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THEORY AND EXPERIMENTAL EVIDENCE

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Behavioral Effects of Student Loan Repayment Plan Options on Borrowers' Career Decisions:
Theory and Experimental Evidence

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ABSTRACT

We study the effects of available student loan repayment plans on borrowers' career choices. By removing the risk of loan default, income driven repayment (IDR) plans make higher-paying but riskier jobs more attractive to those with moderate skill levels. We present experimental evidence that student loan recipients consider the repayment plans offered to them as well as the plans available to other borrowers as a reference in their evaluations of loans and careers. Emotions such as regret over a choice that turns out to be suboptimal ex post and relief at being unburdened from having to make a choice that could turn out badly play significant roles in borrowers' career choices. Compared to giving borrowers a choice between a standard loan repayment plan that requires a fixed amount to be repaid over a shorter period and an IDR plan that protects borrowers from default by linking payments to income, offering only the IDR plan generates notable benefits. Removing the standard plan from borrowers' choice sets makes remunerative but risky careers more appealing to borrowers and raises their expected net income. Moreover, these effects are strongest when borrowers holding different plans coexist in the population, as in this environment relief from the possibility of being exposed to a regret-triggering situation is most salient.

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A data appendix is available at <http://www.nber.org/data-appendix/w24804>

1. Introduction

Over the past decade, college students in the United States have taken on increasing amounts of debt to finance their postsecondary educations.¹ The growth in student borrowing has been accompanied by increases in delinquency and default rates.² In recent cohorts of borrowers, almost 30% defaulted on their loans within 5 years of entering repayment (Looney and Yannelis, 2015). Student loans remain a necessity for many students to finance their education, and for the average borrower, the lifetime earnings gain from college attendance will significantly exceed the cost of borrowing (Avery and Turner, 2012). Even borrowers who will eventually receive a positive return on their postsecondary investment, however, may struggle to repay their loans. An important contributing factor is that the standard repayment plan – which requires borrowers to make fixed monthly payments over a 10-year period – is not well aligned with borrowers’ post-college earnings profiles (Dynarski and Kreisman, 2013; Barr et al., 2017). To address this concern, the U.S. Department of Education (hereafter, ED) has implemented and expanded income-driven repayment (IDR) plans that aim to protect borrowers from default by allowing payments to vary with earnings.

IDR addresses the risk of loan default due to low earnings by setting payments to \$0 when earnings fall below a set level.³ Under IDR, however, a borrower could make larger payments than would be required under the standard loan repayment plan. Thus, the availability of IDR may generate unintended spillovers to decisions in other aspects of borrowers’ lives. Theoretically, access to IDR will have ambiguous effects on career choice. On one hand, by linking payments to income, IDR reduces the expected relative return to choosing a high paying career (Lochner and Monge-Naranjo, 2016). On the other hand, by reducing downside risk, IDR could increase the likelihood that borrowers pursue higher-paying careers that involve more uncertainty and/or require a longer period of job search (Ji, 2017). While there is evidence that IDR can significantly reduce defaults (Hebst, 2018), little is known about the extent to which IDR affects borrowers’ labor market decisions and whether these effects vary with borrower ability.⁴

¹ Among public and nonprofit four-year college graduates in 2015-16, 60% had student debt averaging \$28,400 per borrower (Baum et al., 2017). Cumulative outstanding student loan debt stood at \$1.41 trillion as of March 2018, representing a 10-year increase of 143% (Federal Reserve Bank of New York 2018).

² Over the past 3 years, between 1.5% and 2.5% of borrowers in repayment defaulted on their federal student loans each quarter (U.S. Department of Education, 2018a). As of the first quarter of 2018, 14% of outstanding federal debt held by borrowers in repayment was classified as delinquent (U.S. Department of Education, 2018b).

³ Appendix A includes detailed descriptions of current U.S. student loan repayment options.

⁴ A handful of studies provide evidence that student loan debt affects borrowers’ choice of career. Field (2009) and Rothstein and Rouse (2011) focus on law school students and undergraduates enrolled in highly selective institutions, respectively. Weidner (2016) and Gervais and Ziebarth (2017) show that borrowers in older cohorts – who lacked access to IDR – were more likely to accept a low paying job that was less related to their degree than non-borrowers. Krishnan and

Our paper addresses this gap by investigating theoretically and experimentally how student loan repayment options affect borrowers' choices.⁵ Specifically, we compare borrowers' career choices in three settings — one in which both IDR and the standard fixed repayment (FR) plan are available to all borrowers, one in which some borrowers can choose between IDR and FR while others must participate in IDR, and one in which all borrowers must participate in IDR and do not have knowledge of other options. These three repayment regimes are policy relevant. Many countries have transitioned to universal IDR systems in the past three decades and legislation that would place all new borrowers into IDR has been proposed in the United States.⁶

In the absence of behavioral biases, eliminating the standard repayment plan and requiring all borrowers to participate in IDR should not affect the career choices of borrowers who would have selected IDR when both types of plans were available. Because a borrower's job and loan repayment choices are decisions made under uncertainty, however, what appears to be the best choice *ex ante* may not turn out to have been the best choice *ex post*. A borrower who reevaluates her decision after this uncertainty has been resolved may come to regret her career and/or repayment plan choice. Giving a regret-averse borrower only the IDR repayment option eliminates a potential source of regret (over plan choice), making higher-paying but riskier jobs more attractive. When protection from regret over repayment plan choice is most salient – that is, when borrowers are told that the standard plan is available to be chosen by others – regret-averse borrowers who are only allowed to choose IDR should be even more likely to choose the higher-paying but riskier jobs.

We first investigate theoretically a two-period environment in which risk-neutral borrowers vary in their probability of success in a difficult (risky but high paying) career. A borrower decides between FR and IDR, and between a difficult and easy (safe but low paying) career. Her earnings will depend on job choice and ability; if the borrower is successful in her chosen career, she will be paid, otherwise she will not receive any income. Borrowers who choose the FR plan must make a fixed payment only in the first period (mirroring the shorter horizon of the standard repayment plan), but

Wang (forthcoming) show that the removal of student loans from bankruptcy protection reduced the likelihood of successful entrepreneurship.

⁵ In theory, loan repayment options could influence prospective students' educational investment decisions (Findeisen and Sachs, 2016), but most borrowers are not well-informed about available options (U.S. Government Accountability Office, 2015). Boatman and Evans (2017) report that over 50% of community college students responding to a 2015 survey said that they did not know about IDR and an even smaller share of high school seniors and adults without college degrees reported knowledge of IDR. Furthermore, the establishment of universal IDR in Australia did not affect college enrollment or degree receipt (Chapman and Nicholls, 2013).

⁶ Countries that have adopted universal IDR include Australia (1989), New Zealand (1992), South Africa (1994), the United Kingdom (1998), Hungary (2003), South Korea (2012), and the Netherlands (2012) (Chapman 2006; Lochner and Monge-Naranjo 2016). Students in these countries still may be able to finance college with private loans or family resources, but they do not have access to government guaranteed loans outside of IDR. In the U.S. context, the 2013 ExCEL Act and the 2014 Dynamic Repayment Act would have limited new borrowers to IDR.

risk “default” if they do not have sufficient earnings. The easy job pays enough to fulfill the FR repayment obligation, thus, only borrowers who choose the difficult career risk defaulting on their loans. Borrowers who default are not allowed an opportunity to earn income in the second period. In contrast, under IDR, the borrower must pay a percentage of her income in both periods but does not risk default.

While borrowers with sufficiently low ability always should choose the easy career and those with sufficiently high ability always should choose the difficult career, the decisions of borrowers with intermediate ability may be affected by the decision-making environment. For these borrowers, there will be a cutoff in the probability of being successful at the difficult job such that borrowers whose success probability exceeds this threshold should choose the difficult job and those whose success probability is below the threshold should choose the easy job. The surplus-maximizing cutoff for any period equates the expected returns to performing the difficult and the easy jobs. When FR is the only available repayment plan, the risk of defaulting will lead some borrowers with a probability of success above this threshold to choose the easy job.⁷ In contrast, IDR eliminates the risk of default, and thus encourages these marginal borrowers to choose the difficult job. In the absence of behavioral biases, offering only IDR or offering both IDR and FR should lead to the same percentage of students choosing the difficult job. In the presence of anticipated regret, however, fewer students will pick the difficult job when both IDR and FR are offered than when only IDR is offered.

There are two sources of regret in this environment: regret due to loan choice and regret due to career choice. Consider a skilled student who is planning to choose a more remunerative but riskier career path. If she chooses IDR and is successful enough that she would have ended up paying less under the standard loan repayment plan, she will regret not having chosen FR. On the other hand, if she chooses FR and is unsuccessful in the riskier career, she will regret not having chosen the safer but lower-paying path along which she could have paid her debt in full and avoided the negative consequences of a loan default. Anticipating the possibility of regret, a borrower may alter her decisions to reduce the possibility of suffering from regret (Bell, 1982; Loomes and Sugden, 1982).⁸ The role of regret has been studied in many economically relevant environments, such as auctions (Filiz-Ozbay and Ozbay, 2007; Filiz-Ozbay and Ozbay, 2010; Engelbrecht-Wiggans and Katok, 2008), rent seeking (Hyndman et al., 2012), consumer decision-making (Nasiry and Popescu, 2012) and

⁷ We do not need to assume risk aversion for this result, as it is due purely to the risk of default.

