such that no borrower at least as weak as  $\underline{\theta}$  will ever accept a loan.*

Not all borrowers could ever be encouraged to accept or even be offered a loan; however, over the types that may receive a loan offer there exists a unique subsidy rate for each type that makes it the threshold type. Recall from lemma 4, that  $\frac{d\theta_s}{ds}$  is a strictly monotonic function implying that each subsidy rate induces a unique threshold type. Therefore, rather than thinking in terms of setting the optimal subsidy rate, we can work in terms of the optimal threshold borrower.

A similar principle works in the case of a fixed interest rate environment. Here, the social planner must ensure that two conditions are met. First, that the lender is indifferent between offering the loan to the threshold type; second, that the borrower's IR constraint is not violated.

With fixed interest rates, the planner should have greater flexibility in inducing borrowing. When interest rates were allowed to vary the borrower always knew her type. Under fixed rates, however, the borrower can only estimate her expected type. If the planner is able to set type  $\theta$  as a threshold type in the varying interest rate environment, the planner will also be able to set  $\theta$  as the threshold type in the fixed rate environment.

**Proposition 8.** *Suppose the social planner wants to set threshold rate  $\theta \in (\underline{\theta}, 1)$ . Then  $\theta$  will be a possible threshold rate under both the varying and fixed interest rate scheme.*

When constructing a fixed interest rate program, the social planner can adjust both interest rates and subsidy amounts. The subsidy amount, however, has no direct impact on the borrower's utility. The only determinants of borrower utility are the threshold type and the interest rate.

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<sup>8</sup>With varying interest rates, the lender will always lend at a borrower threshold, since the lender can always charge a higher interest rate,  $\bar{w}$ , then would be accepted by any borrower.

**Lemma 7.** *Suppose the social planner wants to implement a fixed interest rate scheme. If the interest rate is held constant, for all implementable thresholds at that interest rate, there exists a one-to-one mapping from thresholds to subsidies.*

Since there is a one-to-one mapping from subsidies to threshold types with fixed rates as well, we can also think in terms of setting the optimal threshold type rather than the optimal subsidy rate with a fixed interest rate scheme as well.

In terms of interest rates, when guarantees a relatively expensive (i.e.  $\alpha > 1$ ), the social planner will want to minimize the subsidy payments. Holding fixed the desired threshold type, subsidies can go down only if we increase the interest rate. The interest rate can be arbitrarily increased so long as the borrower's IR constraint is not violated.

**Proposition 9.** *If  $\alpha > 1$ , under a fixed interest rate scheme, the borrower's IR constraint will hold with equality.*

For a given threshold type, proposition 9 gives us what the necessary interest rate must be when  $\alpha > 1$ . From there, we can simply find the necessary subsidy rate that is required to induce the proper threshold types. As we now know how to set the interest rate under a fixed rate scheme, we can directly compare the costs of a varying and fixed interest rate scheme.

**Proposition 10.** *When  $\alpha > 1$ , it is always socially optimal to use a fixed interest rate scheme where the borrower's IR constraint holds with equality.*

With fixed interest rates a large continuum of borrowers are all pooled together with the borrower's IR constraint strictly binding. Here, the borrower can only estimate her repayment probability. If interest rates are risk-based, however, then only for the threshold borrower is the IR constraint strictly binding. Therefore holding the threshold types constant, the pool of borrowers must, on average, be stronger when using a fixed interest rate scheme than using a variable interest rate scheme.

[Insert Figure 8 Here]

Since the borrower's utility is increasing in her repayment probability, a higher interest rate can be used and still induce the marginal borrower to accept the loan as a result of the increased pooling. Hence, the government can provide smaller guarantees while still inducing the same level of borrowing as under a varying interest rate policy. By restricting the ability of a borrower to learn from her interest rate, the social planner is able to lower the lending program's costs. The most efficient way to restrict the borrower's information set is to force all acceptable borrowers to pool at the same interest rate.

Pooling all borrowers at the same interest rate will substantially reduce the cost of the loan guarantees. These reduced costs, however, come at a social price. When borrowers are unable to learn from their loan offer some borrowers wind up accepting a predatory loan. In spite of these negative borrower outcomes, when the social planner’s cost of funds is high inducing predatory lending is still the socially optimal way to intervene.

## 8 Public Information

In the previous sections, we assumed that the borrower had no information as to her true type. In practice, however, even if the lender has better information it is reasonable to assume that borrowers might have some information. For example, when a student applies to college students do observe their past results (e.g. GPA, test scores, etc.) and are not completely uninformed.

In this section we will extend the model to allow for a public information component, which we will call “ability,” which borrowers can use to help evaluate their offer. As before we will assume that lenders can still precisely observe the borrower’s type,  $\theta$ . Although lenders are unlikely to know exactly the borrower’s strength, without loss we can think of  $F(\cdot|\theta)$  as the best available estimate of a project’s potential payoffs. So long as  $F(\cdot|\theta)$  accounts for all the information available to the borrower, then .

### 8.1 Setup

Without loss assume that a publicly observable variable  $a \in [0, 1]$  exists. Higher  $a$ ’s will correspond to higher ability levels (i.e. we’d expect that as  $a \rightarrow 1$ , that the borrower’s expected outcomes should be better). Without loss let  $a \sim U[0, 1]$ . As before, the lender will perfectly observe  $\theta$ . Unlike in our base model, however, we assume that  $a$  provides some information about  $\theta$ . In particular, there will exist a mapping from ability,  $a$ , to a distribution over the type space:  $G(\theta|a)$ . To make  $a$  a valid measure of the borrower’s ability we place the following restriction on  $G(\cdot|a)$  :

**Assumption 7.** *The distribution of borrower types conditional on a  $G(\cdot|a)$  has the following properties:*

1.  $G(\cdot|a)$  has the MLRP in  $a$ .
2.  $\forall a$ ,  $G(\cdot|a)$  has full support on the interval  $[0, 1]$

3.  $g_a(\cdot|a)$  exists  $\forall a$  almost everywhere.

The first assumption is the standard assumption that  $a$  is a valid measure of borrower behavior. The second and third assumptions are both technical assumptions on the properties of  $G(\cdot|a)$ .

Unlike in the base model, where the borrower's decision could only be a function of the lender's interest rate and whether a loan was offered, the borrower can now also condition her decision on  $a$ . Even if some borrowers might accept or reject a loan at some interest rate, now some borrowers may accept and others would reject. Conditional on  $\theta$ , however, the borrower's value function is unchanged.

From the lender's perspective  $a$  is irrelevant, the lender's will want to offer a loan if and only if  $V_L \geq 0$ . Since the lender's already observe  $\theta$  the introduction of  $a$  provides no additional information. Hence, lender's will still offer loans so they break-even at each type (in the case of varying interest rates) or so they break-even on the threshold type (in the case of fixed interest rates).

## 8.2 Changes in Behavior

When interest rates were allowed to vary, the borrower was able to perfectly infer her type after observing  $R$ , even if she had *no* information ex-ante. With the introduction of public information, the borrower knows her type is distributed according to  $G(\theta|a)$ . Since her final value is only a function of  $\theta$  and  $R$ . If the borrower is able to infer  $\theta$  and observes  $R$  directly, her behavior won't change in the case of varying interest rates.

**Lemma 8.** *Suppose a varying interest rate scheme is used. Allowing the borrower to observe her ability  $a$  will not change either the borrower's or the lender's behavior.*

With varying interest rates the borrower already had all the information she needs to make a fully informed decision. With fixed interest rates, however, the borrower still faced an information disadvantage. The lender will still offer loans to any borrower at the fixed interest rate as long as  $V_L \geq 0$ . The borrower now knows two things: first, that she faces a distribution of types  $G(\theta|a)$  and that  $\theta \geq \theta'$ . Define  $V'_B(a)$  as the borrower's expected utility conditional on being offered a loan in the fixed rate environment:

$$V'_B(a) = \int_{\theta'}^1 V_B(R; \theta) \frac{g(\theta|a)}{1 - G(\theta'|a)} d\theta. \quad (7)$$

Borrowers know that the threshold type who is offered a loan might have a negative NPV loan; borrowers who place a high probability on being a weak type near the threshold will be unlikely to accept the loan. In contrast, high ability borrowers will place a low weight on being a weak type and may be willing to accept a loan. The introduction of the ability parameter can result in only some borrowers accepting the lender's offer. Depending on the borrower's expectations at the extreme values for  $a$  we can get 3 possible equilibria:

1. If  $V'_B(0) \geq 0$  then all borrowers offered a loan will accept the loan
2. If  $V'_B(1) < 0$ , then no borrowers will accept a loan regardless of whether or not a loan offer is made
3. If  $V'_B(0) < 0 \leq V'_B(1)$ , then there exists  $\tilde{a} \in (0, 1]$  such that a borrower accepts the loan if and only if her ability  $a \geq \tilde{a}$

If  $V'_B(0)$  is non-negative, then regardless of the borrower's beliefs on her ability, getting offered a loan provides enough information to the borrower that she is strong enough. In contrast if  $V'_B(1)$  is negative then no borrower would ever accept the loan. Which equilibria will prevail depends on the values of  $s$  and  $R$ .

[Insert Figure 9 Here]

With the introduction of observable ability, which borrowers accept loans will depend on  $s$  and  $R$ . Figure 9 documents how changes in  $s$  and  $R$  impact both the lender's threshold and the borrowers' decision making. When  $s$  and  $R$  increases the lender extends credit to weaker types; high  $s$  values lower the lender's risk and high  $R$ 's mean the lender will receive more money whenever the borrower repays her loan fully. In contrast, high values of  $s$  and  $R$  hurt borrowers. Obviously, high  $R$ 's mean the borrower will keep less of her project's value. High  $s$  values, however, have no direct impact on borrowers. High  $s$ 's mean that weaker borrowers get credit. Thus, with high  $s$  values (holding  $R$  constant) borrowers may be more hesitant to borrow; if the threshold type,  $\tilde{\theta}$  is lower the possibility that the loan is predatory becomes higher.

**Proposition 11.** *Whenever some borrowers reject the loan and others accept, some loans will be predatory.*

Even with the introduction of a publicly observable, semi-informative variable, the possibility for predatory lending remains real. Our publicly observable variable,  $a$ , helps borrowers better estimate their true type, but the lender still has an information advantage. Without being able to completely infer her true type, the borrower won't know, with certainty, whether she is a strong type for whom the loan is valuable or a weak type for whom the loan is

predatory. Because of this potential for predatory loans some borrowers will want to avoid accepting a loan that they were offered. This behavior has implications for overall loan uptake.

[Insert Figure 10 Here]

In figure 10 we consider, the overall percent of borrowers who end up accepting a loan. Here, the overall loan uptake rate is not monotonic in either interest rates or subsidy levels. To see why this is, consider what happens when interest rates change. Two effects are occurring. First, as interest rates go up, the lender will be willing to offer weaker  $\theta$ 's a loan, since the lender's upside potential is increasing. Hence, as  $R$  increases more types get offered a loan. Second, since more  $\theta$ 's are offered a loan, borrowers become more wary of accepting a loan. Not only is the cost of repaying the loan higher, but also more low  $\theta$  types are offered a loan. Hence, as  $R$  increases only borrowers of higher ability  $a$  will be willing to accept a loan. As fewer low ability borrowers accept a loan loan uptake will decrease. At low levels of  $R$ , the first effect dominates so that increasing  $R$  actually increases overall loan uptake, whereas when  $R$  is already high increasing  $R$  even further will decrease loan uptake.

Two similar effects occur as we vary the subsidy level. As  $s$  increases more borrowers are offered a loan, since the lender's downside risk is decreasing, which increases the potential pool of borrowers who could accept a loan. A second effect occurs, however, as  $s$  increases; since weaker borrowers are offered a loan, only high ability borrowers will be willing to accept the loan since they are less likely to be the low  $\theta$  types now being offered predatory loans. Again, which effect dominates will depend on whether  $s$  is relatively high or low. At low levels of  $s$  the first effect will dominate and at high levels of  $s$  the second effect will dominate.

### 8.3 Optimal Government Policy

Before, all borrowers either accepted or rejected a loan when all borrowers pooled at the same interest rate. As all borrowers had the same information set, their behavior would naturally be identical. Now, however, some borrowers may reject a loan which is accepted by some high ability borrowers. This will have consequences for how the total expected social welfare is calculated. Let  $a'$  and  $\theta'$  be the minimum ability that accepts a loan and  $\tilde{\theta}$  the minimum type  $\theta$  that accepts a loan. Total social welfare will be given by:

$$\int_{a'}^1 \int_{\theta'}^1 V_{SP}(R, s; \theta) dG(\theta|a) d\theta$$

If the social planner chooses to allow interest rates to float then all borrowers above  $\theta'$  will accept the loan regardless of their ability. Recall lemma 8, which states that if interest rates are allowed to vary  $a$  has no impact on borrower behavior. In the varying interest rate case, the borrowers information set is dominated by the information conveyed via the interest rate channel. Hence, if the social planner chooses to use varying interest rates it must be the case that  $a' = 0$ .

When the government pools everybody at the same interest rate  $a'$  need not be 0. Whether  $a' = 0$  will depend on the marginal cost of lowering  $a'$  versus lowering  $\theta'$  to induce a greater level of lending.