⁸ The importance of this phenomenon has been documented in the experimental literature (see, e.g., Zeelenberg, 1999 and Zeelenberg and Pieters, 2004).

product innovation (Jiang, et al., 2016), but ours is the first paper to study the role of anticipated regret in students' choice of career and loan repayment decisions.⁹

In addition to examining the effects of regret on borrowers' decisions, we also examine whether making borrowers aware that a potential source of regret – their choice of loan repayment plan – has been eliminated affects their decisions. Consider a setting in which students are aware that some people have been offered the opportunity to choose between FR and IDR, but they are given only the IDR option.¹⁰ Borrowers who are offered only IDR may feel *gratitude* for not being forced to choose between repayment options. Such borrowers may expect to benefit from IDR but also anticipate that there is some probability they would regret their choice of repayment plan if they were allowed to choose. In this environment, relief from the possibility of being exposed to a regret-triggering situation generates gratitude. We show theoretically that the presence of gratitude should increase the number of students attempting higher-paying but riskier jobs. To the best of our knowledge, the existing literature contains neither a behavioral theory nor experimental evidence on the effects of gratitude due to being protected from a negative emotion.

In the light of our theoretical results, we carry out an experiment to examine career choice among borrowers in the three settings we examine theoretically: (i) both IDR and FR are available to all borrowers (as is the case currently in the United States), (ii) most borrowers must participate in IDR but are aware that some borrowers have been allowed to choose between IDR and FR (as would be the case during a transition to universal IDR), and (iii) IDR is the only loan repayment option (as would be the case in the long run after a shift to universal IDR).. Our results are in line with the prediction of the theoretical model that incorporates regret and gratitude: borrowers are most likely to choose the difficult career in setting (ii) and least likely to choose the difficult career in setting (i).

The remainder of the paper proceeds follows: Section 2 introduces a model of career and loan repayment choice for regretful and grateful borrowers. Section 3 discusses the predictions of the theoretical model for the parameter values used in the experiment we have carried out. The experimental procedures are explained in Section 4. Section 5 presents experimental results and Section 6 concludes.

⁹ A growing body of research examining students' borrowing and repayment decisions suggests that such decisions are influenced by factors such as debt aversion, framing, and self-control issues (e.g., Field, 2009; Cadena and Keys, 2013; Marx and Turner, 2017; Abraham et al., 2018).

¹⁰ This environment corresponds to a transition from the current environment in which students may choose between IDR and FR to an environment in which only IDR is offered. Students who had only the IDR option following the transition would be aware that such a choice had been available in the recent past.

2. Theory

We begin our theoretical investigation of student borrowers' career and loan repayment choices with a simple model containing no behavioral features in which borrowers choose the careers with the highest expected payout given their loan repayment plan. We then introduce into the model the ideas of regret over making a choice that turns out to be suboptimal *ex post* and gratitude for being spared the necessity to make a choice that might lead to regret. The roles that envy and risk aversion might play in our setting are then briefly considered.

A Simple Model of Student Borrowers' Career Choices

Assume that there is a risk-neutral agent who has previously taken out a loan; this can be thought of as an education loan. The agent must now choose a task to be performed in the current and following period to earn income that will be used to repay the loan and for consumption. In this environment, the choice of task can be thought of as the choice of a career and we use the two terms interchangeably.¹¹ There are two types of tasks (careers) available to the agent – an Easy task (denoted by E) and a Difficult task (denoted by D). There is no risk associated with choosing the Easy task; the agent completes this task successfully every time she attempts it. Choosing the Difficult task entails more risk, as the agent's performance in that task is uncertain, with a success rate denoted by $p \in [0,1]$. The probability of success is known to the agent. Successfully performing the Easy task during a period pays L ; successfully performing the Difficult task pays H , where $H > L > 0$. Assume that performance of the tasks is costless to the agent. From the perspective of an omniscient social planner who wishes to maximize total surplus and would like to see agents allocated to tasks accordingly, in any period, an agent with a success rate of p such that $pH > L$ should choose the Difficult task, and an agent with a success rate of p such that $pH < L$ should choose the Easy task. In other words, there exists a unique cut-off:

$$p^* = \frac{L}{H}$$

such that the surplus maximizing choice of any agent with $p > p^*$ is the Difficult task.¹²

¹¹ We study a two-period model, as two periods represents the minimum horizon over which the fixed repayment plan can have a shorter repayment period than income-driven repayment.

¹² The total surplus depends only on the task return, as the loan repayment is just a transfer from the borrower to the lender. For notational simplicity, we set the discount rate equal to 1. Having two periods does not change the surplus maximizing cutoff for the success rate: ($p^* = \frac{L}{H}$) since $p^2(2H) + 2p(1-p)H \geq 2L$ also implies the same threshold $p^* = \frac{L}{H}$.

The requirement that agents repay their loan and the menu of available repayment options may shift agents' career choices away from those that would be surplus maximizing. We consider two repayment plans.¹³ The first is the standard mortgage-style Fixed Repayment (FR) plan, which requires the agent to make a fixed payment of $k > 0$ in the first period. If she does not earn enough to make this payment, she is considered to have defaulted on the loan and is denied the opportunity to earn money in the second period. This feature of the model is an admittedly simplified means of incorporating the idea that defaulting on a loan imposes large financial costs on borrowers. If the agent successfully makes the required payment in the first period, she has fully paid off her loan and keeps all of her second period earnings for consumption. For someone who is repaying a loan under the FR plan, choosing the Easy task (career) is the safe option, since $L > k$ and the borrower is certain to earn enough to make the required loan payment. The two-period payoff for choosing the Easy task under the FR plan is:

$$\begin{aligned}\pi_{E,FR} &= (L - k) + L \\ &= 2L - k\end{aligned}$$

On the other hand, the agent who repays her loan under the FR plan and attempts the Difficult task (career) is taking a risk. If the agent fails to perform the Difficult task successfully in the first period, she earns nothing in the first period, defaults on her loan, and loses the opportunity to earn in the second period. The expected two-period payoff for choosing the Difficult task under the FR plan is:

$$\begin{aligned}\pi_{D,FR}(p) &= p^2(2H - k) + p(1 - p)(H - k) \\ &= p^2H + p(H - k)\end{aligned}$$

where the first term is the payoff received in the event that the agent succeeds in both periods (which has probability p^2) and the second term is the payoff received in the event that the agent succeeds in period one and fails in period two (which has probability $p(1 - p)$).

A risk neutral agent without any behavioral biases will choose the Difficult task when its expected payoff is higher than the payoff of the Easy task.

¹³ Note that we are assuming throughout that the agent does not save for the future and cannot borrow against future expected earnings. This is consistent with evidence that recent college graduates face liquidity constraints (Rothstein and Rouse, 2011).

Proposition 1: *In the absence of behavioral biases, for risk neutral agents repaying a loan under the FR plan, there exists a unique p^{FR} , such that every agent with a success rate of $p \geq p^{FR}$ attempts the Difficult task and $p^{FR} > p^*$.*

Proposition 1 holds because, under FR, the risk of defaulting scares some agents away from attempting the Difficult task, so that fewer than the surplus maximizing number of people choose it. Intuitively, a borrower who defaults on her loan loses the opportunity to earn in the second period, meaning that the risk of default lowers her expected two-period payoff relative to that from choosing the Easy task. This is partially offset by the risk of default also reducing the amount she expects to repay on her loan. On net, however, the risk of default reduces the payoff expected from choosing the Difficult task relative to that from choosing the Easy task and leads borrowers to require $p^{FR} > p^*$ in order to attempt the Difficult task.¹⁴

The second repayment plan we consider - Income Driven Repayment (IDR) - removes the risk of default. IDR requires the agent to pay back a set percentage (denoted by i) of her earnings in each of the two periods in the model.¹⁵ If the agent fails at her chosen task in the first period (and thus has no earnings), she is not required to make a loan payment and is allowed to work in the second period.

Our description of IDR abstracts from many of the complexities in U.S. borrowers' current choices (e.g., time and information gathering costs associated with plan choice) to highlight the particular features of students' decisions that are most relevant for the question of how borrowers would respond to having more versus less choice over repayment options. Appendix A includes detailed descriptions of the repayment options currently available to U.S. student borrowers. The IDR features of particular interest are that: (i) IDR commonly requires a longer repayment period than FR, (ii) IDR removes the risk of loan default due to low earnings, and (iii) IDR may reduce the return to higher-paying jobs by linking payments to earnings.¹⁶ Both the model and the experiment are structured to reflect these features.

The expected two-period payoff for choosing the Difficult task under IDR is:

¹⁴ The proof of Proposition 1 as well as the proofs of the paper's remaining propositions are provided in Appendix B.

¹⁵ Since the IDR plan is offered to remove the possibility of default and there is no risk of defaulting when an agent chooses the Easy task, we set i such that a borrower choosing the Easy task will be indifferent between the FR and IDR plans. This assumption is not required for our analysis, but making it allows us to focus on the task choice of moderate ability borrowers in an environment that offers varied repayment options.

¹⁶ Some existing IDR options cap payment amounts in each period at the amount the borrower would have paid under FR. We abstract from this feature to highlight the effects of a longer repayment period (and potentially higher payments) and the elimination of default risk in borrowers' labor supply decisions.

$$\begin{aligned}\pi_{D,IDR}(p) &= p^2[2H(1-i)] + 2p(1-p)[H(1-i)] \\ &= 2pH(1-i)\end{aligned}$$

where the first term is the payoff received in the event that the agent succeeds in both periods (which has probability p^2) and the second term is the payoff received in the event that the agent succeeds in either period one or period two but not both (which has probability $2p(1-p)$). Note that if she fails in both periods, the agent earns zero and pays back zero. The payoff for the Easy task under IDR is:

$$\begin{aligned}\pi_{E,IDR} &= L(1-i) + L(1-i) \\ &= 2L(1-i)\end{aligned}$$

Proposition 2: *In the absence of behavioral biases, for risk neutral agents repaying a loan under IDR, there exists a unique p^{IDR} , such that every agent with a success rate of $p \geq p^{IDR}$ attempts the Difficult task and $p^{IDR} = p^*$.*

Proposition 2 holds because, under IDR, the expected two-period payoff to the Difficult task will equal the payoff to the Easy task at the same probability that the omniscient social planner would use as the surplus-maximizing threshold for assigning borrowers to the Difficult task (i.e. $p^{IDR} = p^*$.) In other words, under IDR, risk neutral borrowers will make the same decision about which task to perform that a social planner would have chosen for them.

Furthermore, Proposition 2 does not depend on the percentage of earnings i that the borrower must pay on her loan. In other words, for any value of i , IDR leads agents to make the surplus maximizing choices. A lender seeking to maximize revenue would like to set a high value of i . For lower-ability borrowers who choose the Easy task however, the insurance provided by IDR has no value and it would penalize such borrowers to set i so high that they paid more under IDR than they would have paid under FR. The highest that i can be set without making agents who choose the Easy task worse off under IDR than under FR is to set it at the level that makes such agents indifferent between the IDR and the FR plans, i.e. to set $i = \frac{k}{2L}$. Thus, in the rest of what follows, we assume that i takes this value, which allows us to focus on the behavior of those for whom the insurance provided by IDR has value and could affect their choice of task.

Adding Regret and Gratitude to the Model

Thus far, this analysis has assumed that an agent evaluates a loan repayment plan and task independent of the set of loan repayment plans available to her. In reality, an agent who commits to a certain loan repayment and task choice may compare her outcome either with the outcomes that her alternative options would have delivered or with the outcomes that other decision makers receive in a given state of the world. In the event of a discrepancy between her *ex-post* payoff and the best payoff associated with a forgone alternative in the realized state, an agent may suffer from the negative emotion of regret.¹⁷ If the agent is given more options from which to choose, there is more opportunity for her to feel regret over her decisions.

In the environment we have described, there are two potential sources of regret: regret over choice of repayment plan and regret over choice of task. We hypothesize that, even holding the characteristics of an agent's chosen plan constant, having more plans in the market may reduce the agent's expected utility by increasing the likelihood she will regret her choice of plan. Simplifying the agent's decision problem by eliminating some choices could actually raise utility by shutting down potential sources of regret. Hence, in the presence of behavioral biases, the context within which IDR is offered may affect agents' decisions about performing the Difficult task.

There are three ways that IDR could be made available to borrowers:

Choice (C): Both the FR and the IDR plan are available and borrowers are free to choose between the two options.

No Choice (NC): Borrowers are offered only the IDR plan.

No Choice with a Reference Group (NCR): Both the FR and the IDR plans are present but the agents of interest are assigned to the IDR plan. The remaining agents are offered a choice between the FR and IDR plans. Members of both groups are aware of the choices given to members of the other group.

Following the theory of regret, an agent may experience regret if she learns that the outcome associated with a foregone alternative is better than the outcome associated with the chosen alternative. Moreover, the bigger the foregone payoff, the more regret an agent may feel. Formally,

¹⁷ A related possibility is that borrowers rejoice when they realize *ex post* that they made the right choice. Theoretically, the effects of anticipated rejoicing due to having made the right choice will be the opposite of the effects of anticipated regret due to having made the wrong choice (see, e.g., Loomes and Sugden, 1982). Our analysis thus can be viewed as capturing the net effect of the negative emotion of regret and the positive emotion of rejoicing.

the regret function, $R(\cdot): \mathbb{R} \rightarrow \mathbb{R}_+$, which depends on the payoff difference between the best foregone alternative and the chosen alternative, is assumed to be non-decreasing with $R(x) = 0$ for any $x \leq 0$.

When an agent attempts the Easy task, she does not know for sure what would have happened had she chosen the Difficult task unless her probability of success in the Difficult task is 1.¹⁸ Hence, she should not feel regret about not having chosen the Difficult task. If she attempts the Difficult task, however, she is able to compare the realized outcome with all of her possible foregone options.

Under *NC*, when she is forced into IDR, the agent who chooses the Difficult task may regret her choice of task, but she cannot regret her choice of repayment plan, as she is aware of only one plan. Regarding her choice of task, if the agent fails in the Difficult task, she may regret not having chosen the Easy task and getting a payoff of $2L(1 - i)$. If she fails in the Difficult task in both periods, she receives no payoff and the intensity of her regret for not having chosen the Easy task will be proportional to $2L(1 - i)$. If she fails in the Difficult task in one of the periods, she receives a payoff of $H(1 - i)$ and will experience regret if $H < 2L$. In this case, the intensity of her regret will be proportional to $2L(1 - i) - H(1 - i)$. In order to minimize the number of potential sources of regret, we assume $H > 2L$. Thus, under *NC*, which offers only IDR, the utility of attempting the Difficult task becomes:

$$U_{D,IDR}^{NC}(p) = \pi_{D,IDR}(p) - (1 - p)^2 R(2L(1 - i))$$

Under *C*, there are two potential sources of regret: regret about task choice and regret about plan choice. An agent who chooses the Difficult task and ends up with high earnings will make larger loan payments (and take home less income) under IDR than under FR. Therefore, when the agent chooses IDR, in addition to the potential regret associated with the choice of task anticipated in *NC*, there is also the potential for regret due to not having chosen the FR plan. If the agent performs the Difficult task successfully in both periods, she receives a payoff of $2H(1 - i)$ under IDR but the same task performance would have yielded a payoff of $2H - k$ under FR. In this case, the intensity of her regret will be proportional to $2H - k - 2H(1 - i)$. If she performs the Difficult task successfully only in the first period, she receives a payoff of $H(1 - i)$ under IDR, but she would have received a payoff of $H - k$ under FR. Further, had she chosen the Easy task, she would have received a payoff of $2L(1 - i)$. The intensity of her regret in this case (performing the Difficult task under IDR and

¹⁸ In our subject pool, only 1 out of 274 subjects was 100% successful in the Difficult task.

succeeding only in the first period) will be proportional to $\max\{H - k, 2L(1 - i)\} - H(1 - i)$. Given our assumptions that $H > 2L$ and that $k = 2Li$ so that the payoff to the easy task is the same under FR and IDR, $H - k > 2L(1 - i)$, and the regret term for this case reduces to $H - k - H(1 - i)$. Thus, under C , the utility of attempting the Difficult task under IDR becomes:

$$U_{D,IDR}^C(p) = \pi_{D,IDR}(p) - (1 - p)^2 R(2L(1 - i)) - p(1 - p)R(H - k - H(1 - i)) - p^2 R(2H - k - 2H(1 - i))$$

Giving the agent the option to choose her loan repayment plan may decrease her utility. If the agent selects IDR, the presence of the FR plan will invoke regret in states where the payoff under FR would have been larger than the realized payoff under IDR. An agent who anticipates this regret may prefer not having to choose a loan repayment plan and be grateful if she realizes that someone else has made this choice for her. The extent of her gratitude for not having to choose a loan repayment plan will depend on the intensity of any anticipated regret that would have been associated with having to make that choice. Formally, the gratitude function, $G(\cdot): \mathbb{R}_+ \rightarrow \mathbb{R}_+$ is assumed to be non-decreasing with $G(0) = 0$.

Under NCR , the agent's regret is based only on choice of task, and thus is identical to that under NC . In this environment, however, an agent who chooses the Difficult task and performs it successfully may be grateful that she did not have the FR option. Under C , had she chosen IDR when the FR plan was available and then succeeded in the Difficult task, she might have regretted her choice of plan. Any regret anticipated in C from choosing IDR increases the agent's utility under NCR . As already mentioned, under C , if the agent chooses IDR and performs the Difficult task successfully in both periods, her anticipated regret is $R(2H - k - 2H(1 - i))$. The intensity of her gratitude under NCR will be proportional to this anticipated regret. If she succeeds only in the first period, she also may experience regret under C due to not choosing the FR plan. Under the assumptions we are making, the intensity of her gratitude under NCR for succeeding only in the first period will be proportional to $R(H - k - H(1 - i))$. Hence, under NCR , the utility of attempting the Difficult task under IDR becomes:

$$U_{D,IDR}^{NCR}(p) = \pi_{D,IDR}(p) - (1 - p)^2 R(2L(1 - i)) + p(1 - p)G(R(H - k - H(1 - i))) + p^2 G(R(2H - k - 2H(1 - i)))$$

Based on these utilities, we can compare the proportions of agents who choose the Difficult task under C, NC, and NCR.