**Proposition 12.** *When  $\alpha \geq 1$  it is the socially optimal policy to pool all accepted borrowers at the same interest rate.*

Even with the introduction of some publicly available information, borrowers still face an informational disadvantage as compared to lenders. The social planner can leverage this information disadvantage in order to reduce the cost of the guarantee program. With a varying rate scheme the threshold borrower knows she is relatively weak; hence, she will demand a low interest rate in order to borrow. With a fixed interest rate, however, the borrower knows that she has to be at least as strong as the threshold type. Hence, she would be willing to borrow at a higher interest rate, even if her prior places a low probability that she is strictly stronger than the threshold type. Under a fixed rate scheme, the social planner can use lower guarantees and still induce the same level of borrowing.

## 9 Conclusion

We construct a novel measure to capture the downside risk of college attendance. Although we find that on average attending college is a positive NPV investment, we find substantial downside risk. Approximately one-third of students will realize a negative return for their college attendance. This translates to 5 million students currently attending college who will be worse off after attending college. Significant variability exists in the downside risk by school type with for-profit colleges exhibiting the worst performance. Even if we exclude for-profits, however, a large swath of students would have been better off foregoing college.

To explain our results, we consider the impact that the structure of the student loan market can have on borrower behavior. Under today's student loan programs, all borrowers receive the same interest rate on their loans regardless of their ability or repayment prospects.

We also apply the concept of informed lending to the student loan market. In contrast with traditional lending models, we assume that lenders may in fact be the more informed party. Reversing the traditional information asymmetries can lead to counter intuitive results. With uninformed borrowers, an inevitable outcome of today's fully-pooling equilibrium is that some borrowers will take out a predatory loan. If risk-based pricing were the norm, rather than the exception in the origination market for student loans borrowers would know the riskiness of their investment in education. The borrowers least likely to benefit from this investment would be discouraged from taking out a loan with a negative expected value.

Instead, all students who receive a loan assume that since they are being issued a loan they must be "good enough," and the potential payoff is worth the risk. The borrowers most likely to be hurt by current policies are the weakest borrowers whose loans receive the largest subsidies. Lending subsidies do reduce the weak, subsidized borrowers cost of credit; however, these lower interest rates are only helpful when the borrower is able to repay the loan. If a borrower is going to default, a low interest rate offers the borrower nothing of value. In this case students will try to infer their true type from the loan offer they receive.

Although the current student loan structure may be inducing predatory lending, from a social planner's perspective it may still be the optimal social policy. When a social planner attempts to intervene, encouraging the socially optimal level of lending, borrowers may not necessarily be better off. When guarantees are costly, the government has an incentive to hide the size of guarantees from borrowers to reduce program costs. Further, the optimal subsidy program may involve mandating that all borrowers receive a fixed interest rate on their loans similar to what we see in today's student loan market. Thus, in some circumstances allowing borrowers to take out bad loans can be socially optimal.

In the student loan market, many students are taking out loans for what appears to be a negative NPV investment. In fact there are some (although not many) colleges where the median student will be worse off. What can explain this counter-intuitive result? We suggest that the structure of today's student loan programs could be partially to blame. When all students get the same interest rate on their subsidized loans, students cannot learn the true riskiness of attending college. Not aware of the true risk, some students will be induced to accept a predatory loan. Lending programs may not always help weak borrowers

access credit; instead, they may facilitate the creation of predatory loans harming those the programs appear to be helping.

## References

- Akerlof, G.A. (1970): "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism," *Quarterly Journal of Economics*, 84(4), 488-500.
- Agarwal, S., G. Amromin, I. Ben-David, S. Chomsisengphet, & D.D. Evanoff (2014): "Predatory Lending and the Subprime Crisis," *Journal of Financial Economics*, 113(1), 29-52.
- Arcidiacono, P. (2005): "Affirmative Action in Higher Education: How Do Admission and Financial Aid Rules Affect Future Earnings?" *Econometrica*, 73(5), 1477-1524.
- Avery, C. & Turner, S. (2012): "Student Loans: Do College Students Borrow Too Much-Or Not Enough?" *Journal of Economic Perspectives*, 26(1), 165-192.
- Axelson, U. (2007): "Security Design with Investor Private Information," *Journal of Finance*, 62(6), 2587-2632.
- Bennett, W.J. (1987, Feb. 18): "Our Greedy Colleges," *The New York Times*.
- Berndt, A., Hollifield, B., & Sandås, P. (2016): "How Subprime Borrowers and Mortgage Brokers Shared the Pie," *Real Estate Economics*, 44(1), 87-154.
- Biais, B. & Perotti, E. (2008): "Entrepreneurs and New Ideas," *RAND Journal of Economics*, 39(4), 1105-1125.
- Bolton, G. & M. Dewatripont (2005): *Contract Theory*. Cambridge, MA: MIT Press.
- Bond, P., D.K. Musto, & B. Yilmaz (2009): "Predatory Mortgage Lending," *Journal of Financial Economics*, 94(3), 412-427.
- Card, D. (1995): "Using Geographic Variation in College Proximity to Estimate the Return to Schooling," *Aspects of Labor Market Behaviour: Essays in Honour of John Vanderkamp*, ed. by Louis Christofides, E. Kenneth Grant, and Robert Swidinsky.
- Card, D. (1999): "The Causal Effect of Education on Earnings," in *Handbook of Labor Economics*, ed. by Orley Ashenfelter and David Card.
- Card, D. (2001): "Estimating the Return to Schooling: Progress on Some Persistent Econometric Problems," *Econometrica*, 69(5), 1127-1160.
- Carneiro, P., Heckman, J.J., & Vytlacil, E.J. (2011): "Estimating Marginal Returns to Education," *American Economic Review*, 101(6), 2754-2781.

- Casamatta, C. & C. Haritchabalet (2013): "Dealing with Venture Capitalists: Shopping Around or Exclusive Negotiation," *Review of Finance*, 18(5), 1743-1773.
- Castex, G. & Dechter, E.K. (2014): "The Changing Roles of Education and Ability in Wage Determination," *Journal of Labor Economics*, 32(4), 685-710.
- Cellini, S.R. & Goldin, C. (2014): "Does Federal Student Aid Raise Tuition? New Evidence on For-Profit Colleges," *American Economic Journal: Economic Policy*, 6(4), 174-206
- Council of Economic Advisers (2016): "Investing in Higher Education: Benefits, Challenges, and the State of Student Debt."
- Dee, T.S. (2004): "Are there civic returns to education?" *Journal of Public Economics*, (88)9, 1697-1720.
- Della Vigna, S. & U. Malmendier (2004): "Contract Design and Self-Control: Theory and Evidence," *Quarterly Journal of Economics*, 119(2), 353-402.
- Deming, D.J., Goldin, C., & Katz, L.F. (2012): "The for-profit postsecondary school sector: Nimble critters or agile predators?" *Journal of Economic Perspectives*, 26(1), 139-164.
- Edelberg, W. (2006): "Risk-Based Pricing of Interest Rates for Consumer Loans," *Journal of Monetary Economics*, 53, 2283-2298.
- Fishman, R. (2015): "College Decisions Survey Part 1: Deciding to Go to College," New America Education Policy Program.
- Fritzdixon, K., J. Hawkings, & P. Skiba (2014): "Dude, Where's My Car Title: The Law, Behavior, and Economics of Title Lending Markets," *University of Illinois Law Review*, 2014(4), 1013-1058.
- Fryer, R.G. (2016): "Information, Non-Financial Incentives, and Student Achievement: Evidence from a Text Messaging Experiment," *Journal of Public Economics*, 144, 109-121.
- Garmaise, M. (2007): "Informed Investors and the Financing of Entrepreneurial Projects." Unpublished manuscript.
- Habib, M.A. & D.B. Johnsen (2000): "The Private Placement of Debt and Outside Equity as an Information Revelation Mechanism," *Review of Financial Studies*, 13(4), 1017-1055.
- Hendricks, L. & Schoellman T. (2014): "Student abilities during the expansion of US education," *Journal of Monetary Economics*, 63, 19-36.

- Hoekstra, M. (2009): "The Effect of Attending the Flagship State University on Earnings: A Discontinuity-Based Approach," *Review of Economics and Statistics*, 91(4), 717-724.
- Inderst, R. (2008): "'Irresponsible Lending' with a Better Informed Lender," *The Economic Journal*, 118(532), 1499-1519.
- Inderst, R. & H.M. Mueller (2006): "Informed Lending and Security Design," *Journal of Finance*, 61(5), 2137-2162.
- Jaffee, D.M. & T. Russell (1976): "Imperfect Information, Uncertainty, and Credit Rationing," *Quarterly Journal of Economics*, 90(4), 651-666.
- Jensen, R. (2010): "The (Perceived) Returns to Education and the Demand for Schooling," *Quarterly Journal of Economics*, 125(2), 515-548.
- Kane, T.J. (2003): "A Quasi-Experimental Estimate of the Impact of Financial Aid on College-Going," *NBER Working Paper*.
- Kane, T.J. & Rouse, C.E. (1995): "Labor-Market Returns to Two- and Four-Year College," *American Economic Review*, 85(3), 600-614.
- Magri, S. & Pico, R. (2011): "The Rise of Risk-Based Pricing of Mortgage Interest Rates in Italy," *Journal of Banking & Finance*, 35, 1277-1290.
- Manove, M., A.J. Padilla, & M. Pagano (2001): "Collateral versus project screening: a model of lazy banks," *RAND Journal of Economics*, 32(4), 726-744.
- Milligan, K., Moretti, E. & Oreopoulos, P. (2004): "Does education improve citizenship? Evidence from the United States and the United Kingdom," *Journal of Public Economics*, 88(9), 1667-1695.
- Moretti, E. (2004) "Estimating the social return to higher education: Evidence from longitudinal and repeated cross-sectional data," *Journal of Econometrics*, 121, 175-212.
- Morgan, D.P. (2007): "Defining and Detecting Predatory Lending," *Federal Reserve Bank of New York Staff Reports*, Number 273.
- Oreopoulos, P. & Petronijevic U. (2013): "Making College Worth It: A Review of the Returns to Higher Education," *The Future of Children*, 23(1), 41-65.
- Ost, B., Pan, W. Webber, D. (2016): "The Returns to College Persistence for Marginal Students: Regression Discontinuity Evidence from University Dismissal Policies," Unpublished manuscript.

- Reynolds, C.L. (2012): "Where to attend? Estimating the effects of beginning college at a two-year institution," *Economics of Education Review*, 31(4), 345-362.
- Rouse, C.E. (2004): "Low-Income Students and College Attendance: An Exploration of Income Expectations," *Social Science Quarterly*, 85(5), 1299-1317.
- Singell, L.D. & Stone, J.A. (2007) "For whom the Pell tolls: The response of university tuition to federal grants-in-aid," *Economics of Education Review*, 26(3), 285-295.
- Spence, M. (1973): "Job Market Signaling," *Quarterly Journal of Economics*, 87(3), 355-374.
- Stango, V. & J. Zinman (2011): "Fuzzy Math, Disclosure, Regulation, and Market Outcomes: Evidence from Truth-in-Lending Reform," *Review of Financial Studies*, 24(2), 506-534.
- Stiglitz, J.E. & A. Weiss (1981): "Credit Rationing in Markets with Imperfect Information," *American Economic Review*, 71(3), 393-410.
- Stinebrickner, R. & Stinebrickner T.R. (2013): "A Major in Science? Initial Beliefs and Final Outcomes for College Major and Dropout," *Review of Economic Studies*, 81(1), 426-472.
- Stinebrickner, T. & Stinebrickner R. (2012): "Learning about Academic Ability and the College Dropout Decision," *Journal of Labor Economics*, 30(4), 707-748.
- Taber, C.R. (2001): "The Rising College Premium in the Eighties: Return to College or Return to Unobserved Ability?" *The Review of Economic Studies*, 68(3), 665-691.
- Wiswall, M. & Zafar, B. (2015): "Determinants of college major choice: Identification using an information experiment," *Review of Economic Studies*, 82(2), 791-824.
- Woodward S.E. & Hall, R.E. (2012): "Diagnosing Consumer Confusion and Sub-Optimal Shopping Effort: Theory and Mortgage-Market Evidence," *American Economic Review*, 102(7), 3249-3276.
- Zimmerman, S.D. (2014): "The Returns to College Admission for Academically Marginal Students," *Journal of Labor Economics*, 32(4), 711-754.

## Appendix A: Variable Definitions

Variable	Definition
Public	Indicator variable equal to 1 if and only if the school is state owned and operated
For-Profit	Indicator variable equal to 1 if and only if the school is owned and operated by a for-profit entity
4-Year	Indicator variable equal to 1 if and only if the school offers at least one four-year bachelors degree program
Admit Rate	Percent of students applying for fall admissions accepted (self-reported). Set to 1.00 for schools that did not report an admissions rate
Average SAT	Mean SAT Score (Math+Verbal only) for admitted students(self-reported). Set to 0 for schools that did not report SAT data
Female	Number of female students divided by the total number of students (only among those whose wage data is included in the earnings distribution)
STEM	Number of degrees awarded in a science, technology, engineering or mathematics field divided by the total number of degrees awarded
BUSI	Number of degrees awarded in business divided by the total number of degrees awarded
Log(Income)	Log of the median household income for the school's students
First Gen	Number of students whose parents did not attend college divided by the total number of students (only among those whose wage data is included in the earnings distribution)
Part-Time	Percent of students who were enrolled part time in the fall term
Average Cost	Average net price (after subtracting gift aid) for the largest program at the institution
Average Debt	The median amount of loan principal outstanding upon entering repayment conditional on having debt
Earnings (6-Years)	The mean earnings for students with available wage data 6-years after college entry. Note that only those students who received federal aid during their college career are included in the distribution.
Earnings (10-Years)	The mean earnings for students with available wage data 10-years after college entry. Note that only those students who received federal aid during their college career are included in the distribution.

# Proofs

**Proof of Lemma 1:** The lenders' IR condition requires that, in equilibrium,  $\forall \theta V_L(R; \theta) \geq 0$ .

Now let  $R_i(\theta)$  be the interest rate charged by the  $i$ -th lender in equilibrium and let  $p_i(\theta)$  be the probability that the  $i$ -th lender's loan is accepted in equilibrium.

Suppose towards contradiction  $\exists \theta$  such that, in equilibrium, some lender  $j$  makes a positive profit:  $V_L(R_j(\theta); \theta) * p_j(\theta) > 0$ . Observe that this implies that  $p_j(\theta) > 0$  and  $V_L(R_j(\theta); \theta) > 0$ . Since the borrower's utility is strictly decreasing in  $R$ ,  $p_j(\theta) > 0$  implies that  $R_j$  is the lowest interest rate offered in the market.

Now select some lender  $i$  such that  $p_i(\theta) < 1$ . Note that the profit of lender  $i$  conditional on being chosen will have to be  $V_L(R_j(\theta); \theta)$  as lender  $i$  would never be chosen if  $R_i(\theta) > R_j(\theta)$  and  $j$  would never be chosen if  $R_i(\theta) < R_j(\theta)$ . Without loss we can then assume that lender  $i$ 's profit will be  $V_L(R_j(\theta); \theta) * p_i(\theta)$  (either  $V_L(R_i(\theta); \theta) = V_L(R_j(\theta); \theta)$  or  $p_i(\theta) = 0$ ). We will show that this lender will have a profitable deviation.

Let  $V'$  be some value such that  $p_i(\theta) * V_L(R_j(\theta); \theta) < V' < V_L(R_j(\theta); \theta)$ . By the completeness of the reals we know that  $V'$  must exist. Now define  $R'$  as the solution to the equation  $V_L(R'; \theta) = V'$ . Note that since  $V_L$  is continuous in  $R$  and  $V_L(0; \theta) = -1$  and  $V_L(R_j(\theta); \theta) > V'$ , we can apply the intermediate value theorem to conclude that  $\exists R' \in (0, R_j(\theta))$ .

If lender  $i$  offered  $R'$  then the borrower would strictly prefer the offer from lender  $i$  as  $V_B(R; \theta)$  is strictly decreasing in  $R$ . Hence, the borrower will either accept loan offer  $R'$  with probability 1 or all loan offers will be rejected. Finally, we can show that  $R'$  will be accepted as:

$$\mathbb{E}[V_B(R'; \theta) | (R'; R_{-i}(\theta))] > \mathbb{E}[V_B(R_j(\theta); \theta) | (R'; R_{-i}(\theta))] \geq \mathbb{E}[V_B(R_j(\theta); \theta) | (R_i(\theta); R_{-i}(\theta))] \geq 0 \quad (8)$$

The second-to-last inequality follows from our imposition of monotonic beliefs, and the last inequality follows from the fact that  $p_j(\theta) > 0$ . (9) implies that the borrower would accept offer  $R'$  with probability 1 if it were offered. Hence, by offering  $R'$  instead of  $R_i(\theta)$ , lender  $i$ 's profit would be  $V' > p_i(\theta) * V_L(R_j(\theta); \theta)$ . This implies that there can exist no equilibrium where some lender earns a strictly positive profit on some type  $\theta$ . Therefore, in equilibrium for each type  $\theta$ , the lenders must break-even.  $\square$

Since  $V_L(R; \theta)$  is a continuous and increasing function in  $R$ ,  $V_L(R_j(\theta); \theta) > 0$  implies  $\exists R' < R_j(\theta)$  such that  $V_L(R'; \theta) > 0$ . As  $R' < R_j(\theta)$ , the borrower will strictly prefer loan offer  $R'$  to  $R_j(\theta)$  no matter the borrower's expectations **Lemma A.1.** *Let  $h(w)$  be an increasing, non-constant function. Then  $\frac{\partial \mathbb{E}_w[h(w)|\theta]}{\partial \theta} > 0 \forall \theta \in (0, 1)$ .*

*Proof.* By definition:

$$\frac{\partial \mathbb{E}_w[h(w)|\theta]}{\partial \theta} = \int_0^{\bar{w}} h(w) f_\theta(w|\theta) dw.$$

Given assumption 2, that  $f_\theta$  exists and is continuous, it must be the case that  $\frac{\partial \mathbb{E}_w[h(w)|\theta]}{\partial \theta}$  exists.

Second, given our assumption of strict FOSD,  $\mathbb{E}_w[h(w)|\theta]$  must be a strictly increasing function of  $\theta$ . Therefore,  $\frac{\partial \mathbb{E}_w[h(w)|\theta]}{\partial \theta} > 0 \forall \theta \in (0, 1)$ .  $\square$

**Proof of Proposition 1:** The lender will be willing to offer a loan if and only if  $\exists R$  such that  $V_L(R; \theta) \geq 0$ . Since, the lender can at most demand  $\bar{w}$  (any interest rate higher than  $\bar{w}$  would result in the same payments as interest rate  $\bar{w}$ ), a loan will be offered if and only if  $V_L(\bar{w}; \theta) \geq 0$ . Note that when  $R = \bar{w}$ , the lender captures the entire output generated by the project. Hence,  $V_L(\bar{w}; \theta) = \mathbb{E}[w|\theta] - 1$ .

Per lemma A.1,  $\mathbb{E}[w|\theta]$  must be continuous in  $\theta$ . Now, assumption 3 gives us that  $\mathbb{E}[w|\theta = 0] < 1$ . From assumption 4, it follows that  $\mathbb{E}[w|\theta = 1] > 1 + c$ . Therefore, we can apply the intermediate value theorem to conclude  $\exists \underline{\theta}$  such that  $V_L(\bar{w}; \underline{\theta}) = 0$ .

Finally, our assumption of FOSD guarantees that  $\forall \theta > \underline{\theta}$ ,  $V_L(\bar{w}; \theta) > 0$ . Therefore, a borrower will be offered a loan if and only if  $\theta \geq \underline{\theta}$ .  $\square$

**Proof of Lemma 2:** First note that from proposition 1 it follows that  $\forall \theta \geq \underline{\theta} \exists R \in [1, \bar{w}]$  such that  $V_L(R; \theta) = 0$ . Hence,  $R(\theta)$  must exist  $\forall \theta \geq \underline{\theta}$ .

Now, we can rewrite (4.1.2) as:

$$V_L = \mathbb{E}_w[\min(w, R)|\theta] - 1$$

From lemma A.1, we can conclude that  $\frac{\partial V_L}{\partial R} = 1 - F(R|\theta) > 0 \forall \theta \in (0, 1)$ .

$$\frac{dR}{d\theta} = -\frac{\frac{\partial V_L}{\partial \theta}}{1 - F(R|\theta)} < 0$$

The denominator must be non-zero as strict FOSD implies that there must be full support for all types  $\theta \in (0, 1)$ . Therefore  $\forall \theta > \underline{\theta}$ ,  $\frac{dR}{d\theta} < 0$ .  $\square$

**Proof of Lemma 3:** First, note that we can rewrite (4.1.1) as  $V_B = \mathbb{E}[\max(w - R, 0)|\theta] - c$ . Lemma A.1 then implies that  $\frac{\partial V_B}{\partial \theta} > 0$ . Now taking the first derivative of (4.1.1) with respect to  $R$ , we get:

$$\frac{dV_B}{dR} = \underbrace{\frac{\partial V_B}{\partial \theta}}_{+} \underbrace{\frac{d\theta}{dR}}_{-} - \underbrace{[1 - F(R|\theta)]}_{+} < 0$$

$\square$

**Proof of Proposition 2:** The borrower will accept her loan if and only if  $V_B(R; \theta(R)) \geq 0$ . Since the lender always break-even, we can rewrite (4.1.1) as  $V_B = \mathbb{E}[w|\theta] - 1$ . Given our assumption that  $f_\theta$  exists, we know that  $V_B$  must be a continuous function of  $\theta$ . Second when  $R = \bar{w}$ , regardless of  $\theta$ ,  $V_B(\bar{w}; \theta) = -1$ . When  $R = \min(R) = R(1)$ ,  $V_B = \mathbb{E}[w|\theta = 1] - 1 > 1 + c - 1 > 0$ , where the first inequality follows from assumption 3. Therefore, we can apply the intermediate value theorem to conclude that  $\exists \hat{R}$  such that  $V_B(R; \theta(R)) = 0$ .

Then from lemma 3, we know that  $\forall R > \hat{R}$   $V_B(R; \theta(R)) > 0$ . Therefore for all  $R \geq \hat{R}$  the loan will be accepted.  $\square$

**Proof of Proposition 3:** The social value of a loan is given by  $\mathbb{E}[w|\theta] + e - (1 + c)$ . From a social prospective a loans should be accepted if and only if  $\mathbb{E}[w|\theta] \geq 1 + c - e$ . We know that a loan will be accepted if and only if  $V_B \geq 0$ . When  $V_B = 0$ ,  $\mathbb{E}[w|\theta] = 1 + c$ . However, this implies that for all  $\theta$  such that  $1 + c - e \leq \mathbb{E}[w|\theta] < 1 + c$ , the loan will be rejected even though it is socially valuable. We know this set will be non-empty by the continuity of  $\mathbb{E}[w|\theta]$ .  $\square$

**Proof of Lemma 4:**

$\theta_s$  is a strictly decreasing function of  $s$

At the threshold offer type, the lender will charge  $\bar{w}$  and the lender will receive the project's entire payout. Let  $\pi(w, \bar{w})$  be the lender's profit when payout  $w$  is realized and the interest rate is  $\bar{w}$  :

$$\pi(w, \bar{w}) = \begin{cases} s + (1 - s)w & \text{if } w < 1 \\ w & \text{otherwise} \end{cases}.$$

As  $s < 1$ ,  $\pi(w, \bar{w})$  must be an increasing function. To find the threshold type,  $\theta_s$  we can solve (5) implicitly:

$$\int_0^1 s + (1-s)w dF(w|\theta) + \int_1^{\bar{w}} w dF(w|\theta) = \mathbb{E}[\pi(w, \bar{w})|\theta] = 0. \quad (9)$$

Applying the implicit function theorem to (9), we get:

$$\frac{d\theta_s}{ds} = -\frac{\int_0^1 (1-w) dF(w|\theta)}{\frac{\partial \mathbb{E}[\pi(w, \bar{w})|\theta]}{\partial \theta}} < 0.$$

The inequality follows from Lemma A.1 which indicates that the denominator must be positive.

$R$  is a strictly decreasing function of  $s$

Suppose subsidy rates  $s$  and  $s'$  are used with corresponding interest rates  $R$  and  $R'$ . Without loss, let  $s' > s$ . We want to show that  $R' < R$ . Using the lender's zero profit condition, we know that  $V_L(R, s; \theta) = 0$ . From (5), we can see that  $V_L$  must be a strictly increasing function in both  $s$  and  $R$ . Hence  $s' > s$  implies that  $V_L(R, s'; \theta) > 0$ . However, by construction  $V_L(R', s'; \theta) = 0$ . Therefore, as  $V_L$  is strictly increasing in  $R$ , we know that  $R' < R$ .  $\square$

**Proof of Lemma 5:** Let  $\pi(w, R)$  be the lender's profit when payout  $w$  is realized and the interest rate is  $R$ :

$$\pi(w, R) = \begin{cases} s + (1-s)w & \text{if } w < 1 \\ w & \text{if } 1 \leq w < R \\ R & \text{if } R \leq w \end{cases}$$

As  $s < 1$ ,  $\pi(w, R)$  must be a non-decreasing function of  $w$ . Hence from lemma A.1, we can conclude that  $\frac{\partial V_L}{\partial \theta} > 0$ . As the lender's zero profit condition implies that  $V_L(R(\theta, s), s; \theta) = 0$ , we can use the implicit function theorem to find  $\frac{dR}{d\theta}$ :

$$\frac{dR}{d\theta} = -\frac{\frac{\partial V_L}{\partial \theta}}{1 - F(R|\theta)} < 0.$$

$\square$

**Proof of Proposition 4:** First note that as  $R$  is a strictly monotonic function of  $\theta$ ,  $R$  is invertible; after observing  $R$ , the borrower knows  $\theta$ . Hence, the borrower faces no uncertainty as to her true type when interest rates vary.

Since the lender's always break-even in expectation, we can rewrite (4.1.1) as:

$$V_B(R(\theta); \theta) = \mathbb{E}[w|\theta] + \int_0^1 s(1-w)dF(w|\theta) - 1 - c = \mathbb{E}[y(w)|\theta] - 1 - c \quad (10)$$

, where

$$y(w) = \begin{cases} s + (1-s)w & \text{if } w < 1 \\ w & \text{otherwise} \end{cases}. \quad (11)$$

For any  $s < 1$ ,  $y(w)$  must be a continuous, non-decreasing function. From (9), we can apply lemma A.1 to make two observations. First,  $V_B(R(\theta); \theta)$  is a strictly increasing function in  $\theta$ . Second,  $V_B(R(\theta); \theta)$  is continuous in  $\theta$ .