Proposition 3: *The threshold probability of success in the Difficult task that makes a risk neutral agent indifferent between the Difficult task and the Easy task for C, NC, and NCR can be characterized as follows: For any $x > 0$,*

$$\begin{aligned}
 p^C &= p^{NC} = p^{NCR} = p^* && \text{if } R(x) = 0 \\
 p^C &> p^{NC} = p^{NCR} > p^* && \text{if } R(x) > 0 \text{ but } G(R(x)) = 0 \\
 p^C &> p^{NC} > p^{NCR} && \text{if } R(x) > 0 \text{ and } G(R(x)) > 0
 \end{aligned}$$

Proposition 3 states that if agents do not anticipate regret, then under all three conditions (C, NC and NCR), they will make surplus maximizing task choices. If the agents anticipate regret but do not anticipate gratitude, all three conditions will lead fewer than the surplus maximizing number of people to choose the Difficult task. Since the FR plan is an option only in C, there is more potential for regret and hence fewer people will attempt the Difficult task under C than under NC or NCR. Finally, if agents are grateful when they know that they have been precluded from choosing an option that could have produced regret, the largest number of people will attempt the Difficult task under NCR.

Alternative Models

Note that our model offers regret and gratitude as two potential behavioral motives in evaluating risk. Our experiment is designed to test the implications of those potential motives for borrowers' behavior.

Envy is another negative emotion that could affect agents' choices. An agent may be envious if she receives a lower payoff than the payoff to her reference group (see e.g. Fehr and Schmidt, 1999 and Bolton and Ockenfels, 2000). Such an envious agent may be willing to pay in order to reduce the payoff to others (see Zizzo and Oswald, 2001). Furthermore, anticipation of envy may lead to suboptimal behavior (see Mui, 1995). In our setup, under NCR, agents are forced into IDR but know that other agents were given the FR option. In this environment, an agent who chooses the Difficult task and performs it successfully will realize that an agent who completed the same task under FR would have received a higher payoff. This could lead the agent to envy those who were given the FR

option.¹⁹ In contrast, under NC , agents know that anyone who succeeds in the Difficult task receives the same payoff and hence there is no scope for envy. Likewise, under C , all agents are given the same choices, meaning that no one should be envious of anyone else. Thus, an agent who is prone to envying the opportunities made available to others will be less likely to choose the Difficult task under NCR than under either NC or C . Furthermore, since there should be no envy under either NC or C , a model with envy will predict no difference in the choices under those two scenarios. Hence, the behavioral motive of envy would lead to the prediction that $p^{NCR} > p^C = p^{NC} = p^*$.

Risk aversion is an additional factor that could affect agents' decisions, specifically the choice between the Easy and the Difficult task. Because performance in the Difficult task is uncertain, the Difficult task will be less desirable for agents who are more risk-averse. In the absence of behavioral biases, however, risk aversion on its own does not lead to a prediction that the way in which the IDR plan is introduced will affect the choices made by agents under IDR. Hence, for risk-averse agents, absent behavioral biases, we would predict $p^C = p^{NC} = p^{NCR} > p^*$.

3. Experimental Setup and Predictions

The model presented in the previous section motivates the experiment we designed to assess its predictions. In the experiment, we set the payment L (for performing the Easy task) to \$4 and the payment H (for successfully performing the Difficult task) to \$10. The fixed loan repayment amount k under the FR plan is set at \$3.20 and the pay back percentage i under IDR is set at 40% of earnings, which implies a payment of \$1.60 per period for an agent performing the Easy task and \$4.00 per period for an agent successfully performing the Difficult task. An important aspect of these parameters is that the agent who chooses the Easy task is indifferent between FR and IDR. We simplify the loan choice problem for borrowers who should always choose the Easy task because our interest lies with how the availability of loan repayment plan options affects borrowers on the margin of choosing between the Difficult and Easy tasks. Note that while the total loan payment under the IDR plan for agents performing the Easy task is \$3.20, the total loan payment under the Difficult task can be \$0, \$4, or \$8 depending on the outcome realizations in each period.

Up to four different combinations of task and loan repayment plan choices are relevant to an agent. Plugging the parameter values specified for the experiment into the model from Section 2, the two-period payoff for task X and loan plan Y generates the following expected return $\pi_{X,Y}$, for $X \in \{Easy, Difficult\}$, $Y \in \{FR, IDR\}$, and a success rate of p in the Difficult task:

¹⁹ Note that, because we picked the parameters to make the expected return to the Easy task the same under IDR and FR, an agent who chooses the Easy task will have no reason to be envious.

$$\pi_{E,FR} = (4 - 3.2) + 4 = 4.8$$

$$\pi_{D,FR}(p) = p^2(20 - 3.2) + p(1 - p)(10 - 3.2) = p^2(16.8) + p(1 - p)(6.8)$$

$$\pi_{E,IDR} = 4(1 - 0.4) + 4(1 - 0.4) = 4.8$$

$$\pi_{D,IDR}(p) = p^2[20(1 - 0.4)] + 2p(1 - p)[10(1 - 0.4)] = 12p$$

Figure 1 displays the expected payoffs under FR and IDR as a function of the probability of success in the Difficult task. By design, the expected payoff for an agent who chooses the Easy task is the same under FR and IDR. There are two critical levels for p in Figure 1: $p^* = 0.40$ and $p^{**} = 0.52$. Any agent whose probability of success in the Difficult task is lower than 0.40 earns a higher expected payoff by choosing the Easy task, which pays less but can be performed successfully with certainty. Any agent whose probability of success in the Difficult task is between 0.40 and 0.52 earns the highest expected payoff by choosing the Difficult task and IDR. For these agents, the insurance provided by IDR is more valuable than the possibility of making smaller loan payments under FR. Finally, agents whose probability of success in the Difficult task is greater than 0.52 will earn the highest expected payoff by choosing the Difficult task and FR. For these agents, the insurance provided by IDR is not as valuable as making lower loan repayments under FR.

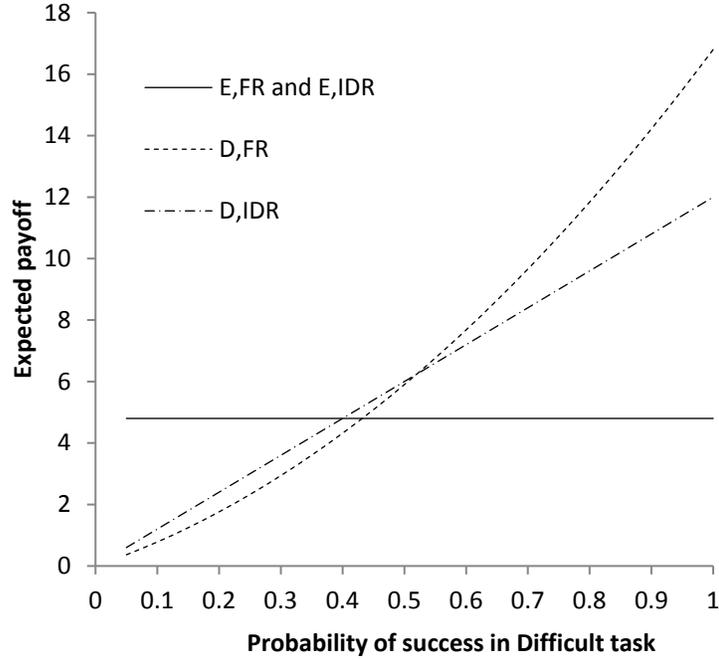


Figure 1. Expected payoff of each task under each loan repayment plan

As noted in Section 2, the above analysis assumes that an agent evaluates a loan repayment plan and task independent of the set of loan repayment plans available to her. Allowing for the possibility of *ex post* regret about her choices and gratitude for not having to make a choice that could turn out badly will alter an agent's evaluation of the Difficult task under IDR. To illustrate the predictions of Proposition 3, we assume linear regret and gratitude functions, $R(x) = \alpha x$ with $\alpha \geq 0$ and $G(x) = \gamma x$ with $\gamma \geq 0$, respectively, and write the expected utility of such a behaviorally motivated agent for the values used in the experiment:

$$U_{D,IDR}(p) = [12p] - \alpha[(1-p)^2(4.8-0)] - I_C \alpha [p^2(16.8-12) + p(1-p)(6.8-6)] + I_{NCR} \gamma \alpha [p^2(16.8-12) + p(1-p)(6.8-6)]$$

In the above formula we introduce the indicator functions I_C , which takes the value 1 for those assigned to Treatment C and zero otherwise, and I_{NCR} , which takes the value 1 for those assigned to Treatment NCR and zero otherwise.

Figure 2 shows the expected utility associated with the Easy task and the Difficult task as a function of p under the IDR plan for each treatment when agents can regret their choices.²⁰ The availability of both repayment plans in Treatment *C* shifts the utility of the Difficult task under IDR downwards relative to the utility that could be gained if only IDR was available, as in Treatment *NC*. In contrast, restricting some subjects to IDR while making them aware that there are subjects who were required to choose between FR and IDR (as in Treatment *NCR*) shifts the utility of choosing the Difficult task under IDR upwards with respect to Treatment *NC*.

These shifts lead to changes in the threshold probabilities of success in the Difficult task such that $p^C > p^{NC} > p^{NCR}$ as stated by Proposition 3. A higher threshold probability results in a smaller share of agents choosing the Difficult task. This theoretical prediction allows us to state the following hypothesis that can be tested by our experimental design.

Hypothesis: Treatment *NCR* will generate the largest share of subjects and Treatment *C* the smallest share of subjects choosing the Difficult task.

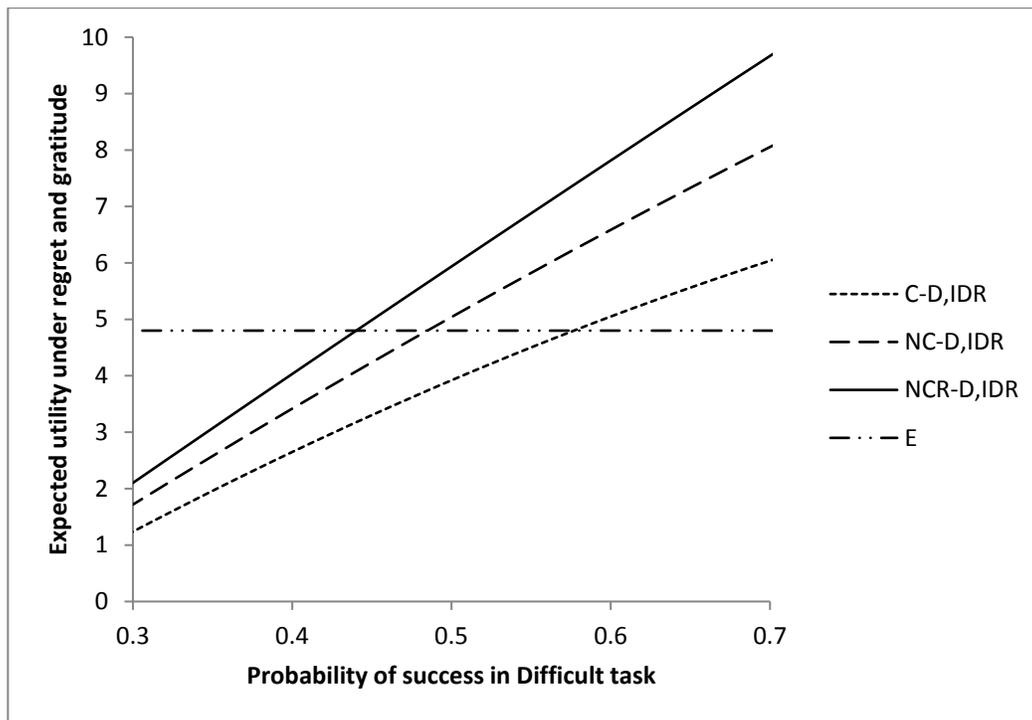


Figure 2. Expected utility of Easy and Difficult tasks under IDR plan by treatment, for $\alpha = 0.8$ and $\gamma = 0.8$.

²⁰ In this figure, α has been set to 0.8 and γ to 0.8. The qualitative relationships between the expected utility curves in Figure 2 hold for any nonzero values of α and γ .

4. Experimental Procedures

Nineteen sessions were conducted in the Experimental Economics Laboratory at the University of Maryland. One of the three treatments was administered during each of these sessions – Treatment *C* (Choice) (7 sessions), Treatment *NC* (No Choice) (6 sessions), and Treatment *NCR* (No Choice with a Reference Group) (6 sessions). There were a total of 91, 90 and 91 subjects who participated in Treatments *C*, *NC*, and *NCR*, respectively.²¹ No subject participated in more than one treatment. Instructions were provided in the form of printed handouts and also were read aloud to subjects to ensure that everyone received the same information.²² The experiments were programmed and conducted with the software z-Tree (Fischbacher, 2007). Each session lasted approximately one hour and subjects earned \$14.50 on average.

The characteristics of our experimental subject pool align closely with those of the University of Maryland undergraduate student body in terms of gender, age, SAT results, debt holding, and financial literacy (see Appendix D for the details of the comparisons). Our experimental sessions were divided into three parts. Subjects received the instructions for each part of the session at its beginning, so that those engaged in the earlier parts of the experiment did not know what would come later. In Part 1, which was the same for all three treatments, each subject performed 30 Easy tasks and 30 Difficult tasks.²³ Each Easy task involved typing a five-letter word that was shown on the subject's screen. Subjects had 20 seconds to type each word and they were paid \$0.10 per correctly typed word. Each Difficult task required subjects to answer a cognitive question from a sample SAT test. Subjects had one minute to answer each question and they were paid \$0.10 for each question they answered correctly. At this point, subjects did not know exactly how their performance on these tasks would affect their later earnings, but they were told that performing better would have a positive and significant impact on their earnings in the next part of the experiment. At the end of Part 1, subjects' computer screens showed them how many of the 30 questions of each type they had answered correctly. Figure 3 displays the distribution of the share of Difficult task questions subjects answered correctly. Recall that, in any given period, when $p \geq 0.40$, choosing the Difficult task generates the highest expected earnings. Figure 3 shows that more than 80% of participants were able to answer at least 40% of the Difficult task questions correctly.

²¹ A total of 92 subjects were recruited for Treatment *C*, but one subject left in the middle of a session. We drop this participant from the data.

²² The instructions for the experiment are provided in Appendix C.

²³ The instructions given to subjects referred to these as Type A tasks and Type B tasks rather than as Easy tasks and Difficult tasks.

The subjects next received the instructions for Part 2 of the experiment. These instructions varied according to the treatment for the subject's session. Subjects learned that they had to take out a \$2 loan to participate in Part 2 of the experiment, that they would have the opportunity to earn income over two periods, and that this income would be used to repay their loan. They were told how their earnings would be determined in each period depending on whether they chose to perform the Easy task or the Difficult task and also how their loan repayment amount would be determined depending on their loan repayment plan (either chosen by the subject or assigned to them, depending on the treatment). The subjects then were asked to choose the type of task that would determine their earnings and, in the case of Treatment *C* (and for one subject in each of the Treatment *NCR* sessions), to choose their loan repayment plan.

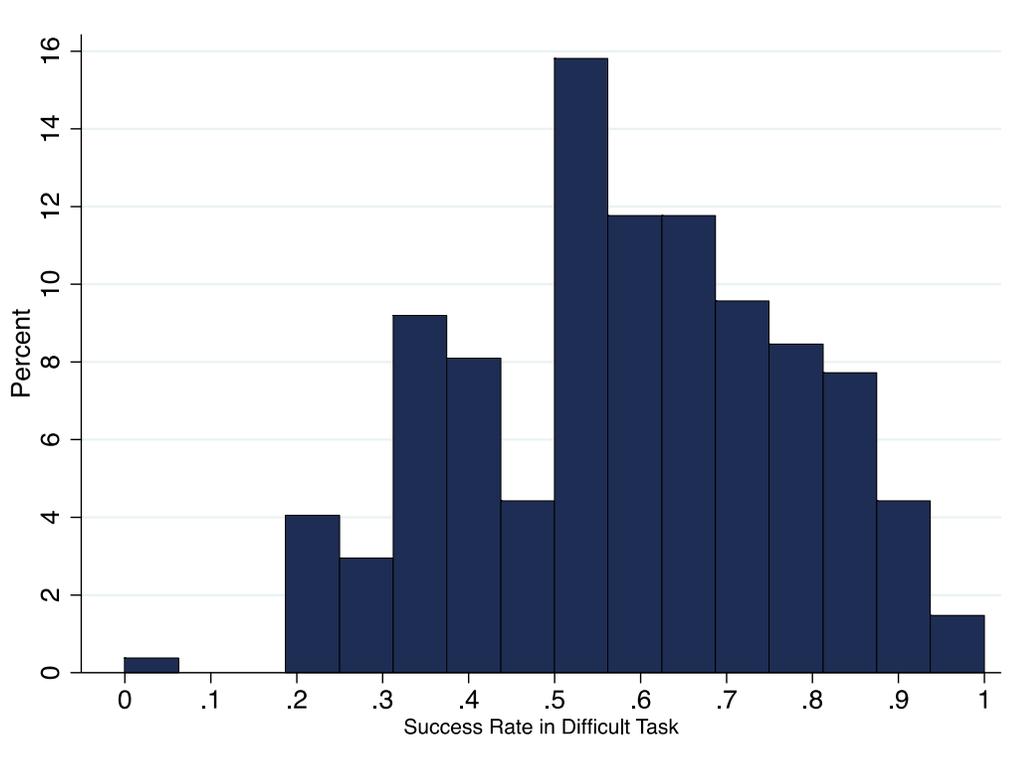


Figure 3: Distribution of success rate in Difficult task in experimental sample

The subjects did not perform their chosen type of task again in Part 2. Instead, they were told that, for each earnings period, the computer would randomly choose one of the questions that they had already answered in Part 1 according to their choice of task, and that their performance on the randomly selected question would determine their earnings in the period. For example, suppose that a subject chose to base her earnings on her performance in the Difficult task. In the

first earnings period, the computer would select one Difficult question out of the 30 the subject had answered in Part 1 as the basis for determining her earnings. If the subject had answered that question correctly, she would earn \$10 and make her loan payment from those earnings. Assuming the borrower avoided default in the first period, the same procedure would be followed in the second period to determine her earnings. At the point the subject was asked to choose the type of task on which her earnings would be based, her screen displayed her Part 1 performance on the two types of tasks, so that she knew the probability of success in each type of task before making her choice. We did not ask subjects to perform their chosen type of task again in Part 2 because we wanted them to be certain about their chances of success. This allowed us to rule out the influence of over- and under-confidence biases regarding their own skill level on subjects' decisions.