Now consider the threshold offer type  $\underline{\theta}_s$ , the lender offers  $R(\underline{\theta}_s) = \bar{w}$ . It is obvious that  $V_B = 0 - c < 0$ . Now when  $\theta = 1$ ,

$$V_B(R(1), 1) = \int_{1+c}^{\bar{w}} (w-1)dF(w|\theta) - c = \mathbb{E}[w|\theta = 1] - (1+c) > 0$$

, where the inequality follows from assumption 3. We can then apply the intermediate value theorem to conclude  $\exists \theta^* \in (\underline{\theta}_s, 1)$  such that  $V_B(R(\theta^*); \theta^*) = 0$ .

Then as  $V_B$  is a strictly increasing function in  $\theta$ , we know that  $\forall \theta \geq \theta^*$  the loan will be accepted and any borrower with  $\theta < \theta^*$  will reject the loan (or not be offered a loan). Therefore, a loan will be accepted if and only if  $\theta > \theta^*$  and this corresponds to those loans that are privately beneficial to the borrower.  $\square$

**Proof of Proposition 5:** When a fixed interest rate is used, the borrower only knows that her type  $\theta \in \tilde{\Theta}$ . Conditional on being offered a loan, the borrower's information set is the same regardless of her true type. Therefore, either all borrowers will accept the loan or reject the loan.  $\square$

**Proof of Proposition 6:** Since the borrower's IR constraint binds,  $\mathbb{E}[V_B|\theta \in \tilde{\Theta}] = 0$ , implying that the borrower will accept the loan. However, as  $\tilde{\theta} < 1$  and  $V_B$  is a strictly increasing function in  $\theta$ ,  $V_B(R; \tilde{\theta}) < V_B(R; 1)$ . This implies that  $\mathbb{E}[V_B|\theta \in \tilde{\Theta}] = 0$  if and only if  $V_B(R; \tilde{\theta}) < 0 < V_B(R; 1)$ . Therefore, the borrower of type  $\tilde{\theta}$  will accept the loan, even though her private value is negative.  $\square$

**Proof of Proposition 7:** The lender will be willing to offer a loan at rate  $R$  so long as  $V_L(R, s; \theta) \geq 0$ . Hence, the threshold offer type,  $\tilde{\theta}$  will be given by solving  $V_L(R, s; \tilde{\theta}) = 0$ .

As  $V_L$  is a strictly increasing function in  $\theta$ , then  $\forall \theta > \tilde{\theta}$ ,  $V_L(R, s; \theta) > 0$ . Therefore the lender makes a strictly positive profit on all borrowers other than the threshold type.  $\square$

**Proof of Lemma 6:** We will proceed in two steps. First, we will show that there exists a  $\underline{\theta}$  such that  $\underline{\theta}$  would be the threshold type if  $s = 1$ . Second, we will show that for each  $\theta > \underline{\theta}$ ,  $\exists s$  such that  $\theta$  would be the threshold type.

**Step 1:**  $\exists \underline{\theta}$ .

From the proof of proposition 4 we know that given  $s$ , the borrower's utility will be given by (9), where  $y(w)$  is defined by (9). If  $s = 1$ , (9) becomes:

$$V_B(R(\theta); \theta) = \int_0^1 1dF(w|\theta) + \int_1^{\bar{w}} wdF(w|\theta) - 1 - c. \quad (12)$$

Given our assumption that  $f_\theta$  exists, (9) must be a continuous function in  $\theta$ . Now when  $\theta = 0$ ,  $V_B(R(0); 0) = -c < 0$  as  $F(1; 0) = 1$ , and when  $\theta = 1$ ,  $V_B(R(1); 1) > 0$  as  $F(1+c; 1) = 0$ . Therefore we can apply the intermediate value theorem to conclude  $\exists \underline{\theta} \in (0, 1)$  such that  $V_B(R(\underline{\theta}); \underline{\theta}) = 0$ .

**Step 2:**  $\forall \theta \in (\underline{\theta}, 1)$ ,  $\exists s$  such that  $\theta$  would be the threshold type.

From (9), we know  $\theta$  will be the threshold type if and only if

$$V_B^s(s; \theta) = \int_0^1 s + (1-s)wdF(w|\theta) + \int_1^{\bar{w}} wdF(w|\theta) - 1 - c = 0 \quad (13)$$

First observe that (9) is a continuous function in  $s$ . Then when  $s = 1$ , we know that  $V_B^s(1; \theta) > 0$  as strict FOSD, gives us that  $V_B^s(1; \theta) > V_B^s(1; \underline{\theta}) = 0$ . Then,

$$\begin{aligned} V_B^s(-\infty; \theta) &= \lim_{s \rightarrow -\infty} \int_0^1 s + (1-s)wdF(w|\theta) + \int_1^{\bar{w}} wdF(w|\theta) - 1 - c = \\ &= \lim_{s \rightarrow -\infty} s \int_0^1 (1-w)dF(w|\theta) + \mathbb{E}[w|\theta] - 1 - c = -\infty \end{aligned}$$

, where the equality follows from our assumptions that  $\mathbb{E}[w|\theta] < \infty$ . Therefore, we can apply the intermediate value theorem to conclude that  $\forall \theta \in (\underline{\theta}, 1)$ ,  $\exists s < 1$  such that  $\theta$  will be the threshold type.  $\square$

**Proof of Proposition 8:** From lemma 6, Let  $\theta^*$  be an arbitrary type such that  $\theta^* \in (\underline{\theta}, 1)$ . From lemma 6,  $\exists s$  such that  $\theta^*$  is the threshold type. At this threshold with varying interest

rates, there must exist some threshold rate  $R^*$  such that the threshold borrower,  $\theta^*$  is offered  $R^*$ .

Let  $(R^*, s)$  be a possible fixed interest rate scheme. The borrower will be offered a loan if and only if she is at least as strong as  $\theta^*$ . To see this note that by construction  $V_L(R^*, s; \theta^*) = 0$  and as  $V_L$  is a strictly increasing function in  $\theta$ ,  $V_L(R^*, s; \theta) \geq 0 \iff \theta \geq \theta^*$ .

From the borrower's prospective as  $\theta^*$  is the threshold borrowing type:  $V_B(R^*; \theta^*) = 0$ . With a fixed interest rate scheme, the borrower's expected value is given by:

$$\int_{\theta^*}^1 \frac{V_B(R^*; \theta)}{1 - \theta^*} d\theta > 0$$

, with the strict inequality following from the fact that  $V_B$  is a strictly increasing function in  $\theta$ . Therefore, the borrower will accept the loan with fixed rate  $R^*$  with subsidy amount  $s$ . As the choice of  $\theta^*$  was arbitrary in  $(\underline{\theta}, 1)$ , it must hold for all  $\theta \in (\underline{\theta}, 1)$ .  $\square$

**Proof of lemma 7:** Suppose the social planner wants to fix the interest rate at  $R$ .  $\theta$  can be the threshold type if and only if  $\exists s < 1$  such that  $V_L(R, s; \theta) = 0$ . By strict FOSD,  $V_L$  is a strictly monotonic function in  $\theta$ . Hence,  $V_L(R, s; \theta) = 0$  implies that  $\forall \theta' \neq \theta$ ,  $V_L(R, s; \theta') \neq 0$ . Therefore, a subsidy amount is paired with at most one threshold type.  $\square$

**Proof of Proposition 9:** When  $\alpha > 1$ ,  $V_{SP}(R, s; \theta)$  will be a decreasing function in  $s$ . Now suppose the planner would like to implement an arbitrary threshold of  $\theta'$  (which could be implemented). To implement this threshold, the borrower's IR constraint must not be violated:  $\mathbb{E}_\theta[V_B(R; \theta) | \theta \geq \theta'] \geq 0$ . Hence,  $\exists R$  such that  $\mathbb{E}_\theta[V_B(R; \theta) | \theta \geq \theta'] \geq 0$ . Since  $V_B(R; \theta)$  is a continuous and strictly decreasing function in  $\theta$  with  $V_B(\bar{w}; \theta) = -c < 0$ ,  $\exists R'$  such that  $\mathbb{E}_\theta[V_B(R'; \theta) | \theta \geq \theta'] = 0$ .

Now since we assumed that  $\theta'$  was an implementable threshold,  $\exists (R, s)$  such that  $V_L(R, s; \theta') = 0$ , and the borrower's IR constraint isn't violated. Suppose that  $R > R'$ . Since  $V_L$  is a strictly increasing function in  $R$ ,  $V_L(R', s; \theta) > 0$ . However, as  $V_L$  is also continuous and strictly increasing in  $s$  with  $V_L(\cdot, -\infty; \theta') = -\infty$ , it must be the case that  $\exists s' < s$  such that  $V_L(R', s'; \theta) = 0$ .

Finally, when we use threshold  $\theta'$  the difference in the social planner's value when using scheme  $(R, s)$  and  $(R', s')$ :

$$\int_{\theta'}^1 (V_{SP}(R', s'; \theta) - V_{SP}(R, s; \theta)) d\theta = -(\alpha - 1) \int_{\theta'}^1 \int_0^1 (s' - s)(1 - w) dF(w | \theta) d\theta > 0$$

, with the inequality following from  $s' < s$ . Therefore when  $\alpha > 1$ , the social planner will always want to ensure the borrower's IR constraint holds with equality.  $\square$

**Proof of Proposition 10:** In proposition 9, we showed that when  $\alpha > 1$  and the social planner uses a fixed interest rate scheme, the borrower's IR constraint will be strictly binding. Now suppose the social planner wants to have a threshold of  $\theta'$ . To find the necessary subsidy and interest rate for a fixed interest rate scheme we have to find  $(R', s')$  such that:

$$\begin{cases} \mathbb{E}_\theta[V_B(R'; \theta) | \theta \geq \theta'] = 0 \\ V_L(R', s'; \theta') = 0 \end{cases}$$

In contrast, if we want to implement a varying interest rate scheme, we have to find  $s''$  such that  $V_B(R(\theta'; s''); \theta') = 0$ . As  $V_B$  is a strictly decreasing function in its second argument:  $V_B(R; \theta') < \mathbb{E}_\theta[V_B(R; \theta) | \theta \geq \theta'] \forall R$ . Thus, the equations:

$$\begin{cases} \mathbb{E}_\theta[V_B(R'; \theta) | \theta \geq \theta'] = 0 \\ V_B(R(\theta'; s''); \theta') = 0 \end{cases}$$

imply that  $R(\theta'; s'') < R'$ . Since the lender breaks even at the threshold type under either scheme  $R(\theta'; s'') < R'$  implies that  $s'' > s'$ .

Comparing the social planner's value when using the two schemes:

$$\int_{\theta'}^1 (V_{SP}(R', s'; \theta) - V_{SP}(R(\theta; s), s; \theta)) d\theta = -(\alpha - 1) \int_{\theta'}^1 \int_0^1 (s' - s'')(1 - w) dF(w | \theta) d\theta > 0.$$

Therefore, when  $\alpha > 1$  it is preferable to use a fixed interest rate scheme where the borrower's IR constraint will be strictly binding.  $\square$

**Proof of Lemma 8:** The lender's utility function is dependent only on  $R$ ,  $s$ , and  $\theta$ . Since the lender observes  $\theta$ , regardless of the availability of  $a$ , the existence of  $a$  will have no impact on the lender's behavior.  $\square$

**Lemma A.2**  $V'_B(a)$  is a strictly increasing and continuous function in  $a$ .

*Proof.* The borrower's utility conditional on  $a$  is given by (8.2). This is equal to  $V'_B(a) = \mathbb{E}_\theta[V_B(R; \theta) | \theta \geq \tilde{\theta}; a]$  Now recall that  $V_B(R; \theta)$  is a strictly increasing function of  $\theta$ . Since we assumed that  $G(\cdot | a)$  satisfies the MLRP, for any strictly increasing function  $h(\theta)$  and  $\theta'$  on

the support of  $G(\cdot|a)$ ,  $\mathbb{E}_\theta[h(\theta)|\theta \geq \theta'; a]$  is a strictly increasing function of  $a$ . Therefore, it immediately follows that  $V'_B(a)$  must be strictly increasing.

Note that we can rewrite (8.2) as:

$$V'_B(a) = \int_{\tilde{\theta}}^1 V_B(R; \theta) \frac{g(\theta|a)}{\int_{\tilde{\theta}}^1 g(x|a) dx} d\theta \quad (16)$$

Since  $g_a(\cdot|a)$  exists almost everywhere, (9) is differentiable  $a$ , implying  $V'_B(a)$  must be continuous in  $a$ .  $\square$

**Proof of Proposition 11:** If  $\tilde{a} > 0$ . Then it must be the case that  $V'_B(\tilde{a}) = 0$ . Now if  $V'_B(\tilde{a}) < 0$  then borrower of ability  $\tilde{a}$  would not accept the loan. If  $V'_B(\tilde{a}) > 0$ , then from lemma A.2, we can conclude  $\exists a' < \tilde{a}$  such that  $V'_B(a') > 0$  contradicting our assumption that the loan is accepted if and only if  $a \geq \tilde{a}$ . Hence,  $V'_B(\tilde{a}) = 0$ .

Next, suppose  $a \in [\tilde{a}, 1)$  implying the borrower accepts the loan. We know that at  $\tilde{a}$   $V'_B(\tilde{a}) = 0$ . This implies that  $V_B(R; \tilde{\theta}) < 0 < V_B(R; 1)$ .

Since  $G(\cdot|a)$  has full support, we know that  $\tilde{\theta}$  is in the support of  $G(\cdot|a)$ . Since  $V_B(R; \tilde{\theta}) < 0$  and  $V_B(R; \theta)$  is strictly increasing in  $\theta$ , we know that there exists a non-zero interval of types  $\forall a \in [\tilde{a}, 1)$  such that  $V_B(R; \theta) \leq 0$ . Therefore, any borrower with a type  $\theta$  such that  $V_B(R; \theta) \leq 0$  will accept a predatory loan and this occurs with a strictly positive probability.  $\square$

**Proof of Proposition 12:** With varying interest rates, the borrower will be able to infer her true type,  $\theta$  (see lemma 8). Hence, if the social planner allows interest rates to vary across borrowers it must be the case that  $a' = 0$  (i.e. all borrowers accept the loan regardless of  $a$ ). We will now show that for any  $\theta'$  the social planner will be better off using a fixed rate scheme.

Suppose the social planner wanted to implement a fixed rate scheme with type threshold  $\theta'$  and ability threshold  $a' = 0$ . Let  $s_V$  and  $s_F$  be the subsidy levels under a varying rate scheme and a fixed rate scheme respectively. Using logic similar to proposition 9, we can show that under a fixed rate scheme with ability threshold  $a' = 0$ , the social planner will want to insure that for  $a = 0$ , the borrower's IR constraint binds ( $\mathbb{E}_{\tilde{\theta}}[V_B(R; \theta)|\theta \geq \theta'; a = 0] = 0$ ). To implement the fixed rate scheme we need to solve the following equations for  $(R_F, s_F)$ :

$$\begin{cases} \mathbb{E}_{\tilde{\theta}}[V_B(R_F; \theta)|\theta \geq \theta'; a = 0] = 0 \\ V_L(R_F, s_F; \theta') = 0 \end{cases}$$

Then under the varying rate scheme, the subsidy amount must satisfy:

$$\begin{cases} V_B(R(\theta'; s_V); \theta') = 0 \\ V_L(R(\theta'; s_V), s_V; \theta') = 0 \end{cases}$$

Since  $V_B$  is a strictly decreasing function in the second argument at  $G(\cdot|a = 0)$  has full support, it must be the case that  $V_B(R; \theta') < \mathbb{E}_\theta[V_B(R; \theta)|\theta \geq \theta'; a = 0] \forall R$ . Thus, we can conclude that  $R(\theta'; s_V) < R_F$ . Since the lender breaks even at the threshold type regardless of the scheme  $R(\theta'; s_V) < R_F$  implies that  $s_V > s_F$ .

Comparing the social planner's value when using the two schemes:

$$\begin{aligned} & \int_{a'=0}^1 \int_{\theta'}^1 [V_{SP}(R_F, s_F; \theta) - V_{SP}(R(\theta'; s_V), s_V; \theta)] dG(\theta|a) da = \\ & = \int_{a'=0}^1 \int_{\theta'}^1 \int_0^1 -(\alpha - 1)(1 - w)(s_F - s_V) dF(w|\theta) dG(\theta|a) da \end{aligned} \quad (17)$$

As  $s_F < s_V$ , (9) will be positive if and only if  $\alpha \geq 1$ . Since, this will hold for any  $\theta'$ , it must still be the socially optimal policy to pool all borrowers at the same interest rate.  $\square$

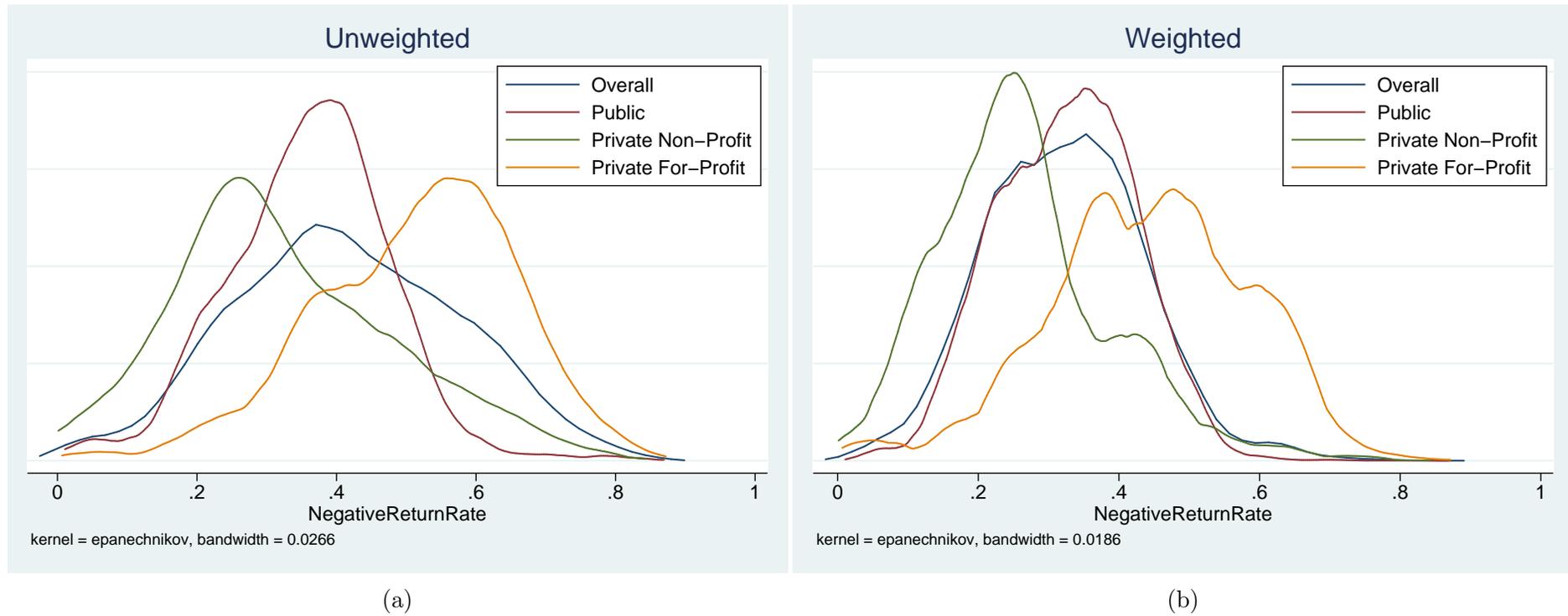


Figure 1: Here we present the empirical PDFs of the *NegativeReturnRate* measure by college. The empirical PDFs were estimated using kernel density estimation. The x-axis represents the percent of students at a given school who realize a negative return. We show the density estimates for the complete sample of schools and broken out by ownership type. Panel (a) presents the unweighted results, and panel (b) presents the results weighted by number of students.

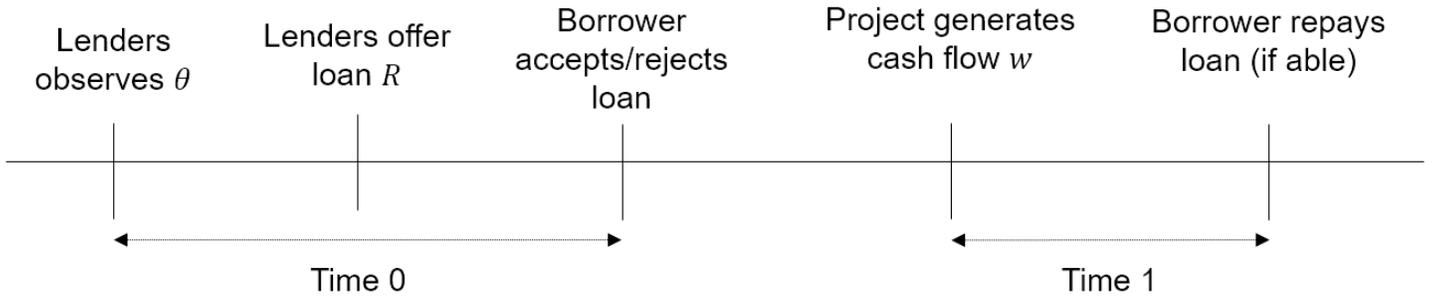


Figure 2: Timeline

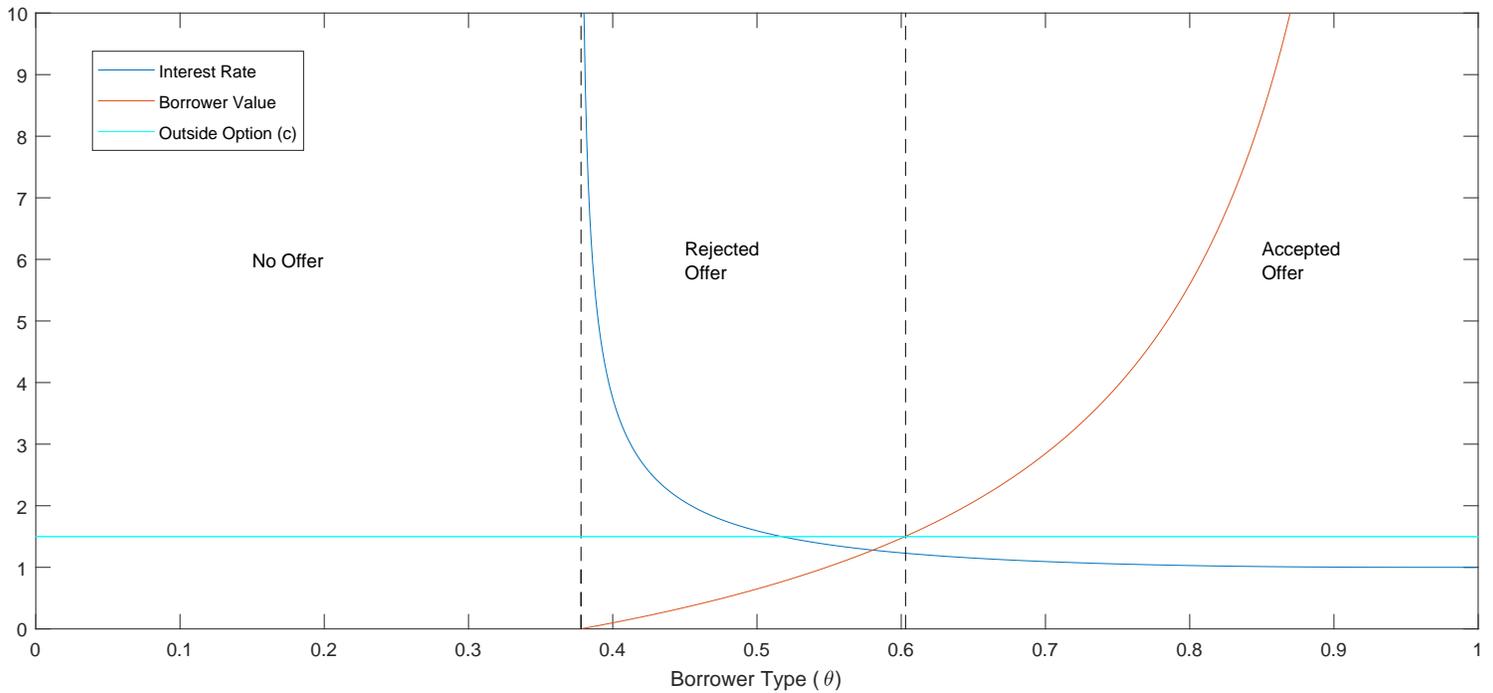


Figure 3: We present the borrower's expected utility and the interest rate, if any, offered to each type. There are 3 regions of behavior. First, the weakest types receive no loan offer.

Second, there exists an intermediate group who offered loans, but reject them as the interest rate is too high. Finally, the strongest borrowers will accept a loan offer as these borrowers have a positive expected value from the loan.