Our treatments are distinguished by the loan repayment options available in the session. The instructions for Part 2 provided the details of the repayment plans available in each subject's session. In Treatment *C*, both the FR and the IDR option were described. In Treatment *NC*, only the IDR option was described. In Treatment *NCR*, both the FR and the IDR options were explained to all subjects. Subjects also were told that some participants would be allowed to pick either the FR or the IDR plan, while the remainder of the subjects would not be allowed to choose and would be assigned to the IDR plan. At the time the instructions regarding the plans were given, a subject did not know if she would be a choosing subject or a non-choosing subject. Since our interest in Treatment *NCR* lies with the behavior of non-choosing subjects in the presence of choosing subjects, we assigned only one choosing subject in each session; all other participants in each Treatment *NCR* session were non-choosing subjects and our analysis makes use only of the data for the non-choosers. Once the instructions for Part 2 had been provided, each Treatment *NCR* subject's screen displayed whether they were allowed to choose their repayment plan. Choosing subjects then decided on their loan repayment plan and all subjects decided on their task type.

A subject's choice of task type applied to both periods. To ensure that subjects understood the decision about task and plan, subjects were given a quiz that presented them with scenarios and asked them to calculate the earnings, loan payments and net payoffs associated with those scenarios. A subject could not proceed until they had answered the quiz questions correctly. After the subjects made their task choices and (when allowed) plan choices, the computer reported the subjects' performance on the randomly selected task for period 1, the randomly selected task for period 2, their earnings in each period, and loan repayments according to their loan repayment plan. This concluded Part 2 of the experiment.

In Part 3, we elicited subjects' risk preference using a method devised by Holt and Laury (2002). Appendix C includes a screen shot of the ten binary choice problems that we used for implementing the Holt and Laury method. In each problem, subjects chose between an Option A and an Option B, with the problems designed so that Option B gradually involves less risk than Option A as one moves from the first to the tenth problem. More risk-averse decision makers should switch to Option B at a later problem in the sequence. This was the last incentivized activity of the experiment. After that, the subjects completed a short questionnaire that included questions about gender, age, debt holding, the subject's self-assessed willingness to take risk (measured on a scale from 0 for the most unwilling to 10 for the most willing), and SAT and/or ACT scores, together with two questions designed to assess subjects' financial literacy. This questionnaire is available at the end of Appendix C.

5. Experimental Results

We begin by reporting the performance of subjects assigned to different treatments on the tasks carried out in Part 1 of the experiment. Table 1 reports the average success rate of subjects in each treatment on the 30 Easy tasks and the 30 Difficult tasks they performed. The success rates in the Difficult task were substantially lower than those in the Easy task and very similar across the three treatments.

As intended, the success rates on the Easy task were very high in all three Treatments. In each treatment, however, a handful of participants did not succeed at the Easy task 100% of the time. Specifically, 2 out of 91 subjects in Treatment C, 3 out of 90 subjects in Treatment NC, and 3 out of 91 subjects in Treatment NCR made at least one error when completing the Easy task. In our regret model, the agent is required to know what would have happened had the alternative option been selected, as this is what determines the disutility from regret. This means that, strictly speaking, the model applies only for subjects who know for sure the outcome they would have realized had they chosen the Easy task. Thus, we exclude these 8 subjects from all analyses. We also exclude participants who were given a choice over repayment plans in Treatment NCR ($N = 6$) as we are interested only in the behavior of the non-choosing subjects in this treatment. As shown at the bottom of Table 1, these restrictions do not substantially alter the success rate on the difficult task across treatment groups or for the sample as a whole.

Table 1. Average Success Rate of Experiment Subjects by Task and Treatment

	Treatment C	Treatment NC	Treatment NCR	All
Success Rate on Easy Task	0.998 (0.016)	0.998 (0.010)	0.997 (0.014)	0.998 (0.014)
Success Rate on Difficult Task	0.588 (0.187)	0.578 (0.175)	0.595 (0.205)	0.587 (0.189)
Observations (full sample)	91	90	91	272
Success Rate on Difficult Task (restricted sample)	0.588 (0.188)	0.578 (0.176)	0.603 (0.195)	0.590 (0.186)
Observations (restricted Sample)	89	87	82	258

Standard deviations are in parentheses. The restricted sample excludes the 8 subjects with less than 100% success on the Easy task and the 6 choosing subjects in Treatment NCR.

Figure 4 shows the cumulative distributions of the Difficult task success probability in each of the three treatments. Kolmogorov-Smirnov tests do not reject the hypothesis that the distributions are the same (p -values from all pairwise comparisons are greater than 0.5). We likewise fail to reject the hypothesis that the distribution of the probability of success in the Difficult task is equal in the restricted sample for all pairwise comparisons across treatments. Hence, we deem our assumption that the subject pools participating in the different treatments did not differ from each other in terms of their ability to perform the Difficult task to be reasonable.

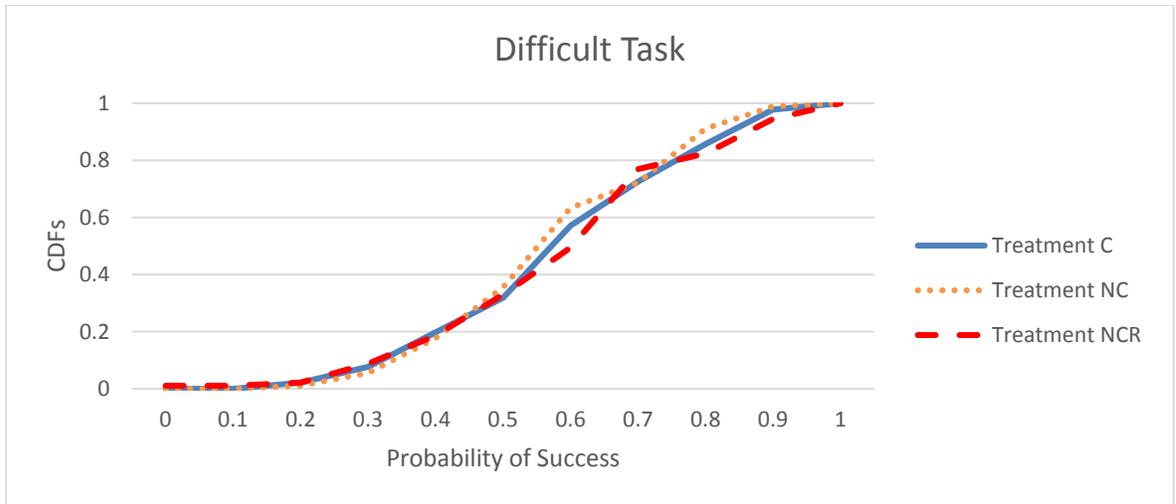


Figure 4. CDFs of probability of success in Difficult tasks in Treatment C, NC, and NCR

Switching from Easy to Difficult Task:

We hypothesize that, in the presence of regret and gratitude, the share of subjects choosing the Difficult task should be largest in Treatment *NCR* and smallest in Treatment *C*. The actual percentages of subjects choosing the Difficult task were 81.6%, 68.2%, and 61.4% in Treatments *NCR*, *NC*, and *C*, respectively (with $p < 0.05$ for all pairwise comparisons), a pattern consistent with our hypothesis.

Our prediction about the share of subjects choosing the Difficult task being different across treatments is driven by our behavioral model, which predicts shifts in the expected utility of choosing the Difficult task across the treatments. These shifts are caused by anticipation of regret about foregone choices and, in the case of Treatment *NCR*, gratitude for not having to make choices that could lead to regret. For each treatment, Proposition 3 states that there is a cutoff success rate for the difficult task such that a subject should pick the Difficult task if and only if her p is above that cutoff. Our behavioral model predicts that the threshold probability of success at which a subject would switch from the Easy task to the Difficult task will be lowest under Treatment *NCR* and highest under Treatment *C*. While in all treatments, subjects with a very high probability of success should pick the Difficult task and subjects with a very low probability of success should pick the Easy task, we expect to see differences in behavior across treatments among participants of moderate ability. This is because these agents face the potential for regret over both task and repayment plan choice and the latter source of potential regret will affect the choice of task difficulty.