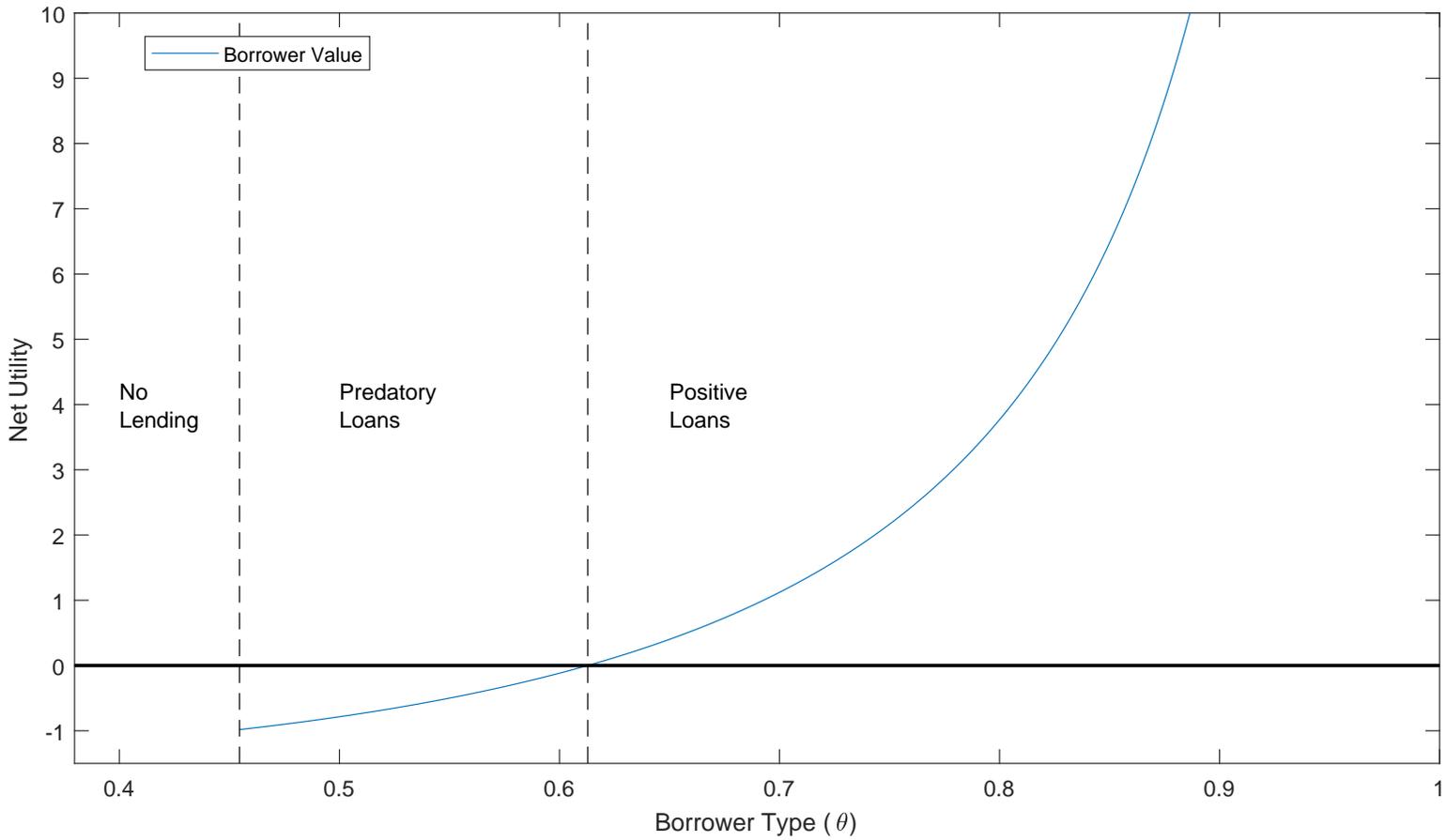


Figure 4: We construct a pool of borrower's who are offered a loan. The plot shows the borrower's value versus her type. Here the borrower's expected value from the loan is non-negative, so the borrower will accept the loan when offered. For the weakest borrower's, however, the expected value of the loan is negative. For these borrowers they will accept a predatory loan. The strongest borrowers, however, take out a positive NPV loan.

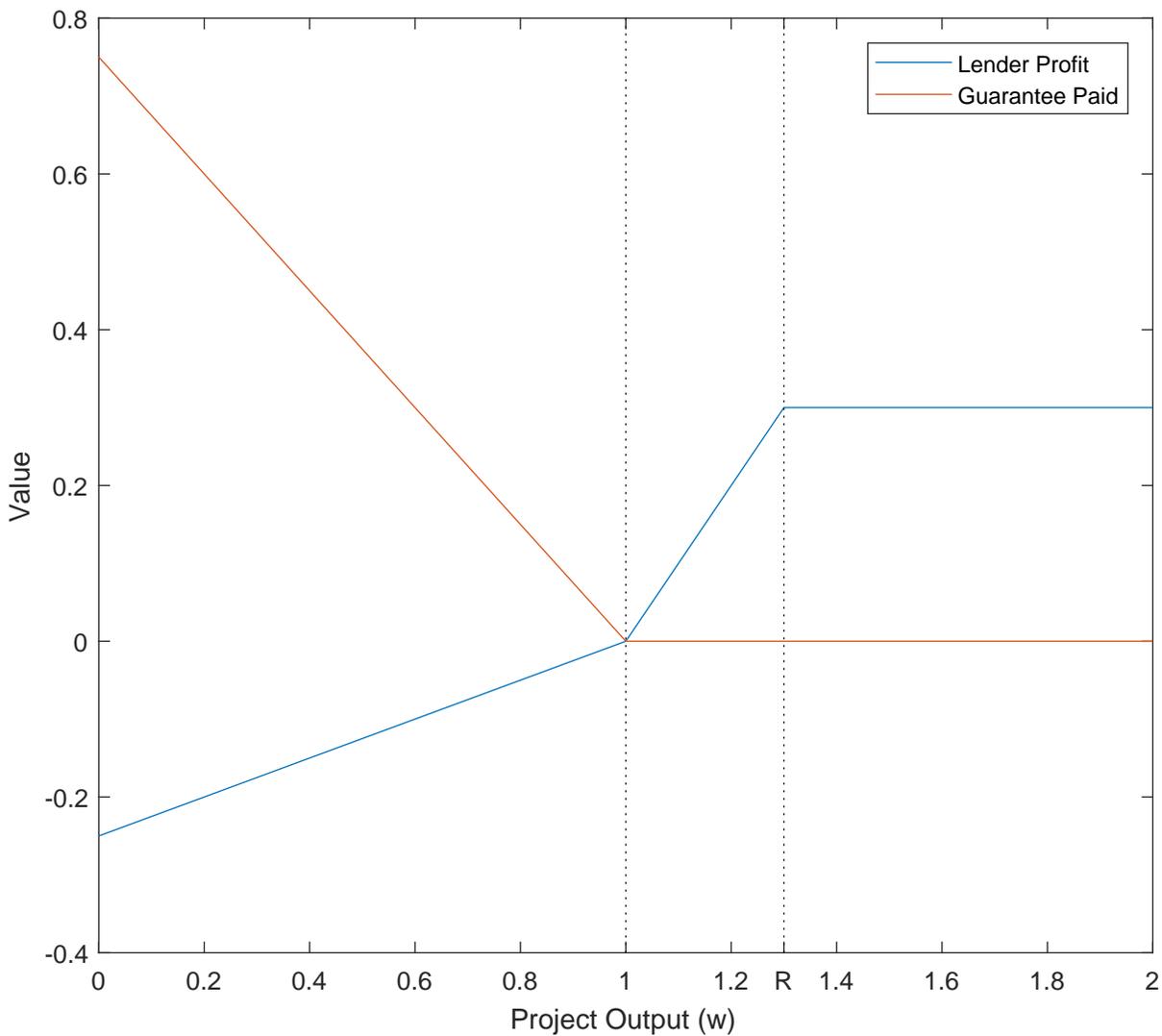


Figure 5: We plot the lender's profit and the actual guarantee paid out as a function of the project's output. The guarantee reduces the lender's loss conditional on the project generating less than the project's cost of 1. When the project generates an output of at least 1, no guarantee is paid out and the lender captures the full project value up to the interest rate  $R$ .

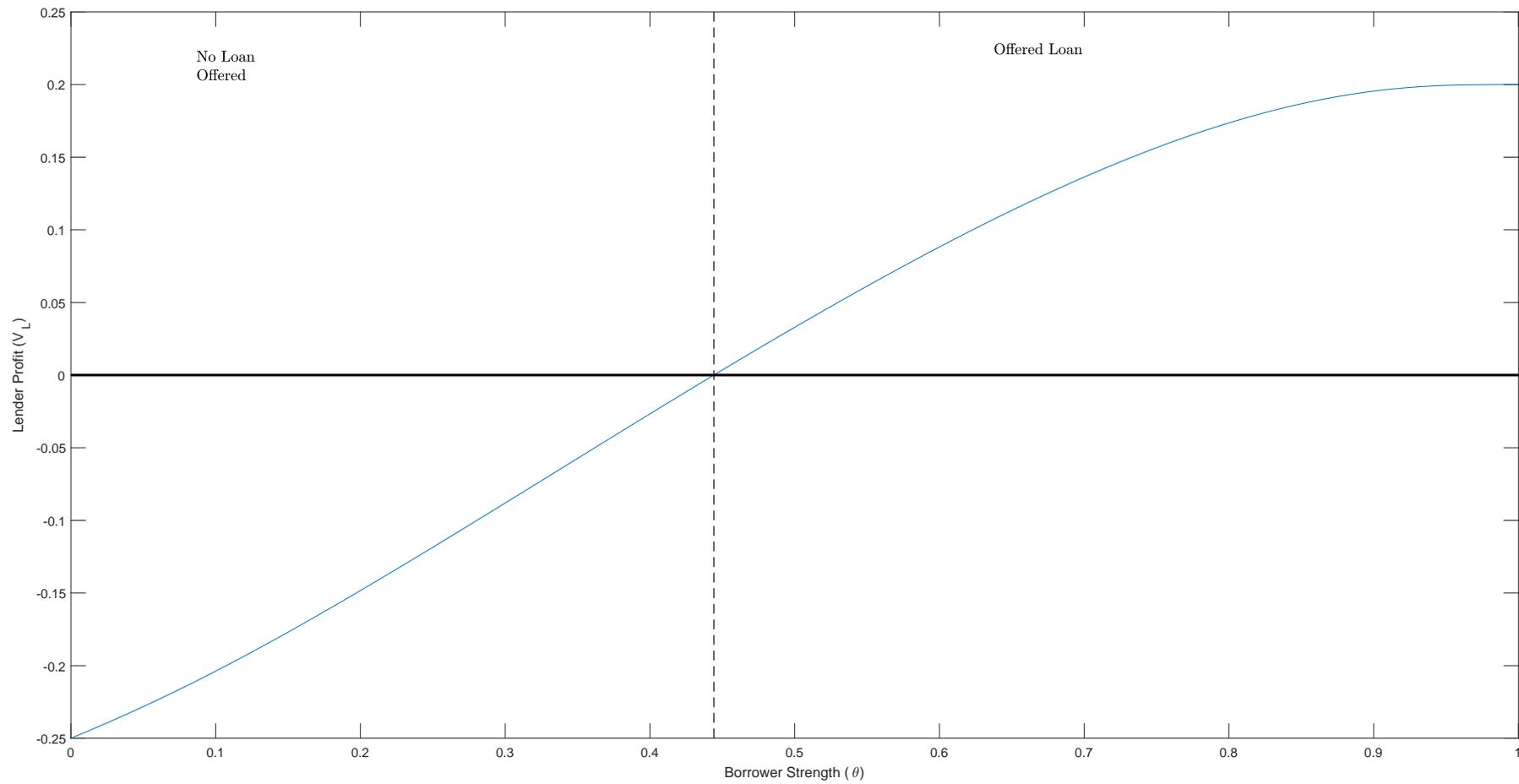


Figure 6: We plot the lender's expected profit versus the borrower's type for a fixed interest rate and subsidy scheme. The borrower will be offered a loan if and only if the lender's expected profit is non-negative.

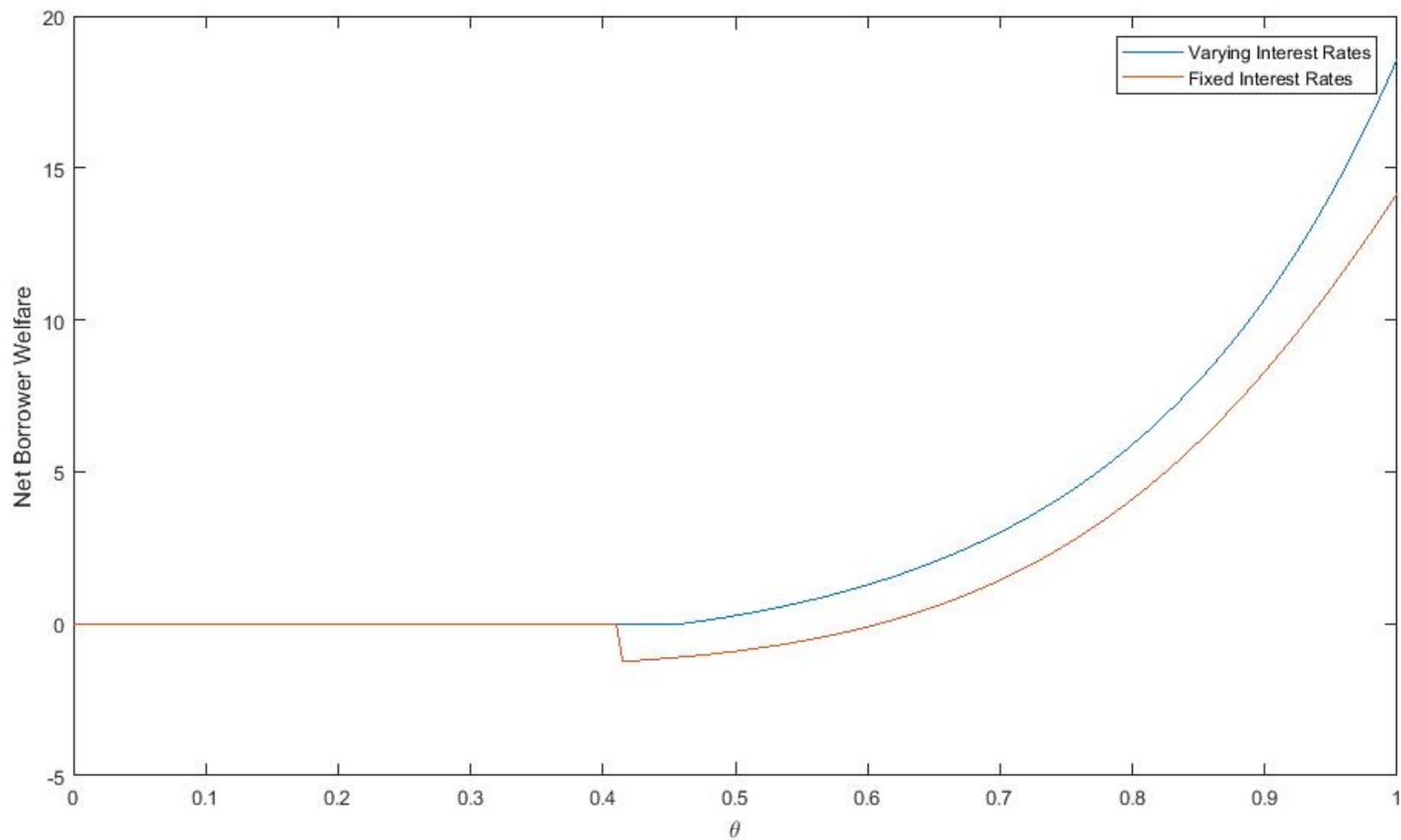


Figure 7: We plot borrower strength versus borrower welfare under both the varying interest rate and fixed interest rate schemes. For all borrower types  $\theta$ , borrowers who accept a loan are strictly better off under the varying interest rate scheme. Further, under a varying interest rate scheme some borrowers accept predatory loans.

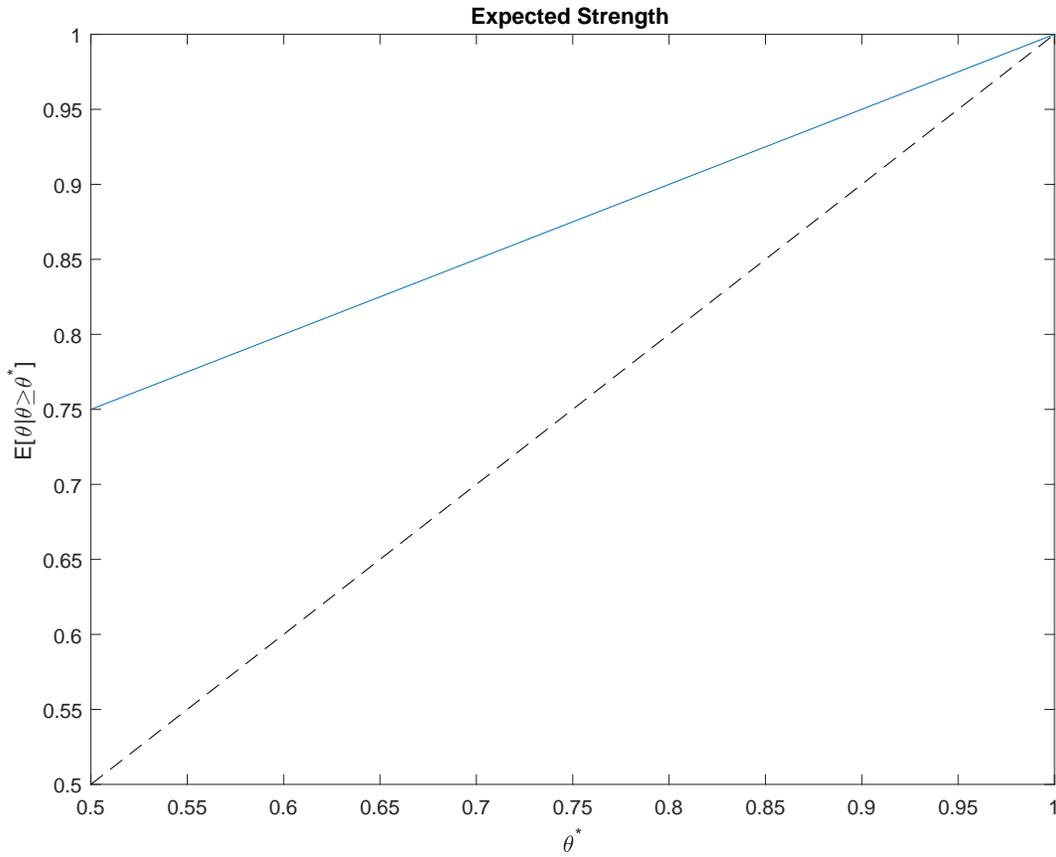
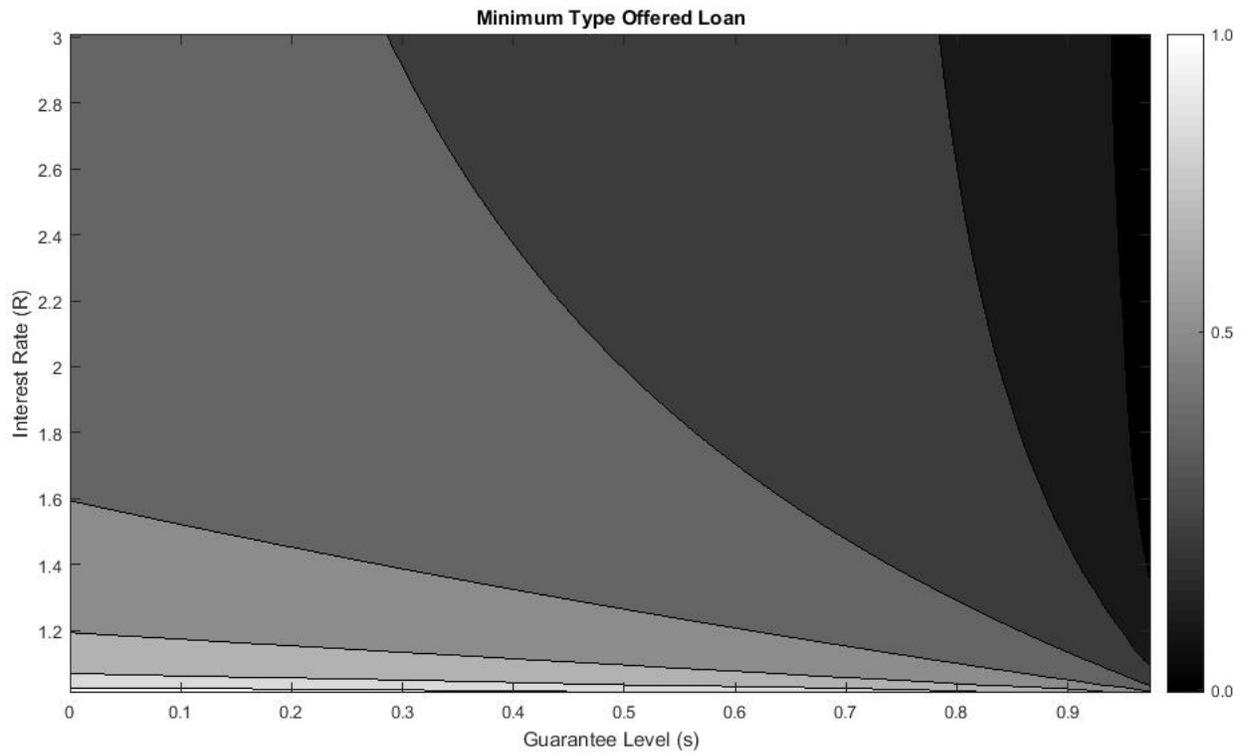
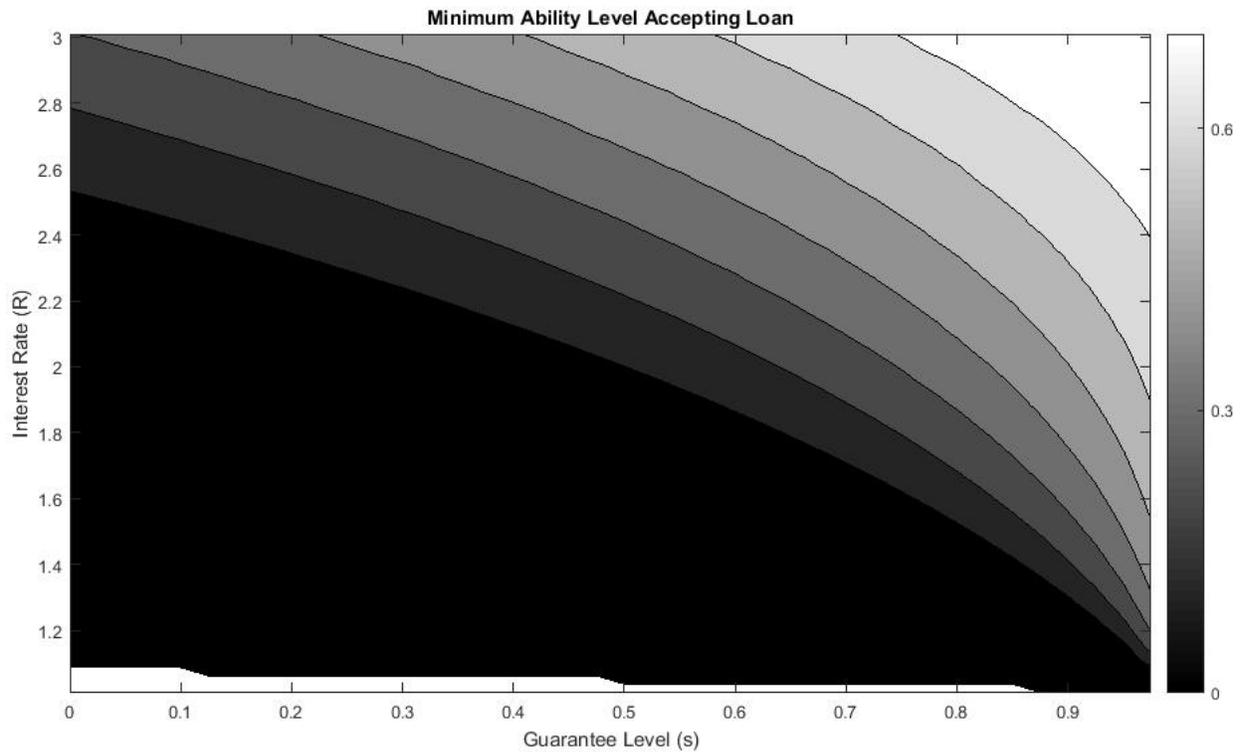


Figure 8: The solid line plots the borrower's expected strength conditional on being offered a loan. The dotted line is the 45-degree line. When all borrowers receive the same interest rate, the weakest borrower is much weaker than her expected strength conditional on being offered a loan.



(a)



(b)

Figure 9: (a) shows the change in lender threshold levels,  $\tilde{\theta}$  as the fixed interest rate and guarantee levels vary. As guarantees levels increase and interest rates go up, lenders are willing to extend weaker borrowers credit. (b) shows the change in the ability threshold,  $\tilde{a}$ , for different levels of the fixed interest rate and guarantee levels.

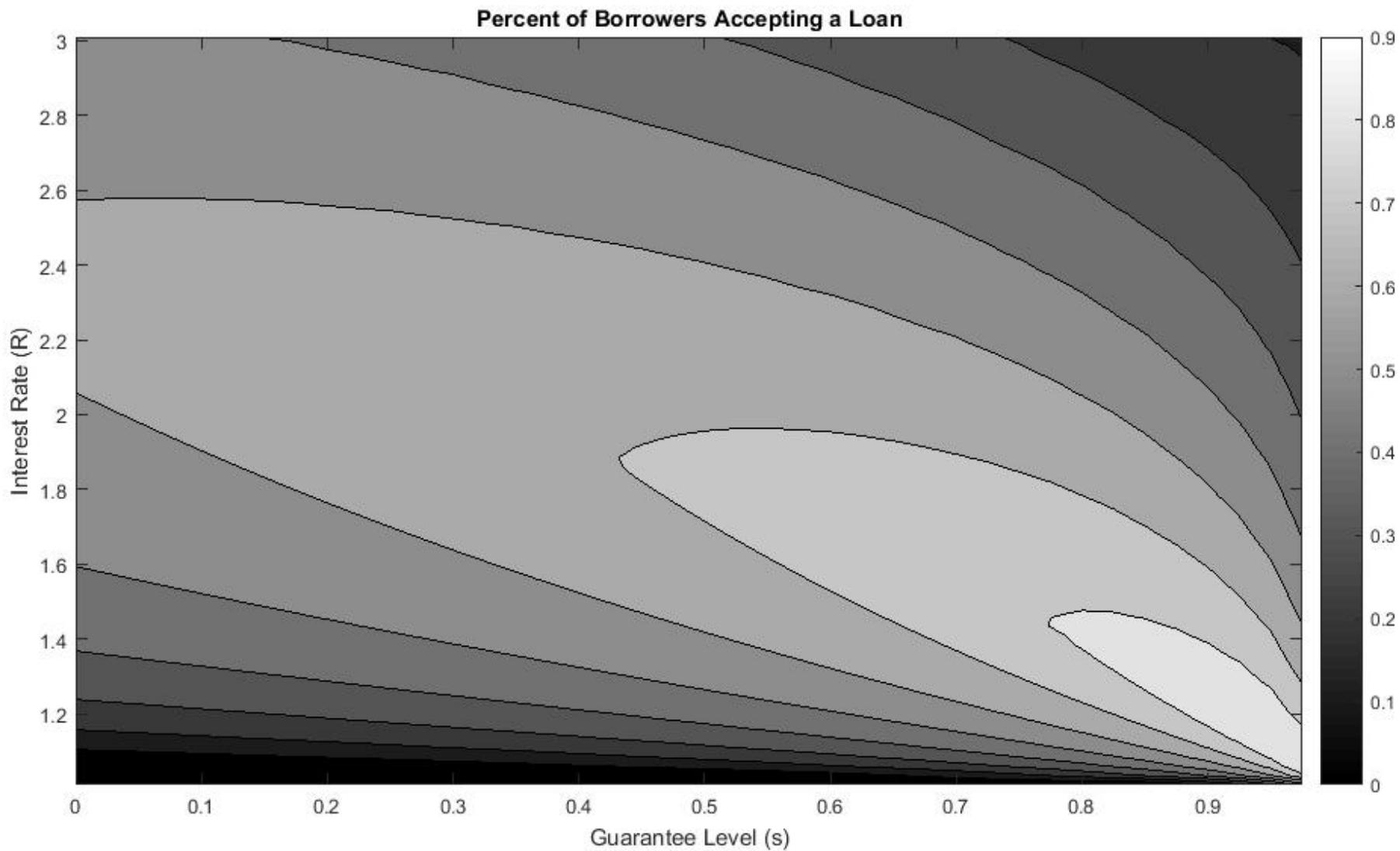


Figure 10: We present the overall percent of borrowers who end up accepting a loan when interest rates are fixed. The x-axis shows the subsidy level the social planner is providing and the y-axis shows the interest rate the social mandates be charged.