Table 2 reports the percentage of subjects choosing the Difficult task among subjects with low-range, mid-range and high-range skills in this type of task. We consider participants to have mid-

range skills if their probability of success in the Difficult task falls between 0.25 and 0.75.²⁴ Subjects with low and high skill levels chose their task rationally; in all of the treatments, all of the subjects with a probability of success on the Difficult task below 25% chose the Easy task and all of the subjects with a probability of success above 75% chose the Difficult task. As predicted, differences in choosing the Difficult task across treatments arise from differences in the choices of the subjects with mid-range skills. Among these students, we observe the highest percentage (81.7%) choosing the Difficult task under Treatment *NCR* and the lowest percentage (50.7%) under Treatment *C*.

Table 2. Percentages of Experiment Subjects Choosing Difficult Task, by Treatment and Success Rate

Prob. of Success in Difficult Task	Treatment C	Treatment NC	Treatment NCR
$p \leq 0.25$	0%	0%	0%
$0.25 < p < 0.75$	50.7%	61.9%	81.7%
$p \geq 0.75$	100%	100%	100%
All	61.4%	68.2%	81.6%
Observations	89	87	82

Next, we estimate thresholds for choosing the Difficult task in each treatment. Note that perfect step functions exist only for perfectly rational and homogeneous subjects; hence in reality, there will not be a clear threshold dividing those who choose the Difficult versus the Easy task. We therefore look instead for the threshold probability of performing the Difficult task successfully such that more than half of agents with any probability above the threshold choose the Difficult task. We first estimate these thresholds via logistic regressions in which we relate choice of the Difficult task to the probability of performing the Difficult task correctly (see Table 3). Formally, the logistic function is $\exp(a + bx) / (1 + \exp(a + bx))$, and thus, it takes the value of 1/2 when $a + bx = 0$. In our case, the x variable is the probability of performing the Difficult task correctly, and we are interested

²⁴ The general pattern is robust to different choices for the range of p that is used to identify subjects with mid-range skills. See Table D.1 in Appendix D for mid-range skill boundaries of 0.33 and 0.66.

in identifying the threshold value of x such that subjects have a 50% probability of taking either action (see e.g. Cabral et al 2014). This threshold x^* can be found by setting $x^* = -a/b$, where a is the constant term and b is the coefficient estimated for the variable x (the success rate on the Difficult task) in Table 3. This methodology yields $p^C = 0.54$, $p^{NC} = 0.45$, and $p^{NCR} = 0.38$. This ranking of the estimated cutoff for being more likely than not to choose the Difficult task is consistent with Proposition 3 for strictly positive regret and gratitude parameters and in line with Figure 2.

Table 3. Logistic Regression on Choosing Difficult Task

	Treatment C	Treatment NC	Treatment NCR
Probability of Success in Difficult Task	11.90*** (2.510)	9.34*** (2.181)	15.08*** (3.904)
Constant	-6.42*** (1.434)	-4.19*** (1.180)	-5.73*** (1.727)
Observations	89	87	82
Log likelihood	-36.47	-39.62	-19.25

Standard errors in parentheses. *:p <.1, **: p <.05, ***:p<0.01

As a robustness check, we also calculate threshold probabilities for choosing the Difficult task using the methodology of Cabral et al. (2014). There are two ways to deviate from the step function: choosing the Difficult task when the probability of success is below the cutoff or choosing the Easy task when the probability of success is above the cutoff. We identify the minimum number of observations that would need to be eliminated to generate a data set in which the task choice becomes a step function. When we use this cutoff calculation strategy, we estimate $p^C \in [0.57, 0.60]$ by eliminating 15 out of 89 observations; $p^{NC} \in [0.41, 0.43]$ by eliminating 20 out of 87 observations; and $p^{NCR} \in [0.27, 0.33]$ by eliminating 8 out of 82 observations. Hence, the same ranking of the cutoffs is obtained as predicted by Proposition 3 with strictly positive regret and gratitude parameters.

These findings are not consistent with the “envy” model, which predicts $p^{NCR} > p^C = p^{NC}$. In other words, contrary to the prediction of the envy model, the NCR treatment did not discourage subjects from choosing the Difficult task.

Our findings also are not consistent with a story grounded purely in risk aversion as an explanation for agents’ behavior. On its own, risk aversion would increase the success probability

cutoff for choosing the Difficult task, but equally in all of the Treatments. Thus, the pattern of treatment differences we observe cannot be explained by risk aversion alone.

We further investigate the effect of attitudes towards risk on task choice in the models reported in Table 4. As in Table 3, the dependent variable in these logistic regressions is whether the subject chose the Difficult task. The sample for Table 4 includes all subjects for whom we have the information on risk attitudes and other individual characteristics needed to estimate the full set of included specifications. The model in column (1) is estimated without any of these controls. Consistent with the evidence already presented, the coefficient estimates imply that, holding constant a subject's probability of completing the Difficult task successfully, those in Treatment NCR are most likely, and those in Treatment C (the omitted treatment group) least likely, to choose the Difficult task. Our two measures of risk attitudes are introduced in the next three columns, the Holt-Laury Switch measure in column (2), the subject's self-assessment of their willingness to take risk in column (3), and both together in column (4). Although both measures take on coefficients of the expected sign (negative for the Holt-Laury measure which has larger values for people who are more risk averse and positive for the self-assessment measure which has larger values for people who are more willing to take risk), neither is statistically significant in any of these models and their introduction has a negligible effect on the coefficients estimated for the treatment dummy variables. Measures of various individual characteristics are introduced in the next two columns – whether female, age in years, and raw SAT score on a 2400 point scale in column (4) and those same variables plus number of financial literacy questions answered correctly (0, 1 or 2) and whether the subject had any student loan debt in column (5). None of these coefficients is statistically significant and their introduction has a negligible effect both on the treatment dummy coefficients and on the risk variable coefficient estimates.

Table 4. Logistic Regression on Choosing Difficult Task

	(1)	(2)	(3)	(4)	(5)	(6)
NC Treatment (yes=1)	0.948** (0.477)	0.941** (0.480)	0.964** (0.482)	0.956** (0.485)	1.005** (0.499)	0.981** (0.500)
NCR Treatment (yes=1)	2.677*** (0.635)	2.645*** (0.642)	2.698*** (0.636)	2.651*** (0.643)	2.549*** (0.662)	2.567*** (0.666)
Prob. of Success in Difficult Task	13.52*** (2.032)	13.42*** (2.040)	13.82*** (2.094)	13.71*** (2.107)	13.65*** (2.286)	13.89*** (2.331)
Holt-Laury Switch		-0.186 (0.125)		-0.192 (0.125)	-0.166 (0.131)	-0.165 (0.130)
Willingness to Take Risk			0.130 (0.0918)	0.138 (0.0939)	0.140 (0.0997)	0.134 (0.100)
Female (yes=1)					-0.0854 (0.467)	-0.143 (0.482)
Age (years)					-0.181 (0.153)	-0.152 (0.161)
SAT (600-2400)					0.000334 (0.000905)	0.000456 (0.000934)
Financial Literacy (0, 1 or 2)						-0.215 (0.337)
Loan (yes=1)						0.0346 (0.437)
Constant	-7.622*** (1.223)	-6.292*** (1.474)	-8.347*** (1.377)	-7.001*** (1.596)	-4.014 (3.732)	-4.811 (3.954)
Observations	216	216	216	216	216	216
Log Likelihood	-74.31	-73.16	-73.27	-72.04	-71.21	-71.00

Standard errors in parentheses. *:p <.1, **: p < .05, ***:p<0.01

Finally, we measure the share of subjects in each treatment who choose the surplus maximizing task. Recall that, for the parameter values in this experiment, the surplus-maximizing allocation of subjects to task occurs when subjects with a success rate in the Difficult task above 0.4 choose the Difficult task and those with lower success rates choose the Easy task. The share of subjects choosing the surplus-maximizing task is highest in Treatment *NCR* (87.8%), lower in Treatment *NC* (75.9%) and lowest in Treatment *C* (70.8%). The deviation from the surplus-maximizing allocation is due mainly to subjects with success rates higher than 0.4 choosing the Easy task. Among subjects with a success rate in the Difficult task greater than 0.4, some 32.4% of those in Treatment *C*, 23.3% of those in Treatment *NC*, and just 8.6% of those in Treatment *NCR* chose the Easy task.

6. Conclusion

In this paper, we have studied the effects of the available set of loan repayment plans on student borrowers' post-graduation career (task) choices. Our analysis rests on a behavioral model of regret and gratitude that we have developed and that provides the basis for our empirical predictions. In the experiments described in the body of the paper, we observe behavior that is consistent with the predictions of the behavioral model and that cannot be explained by standard economic theory.

Currently available fixed student loan repayment plans put borrowers at the risk of default during periods of low income. For moderately-skilled borrowers, the desire to avoid this risk may lead them to avoid risky but high return career paths (Weidner, 2016; Gervais and Ziebarth, 2017; Krishnan and Wang, forthcoming). Income-driven student loan repayment plans, which link payments to income, provide insurance against unaffordable loan payments and potentially encourage take-up of riskier career paths (Ji, 2017). Our paper argues that the loan and career choices of a borrower are affected by the set of plans available to her and by the set of existing plans, even when the borrower does not have access to all of them. We show, both theoretically and experimentally, that the anticipation of regret will diminish the value of a repayment plan if there are other available options that would produce better outcomes in some states of the world. Hence, the value of an IDR plan is lower if borrowers are allowed to choose between an IDR and an FR plan. Concerns about regretting a choice that turns out to be suboptimal *ex post* shrinks the number of students who choose the paths with more volatile potential incomes below the surplus maximizing level.

Note that in the transition period following the elimination of fixed repayment plans for new borrowers, some previous borrowers still will participate in the FR plan. If new borrowers take the repayment plans of others as a reference in evaluating their options, and realize that the repayment plans not presented to them were a potential source of regret, they may feel gratitude for having a smaller set of choices, increasing the probability that they will choose the risky, high-paying career path. We find strong evidence supporting the behavioral predictions of a model that includes both regret and gratitude. In our setting, this implies that if there was a transition to universal IDR, the distortions to career choice associated with available loan repayment plans would be smallest during the transition period.

Our findings highlight the fact that the set of available loan repayment plans in the market should be considered not only from an expected return perspective but also from a behavioral perspective. Student borrowers who are relatively new to making financial decisions may be most likely to anticipate regret over their labor market choices once uncertainty is resolved. While it is difficult to measure the welfare consequences of alternative loan repayment plan designs, the clear behavioral biases we have identified in the lab shed light on the expected welfare changes each design choice brings to the picture.

References

- Abraham, Katharine G., Emel Filiz-Ozbay, Erkut Ozbay, and Lesley J. Turner (2018). "Framing Effects, Earnings Expectations, and the Design of Student Loan Repayment Schemes." NBER working paper 24484.
- Avery, Chris and Sarah Turner (2012). "Student Loans: Do College Students Borrow Too Much – Or Not Enough?" *Journal of Economic Perspectives*, 26(1): 165-192.
- Barr, Nicholas, Bruce Chapman, Lorraine Dearden, and Susan Dynarski (2017). "Getting Student Financing Right in the US: Lessons from Australia and England." Centre for Global Higher Education working paper no. 16.
- Baum, Sandy, Jennifer Ma, Matea Pender, and Meredith Welch (2017). "Trends in Student Aid 2017." The College Board. Available at: https://trends.collegeboard.org/sites/default/files/2017-trends-student-aid_0.pdf
- Bell, David E. (1982). "Regret in Decision Making under Uncertainty." *Operations Research*, 30(5): 961–981.
- Boatman, Angela and Brent J. Evans (2017). "How Financial Literacy, Federal Aid Knowledge, and Credit Market Experience Predict Loan Aversion for Education." *The ANNALS of the American Academy of Political and Social Science*, 671(1).
- Bolton, Gary E., and Axel Ockenfels (2000). "ERC: A Theory of Equity, Reciprocity, and Competition." *American Economic Review*, 90 (1): 166–193.
- Cabral, Luis, Erkut Y. Ozbay, and Andrew Schotter (2014). "Intrinsic and Instrumental Reciprocity: An Experimental Study." *Games and Economic Behavior*, 87: 100–121.
- Cadena, Brian C. and Benjamin J. Keys (2013). "Can Self-Control Explain Avoiding Free Money? Evidence from Interest-Free Student Loans." *Review of Economics and Statistics*, 95(4): 1117–1129.
- Chapman, Bruce (2006). "Income Contingent Loans for Higher Education: International Reforms." In *Handbook of the Economics of Education*, Volume 2, ed. Eric A. Hanushek and Finis Welch. Elsevier.
- Chapman, Bruce and Jane Nicholls (2013). "Higher Education Contribution Scheme (HECS)." Crawford School Asia and the Pacific Policy Studies Research Paper No. 02/2013.
- Dynarski, Susan, and Daniel Kreisman (2013). "Loans for Educational Opportunity: Making Borrowing Work for Today's Students." Hamilton Project Discussion Paper 2013-05.
- Engelbrecht-Wiggans, Richard and Elena Katok (2008). "Regret and Feedback Information in First-Price Sealed-Bid Auctions." *Management Science*, 54(4): 808-819.
- Federal Reserve Bank of New York (2018). "Quarterly Report on Household Debt and Credit, 2018: Q1." New York, NY: Federal Reserve Bank of New York.

Field, Erica (2009). "Educational Debt Burden and Career Choice: Evidence from a Financial Aid Experiment at NYU Law School." *American Economic Journal: Applied Economics*, 1(1): 1–21.

Fehr, Ernst, and Klaus M. Schmidt (1999). "A Theory of Fairness, Competition, and Cooperation." *Quarterly Journal of Economics*, 114 (3): 817–868.

Filiz-Ozbay, Emel and Erkut Y. Ozbay (2007). "Auctions with Anticipated Regret: Theory and Experiment." *American Economic Review*, 97(4): 1407-1418.

Filiz-Ozbay, Emel and Erkut Y. Ozbay (2010). "Anticipated Loser Regret in Third Price Auctions." *Economic Letters*, 107(2): 217-219.

Findeisen, Sebastian and Dominik Sachs (2016). "Education and Optimal Dynamic Taxation: The Role of Income-Contingent Student Loans." *Journal of Public Economics*, 138: 1–21.

Fischbacher, Urs (2007). "z-Tree: Zurich Toolbox for Ready-made Economic Experiments." *Experimental Economics*, 10(2): 171-178.

Gervais, Martin, and Nicolas L. Ziebarth (2016). "Life after Debt: Post-Graduation Consequences of Federal Student Loans." Working paper.

Hebst, Daniel (2018). "Liquidity and Insurance in Student Loan Contracts: Estimating the Effects of Income-Driven Repayment on Default and Consumption." Working paper.

Holt, Charles A., and Susan K. Laury (2002). "Risk Aversion and Incentive Effects." *American Economic Review*, 92(5): 1644-1655.

Hyndman, Kyle, Erkut Y. Ozbay and Pacharasut Sujarittanonta (2012). "Rent Seeking with Regretful Agents: Theory and Experiment," *Journal of Economic Behavior and Organization*, 84(3): 866-878.

Ji, Yan (2017). "Job Search under Debt: Aggregate Implications of Student Loans." Working paper.

Jiang, Baojun, Chakravarthi Narasimhan, and Özge Turut (2016). "Anticipated Regret and Product Innovation," *Management Science*, 63(12):4308-4323.

Krishnan, Karthik and Pinshou Wang (forthcoming). "The Cost of Financing Education: Can Student Debt Hinder Entrepreneurship?" *Management Science*.

Lochner, Lance, and Alexander Monge-Naranjo (2016). "Chapter 8 – Student Loans and Repayment: Theory, Evidence, and Policy." *Handbook of the Economics of Education*, Hanushek, Eric A., Stephen Machin, and Ludger Woessmann (eds).

Loomes, Graham, and Robert Sugden (1982). "Regret Theory: An Alternative Theory of Rational Choice Under Uncertainty." *The Economic Journal*, 92 (368): 805-824.

Looney, Adam and Constantine Yannelis (2015). "A Crisis in Student Loans? How Changes in the Characteristics of Borrowers and in the Institutions They Attended Contributed to Rising Loan Defaults." *Brookings Papers on Economic Activity*, 1–89.

Marx, Benjamin M. and Lesley J. Turner (2017). "Student Loan Nudges: Experimental Evidence on Borrowing and Educational Attainment." NBER working paper 24060.

Mui, Vai-Lam (1995). "The Economics of Envy," *Journal of Economic Behavior and Organization*, 26(3), 311-336.

Nasiry, Javad and Ioana Popescu (2012). "Advance Selling When Consumers Regret," *Management Science* 58(6):1160-1177

Rothstein, Jesse and Cecilia Elena Rouse (2011). "Constrained After College: Student Loans and Early-Career Occupational Choices." *Journal of Public Economics*, 95: 149-163.

U.S. Department of Education (2018a). "Direct Loans Entering Default." Washington, DC.
<https://studentaid.ed.gov/sa/sites/default/files/fsawg/datacenter/library/DLEnteringDefaults.xls>.

U.S. Department of Education (2018b). "Portfolio by Delinquency Status." Washington, DC.
<https://studentaid.ed.gov/sa/sites/default/files/fsawg/datacenter/library/DLPortfoliobyDelinquencyStatus.xls>.

U.S. Government Accountability Office (2015). "Federal Student Loans: Education Could Do More to Help Ensure Borrowers Are Aware of Repayment and Forgiveness Options." GAO-15-663. Washington, DC. Available at: <http://www.gao.gov/assets/680/672136.pdf>.

Weidner, Justin (2016). "Does Student Debt Reduce Earnings?" Working paper.

Zeelenberg, Marcel (1999). "Anticipated Regret, Expected Feedback and Behavioral Decision Making," *Journal of Behavioral Decision Making*, 12: 93–106.

Zeelenberg, Marcel and Rik Pieters (2004). "Consequences of Regret Aversion in Real Life: The Case of the Dutch Postcode Lottery." *Organizational Behavior and Human Decision Processes*, 93: 155–168.

Zizzo, Daniel John and Andrew Oswald (2001). "Are People Willing to Pay to Reduce Others' Incomes?" *Annales d'Economie et de Statistique*, 63-64, 39-62.