Table 1: Summary Statistics

Panel A: Unweighted						
	Mean	SD	p25	p50	p75	N
Public	0.348	0.476	0	0	1	4,978
For-Profit	0.406	0.491	0	0	1	4,978
4-Year	0.456	0.498	0	0	1	4,978
Admit Rate	0.682	0.203	0.557	0.699	0.829	1,889
Average SAT	1058	133	972	1038	1119	1,264
Female	0.631	0.183	0.538	0.614	0.753	4,679
STEM	0.082	0.120	0	0.044	0.120	4,978
BUSI	0.107	0.135	0	0.76	0.163	4,978
Log(Income)	10.925	0.191	10.800	10.930	11.050	4,446
First Gen	0.459	0.124	0.384	0.489	0.542	4,828
Part-Time	0.231	0.230	0.013	0.173	0.380	4,977
Average Cost	16,322	7,610	10,127	16,385	21,561	4,978
Average Debt	11,841	5,544	7,800	10,000	15,168	4,685
Earnings (6-Years)	29,113	9,256	22,400	27,800	33,600	4,976
Earnings (10-Years)	36,088	12,582	27,000	34,100	42,800	4,960
Panel B: Weighted by # of Students						
	Mean	SD	p25	p50	p75	N
Public	0.760	0.427	1	1	1	4,978
For-Profit	0.072	0.258	0	0	0	4,977
4-Year	0.619	0.486	0	1	1	4,977
Admit Rate	0.646	0.192	0.529	0.662	0.786	1,889
Average SAT	1104	130	1014	1083	1185	1,264
Female	0.581	0.093	0.542	0.578	0.617	4,678
STEM	0.117	0.095	0.050	0.098	0.166	4,977
BUSI	0.150	0.102	0.087	0.138	0.0192	4,977
Log(Income)	10.98	0.19	10.86	10.99	11.11	4,445
First Gen	0.411	0.122	0.323	0.427	0.505	4,828
Part-Time	0.319	0.253	0.084	0.250	0.579	4,977
Average Cost	13,533	7,582	7,534	11,990	17,690	4,977
Average Debt	11,895	5,895	6,000	12,000	16,500	4,684
Earnings (6-Years)	33,843	8,746	27,700	32,300	37,800	4,977
Earnings (10-Years)	43,509	12,530	34,800	40,900	49,300	4,959

Table 2: Cross-Correlation Table

Panel A: Unweighted															
	Public	For-Profit	4-Year	Admit Rate	Avg. SAT	Female	STEM	BUSI	Log(Income)	First Gen	Part-Time	Avg. Cost	Avg. Debt	Earnings(6)	Earnings(10)
Public	1.000														
For-Profit	-0.610	1.000													
4-Year	-0.105	-0.346	1.000												
Admit Rate	0.049	0.412	-0.569	1.000											
Avg. SAT	0.063	-0.472	0.607	-0.682	1.000										
Female	-0.205	0.312	-0.243	0.171	-0.178	1.000									
STEM	0.082	-0.208	0.428	-0.285	0.331	-0.407	1.000								
BUSI	0.070	-0.271	0.430	-0.189	0.263	-0.115	0.173	1.000							
Log(Income)	-0.098	-0.053	0.219	-0.239	0.267	0.005	0.093	0.093	1.000						
First Gen	-0.044	0.473	-0.577	0.593	-0.648	0.270	-0.317	-0.183	-0.333	1.000					
Part Time	0.408	-0.195	-0.154	0.234	-0.252	0.024	-0.035	0.103	-0.009	0.209	1.000				
Avg. Cost	-0.593	0.249	0.360	-0.293	0.220	0.027	0.117	0.047	0.423	-0.304	-0.368	1.000			
Avg. Debt	-0.254	-0.227	0.658	-0.537	0.572	-0.145	0.294	0.252	0.368	-0.616	-0.349	0.573	1.000		
Earnings (6)	0.104	-0.406	0.514	-0.538	0.519	-0.304	0.369	0.284	0.451	-0.550	-0.005	0.333	0.520	1.000	
Earnings (10)	0.079	-0.423	0.561	-0.588	0.591	-0.360	0.420	0.318	0.486	-0.632	-0.075	0.353	0.564	0.940	1.000
Panel B: Weighted by # of Students															
	Public	For-Profit	4-Year	Admit Rate	Avg. SAT	Female	STEM	BUSI	Log(Income)	First Gen	Part-Time	Avg. Cost	Avg. Debt	Earnings(6)	Earnings(10)
Public	1.000														
For-Profit	-0.511	1.000													
4-Year	-0.277	-0.033	1.000												
Admit Rate	0.195	0.187	-0.631	1.000											
Avg. SAT	-0.039	-0.262	0.704	-0.752	1.000										
Female	-0.177	0.238	-0.030	0.087	-0.138	1.000									
STEM	-0.003	-0.124	0.446	-0.376	0.474	-0.337	1.000								
BUSI	-0.149	-0.019	0.341	-0.120	0.180	0.052	0.111	1.000							
Log(Income)	-0.029	-0.118	0.153	-0.259	0.281	-0.087	0.125	0.103	1.000						
First Gen 0.172	0.230	-0.596	0.602	-0.698	0.237	-0.463	-0.102	-0.350	1.000						
Part-Time	0.314	-0.043	-0.632	0.602	-0.684	0.119	-0.392	-0.086	-0.112	0.650	1.000				
Avg. Cost	-0.663	0.248	0.554	-0.481	0.462	0.032	0.250	0.177	0.355	-0.588	-0.583	1.000			
Avg. Debt	-0.346	-0.062	0.732	-0.642	0.731	-0.065	0.421	0.216	0.331	-0.737	-0.737	0.742	1.000		
Earnings(6)	-0.214	-0.106	0.532	-0.612	0.595	-0.193	0.450	0.213	0.510	-0.592	-0.404	0.508	0.565	1.000	
Earnings (10)	-0.177	-0.177	0.543	-0.683	0.661	-0.256	0.473	0.192	0.541	-0.657	-0.486	0.520	0.605	0.957	1.000

Table 3: Percent of Students Realizing a Negative Return by School

<i>NegativeReturnRate</i>	<u>Schools</u>		<u>Students</u>	
	Number	%	Number	%
$X < 0.10$	129	2.6%	317,076	2.1%
$0.10 \leq X < 0.20$	337	6.8%	1,768,702	11.6%
$0.20 \leq X < 0.30$	806	16.2%	4,500,433	29.6%
$0.30 \leq X < 0.40$	1,139	22.9%	4,885,748	32.1%
$0.40 \leq X < 0.50$	1,036	20.8%	2,904,227	19.1%
$0.50 \leq X < 0.60$	828	16.6%	597,541	3.9%
$0.60 \leq X < 0.70$	517	10.4%	195,298	1.3%
$0.70 \leq X < 0.80$	161	3.2%	31,312	0.2%
$0.80 \leq X < 0.90$	25	0.5%	3,048	< 0.0%
$0.90 \leq X$	0	0.0%	0	0.0%
TOTAL	4,978	100.0%	15,203,385	100.0%

*NegativeReturnRate* is our calculation for the percent of students at each school who will realize a negative financial return for having attended that college. *NegativeReturnRate*=0 corresponds to no students realizing negative returns, whereas *NegativeReturnRate*=1 implies that all students at that school will realize a negative return. The Schools columns are the number of institutions that fall into each *NegativeReturnRate* bucket. The Students columns correspond to the total number of students enrolled in institutions in each *NegativeReturnRate* bucket.

Table 4: *NegativeReturnRate* by College Classification and Ownership Structure

Panel A: Unweighted				
College Type		Public	Non-Profit	For-Profit
Unclassified	Mean	0.344	0.406	0.562
	SD	0.149	0.244	0.139
	N	215	58	1,019
2-Year	Mean	0.406	0.392	0.498
	SD	0.088	0.224	0.123
	N	880	61	482
4-Year (Inclusive)	Mean	0.357	0.389	0.432
	SD	0.111	0.161	0.126
	N	280	452	519
4-Year (Selective)	Mean	0.276	0.297	0.287
	SD	0.077	0.101	0.267
	N	245	360	2
4-Year (Most Selective)	Mean	0.219	0.224	0.103
	SD	0.086	0.113	N\A
	N	113	291	1
Panel B: Weighted by # of Students				
College Type		Public	Non-Profit	For-Profit
Unclassified	Mean	0.381	0.377	0.502
	SD	0.120	0.255	0.157
	N	215	58	1,019
2-Year	Mean	0.388	0.399	0.477
	SD	0.067	0.192	0.120
	N	880	61	482
4-Year (Inclusive)	Mean	0.334	0.341	0.408
	SD	0.085	0.131	0.132
	N	280	452	519
4-Year (Selective)	Mean	0.266	0.275	0.435
	SD	0.067	0.090	0.165
	N	245	360	2
4-Year (Most Selective)	Mean	0.224	0.196	0.103
	SD	0.071	0.093	N\A
	N	113	291	1

Schools are classified based on their Carnegie Classifications. The *NegativeReturnRate* is our constructed variable that estimates what percent of a school's students will realize a negative return on their investment in education. The Carnegie Classifications are based off of reported test scores. Inclusive schools either do not report test scores or the test score ranges indicate that these schools are in the bottom 40th percentile in terms of admissions rigor. For selective schools, the reported test score ranges indicate that these schools are in the middle 40th percentile in terms of admissions rigor. For the most selective schools, the reported test score ranges indicate that these schools are in the upper 20th percentile in terms of admissions rigor.

Table 5: Regression of Plausible Predictors of *NegativeReturnRate*

	Unweighted				Weighted			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Public	0.036*** (0.005)	-0.017*** (0.005)	-0.018*** (0.005)	-0.030*** (0.005)	0.062*** (0.004)	0.012*** (0.004)	-0.008** (0.003)	-0.009*** (0.003)
For-Profit	0.189*** (0.005)	0.125*** (0.006)	0.103*** (0.006)	0.074*** (0.006)	0.179*** (0.007)	0.132*** (0.006)	0.090*** (0.006)	0.064*** (0.006)
4-Year		-0.100*** (0.004)		-0.003 (0.005)		-0.114*** (0.003)		-0.023*** (0.004)
Female			0.111*** (0.011)	0.128*** (0.011)			0.036** (0.014)	0.086*** (0.014)
STEM			-0.139*** (0.017)	-0.087*** (0.017)			-0.237*** (0.015)	-0.167*** (0.014)
BUSI			-0.092*** (0.014)	-0.069*** (0.014)			-0.159*** (0.012)	-0.118*** (0.012)
Log(Income)			-0.285*** (0.010)	-0.274*** (0.010)			-0.228*** (0.007)	-0.213*** (0.007)
First Gen			0.190*** (0.020)	0.091*** (0.022)			0.160*** (0.016)	0.084*** (0.016)
Part-Time			0.008 (0.009)	-0.028*** (0.009)			0.076*** (0.007)	-0.005 (0.008)
Average SAT				-0.000*** (0.000)				-0.000*** (0.000)
Admit Rate				0.084*** (0.012)				0.068*** (0.008)
<i>N</i>	4978	4978	4073	4073	4978	4978	4073	4073
adj. <i>R</i> <sup>2</sup>	0.266	0.335	0.493	0.512	0.127	0.338	0.572	0.610

The dependent variable in all regressions is *NegativeReturnRate*. Average SAT is 0 for all schools that didn't report an average SAT score. Admit Rate is 1.00 for all schools that don't report their admissions rate. Columns (1)-(4) present the unweighted results. In columns (5)-(8), the observations are weighted by school size. SEs are reported in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$