Equity and Incentives in Human Capital Investment *

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Abstract

We study equity contracts in human capital investment. First proposed by Friedman (1955), income-share agreements pay for college costs in exchange for a share of future earnings. While the contracts provide insurance to borrowers, implementation can be hindered by information asymmetries. We use random variation in contract terms, converting equity to debt, to identify adverse selection, moral hazard and liquidity using a field experiment conducted in Latin America. The experiment varies (1) the share of income owed, and (2) a flat monthly payment. Comparing realized earnings, repayment, and baseline characteristics across these two dimensions, we can separately identify the three effects of interest. Preliminary results suggest significant adverse selection.

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1 Introduction

For more than fifty years, human capital investments have been financed through a patchwork of student loans, parental cash transfers, and public or private subsidies. These methods of financing provide little or no insurance against poor returns, exposing college enrollees to significant risk. If a student drops out of college or fails to earn a premium for their degree, they are often still liable for thousands of dollars in student loans, exposing millions of students to undue income uncertainty and preventing efficient human capital investment among risk-averse potential enrollees.

One way to abate this college investment risk would would be to finance college through equity contracts rather than debt, or income-share agreements (ISAs). First proposed by Friedman (1955), these contracts provide students up-front tuition assistance in exchange for some share of their post-college earnings. Under perfect information and risk neutrality, financing college through debt or equity should not affect efficiency, much like in the case of the firm (Modigliani and Miller, 1958). However when borrowers are risk averse, income-contingent college financing is theoretically attractive because it provide insurance to borrowers—payments automatically rise and fall with earnings. But, as with any equity or insurance product, these contracts are vulnerable to information asymmetries and distorted incentives. Students with lower future income could sort into contracts offering higher insurance (adverse selection), or an income-share agreement could induce some graduates to earn less, whether by disincentivizing work (moral hazard) or increasing their cash-on-hand (liquidity). Depending on their relative magnitudes, these effects can lead to inefficient human capital investments or even market collapse (Nerlove, 1975).

In this study, we test for adverse selection, moral hazard, and liquidity effects in income-share agreements. Specifically, we conduct a large field experiment among ISA borrowers in Latin America, which randomly varies contract offers across two dimensions: (1) the share of income owed, and (2) a flat monthly payment. Comparing realized earnings, repayment, and baseline characteristics across these two dimensions, we can separately identify the three effects of interest. For example, one treatment group offers a 5pp reduction in income-share obligation in exchange for $20 per month, while another offers the same 5pp reduction for

$0.25 per month. Comparing outcomes between those borrowers in each group who *declined* their respective offers identifies adverse selection because both groups of "non-compliers" faced different menus of options but ultimately chose the same pre-offer contract terms. At the same time, because these two treatment contracts offer the same earnings disincentive (income-share reduction) but different liquidity benefits (flat monthly payment), estimating their treatment effects relative to control borrowers allows us to separately identify moral hazard and liquidity effects.

Findings from a pilot currently in the field are suggestive of significant adverse-selection effects. Those who opt-out of contract offers with reduced income-share obligations have lower baseline income and higher unemployment rates than those who opt-in. Comparing across treatment groups, this group becomes increasingly *more* adversely selected as we reduce the income-contigency of the alternative contract: the average monthly income among non-compliers decreases by $18 for every one-percentage-point reduction in the alternative contract's income share.

This paper primarily joins a literature in household finance, which studies how information asymmetries interact with contract design. We focus on an uncommon form of household finance, through equity rather than debt. While equity finance provides insurance for borrowers, information frictions may prevent these contracts for arising. Our study links to a number of papers discuss testing for information asymmetries in various credit markets including the mortgage market (Stroebel, 2016; Gupta and Hansman, 2019), auto loans (Adams, Einav and Levin, 2009; Einav, Jenkins and Levin, 2012), credit cards (Ausubel, 1999; Agarwal, Chomsisengphet and Liu, 2010) and payday loans (Dobbie and Skiba, 2013). While many studies have used observational data to estimate moral hazard and adverse selection (Einav, Finkelstein and Cullen, 2010; Chiappori and Salanie, 2000; Hendren, 2017), few studies have used experimental methods to detect these phenomena. DeFusco, Tang and Yannelis (2021) discuss how to measure the welfare costs of adverse selection using an experiment conducted by a FinTech lender in China. Karlan and Zinman (2009), which randomizes contract offerings on microfinance loans in South Africa, is a notable expectation. Much like our design, their experiment isolates selection on unobservables by comparing borrowers who faced different menus of options but ultimately chose the same contract terms. They find strong evidence of

moral hazard and weaker evidence of adverse selection.

This paper also joins a literature on the optimal financing of higher eduction. Beginning with Friedman (1955), many researchers have documented the theoretical benefits of income-contingent student debt. (Nerlove, 1975) first pointed about that information asymmetries might prevent functional private income contingent plans. Most of the empirical literature focuses on student loans, for example see Avery and Turner (2012), Looney and Yannelis (2015), Looney and Yannelis (2019) and Amromin and Eberly (2016) for an overview. A smaller literature has documented many of the benefits of flexible alternatives to traditional student loans, in particular focusing in income-driven repayment (IDR) plans which tie payments to earnings (Mueller and Yannelis, 2019; Herbst, 2020; Mueller and Yannelis, 2020).[1] IDR plans different from equity, since payment amounts are capped by principal plus accrued interest. IDR plans are thus alternative repayment plans for student borrowers, with an insurance component, while ISAs finance human capital investments with equity rather than debt. The only existing study of ISAs is Mumford (2020), which studies an ISA program at Purdue University in Indiana using observational data. Mumford (2020) finds evidence of selection on observables. Given the lack of experimental data, the study does not focus on selection on unobservables, or disentangle between moral hazard, liquidity and adverse selection.

Our paper makes several contributions to the literature in household finance and higher education finance. Our study is the first to study experimental variation in ISAs to identify how selection varies across a continuum of income-contingent contract terms. More importantly, our experimental design allows us to estimate selection on *unobservables*, as we compare the realized outcomes of borrowers who face different ex-ante contract menus but identical ex-post contract terms. Second, we will estimate the treatment effect of revised ISA contract terms on earnings, effectively allowing us to calculate a short-run elasticity of earned income with respect to income-share obligation. While the income-tax literature includes numerous estimates of similar elasticities (Saez, Slemrod and Giertz, 2012; Chetty, 2012), estimating them in our context holds particular relevance for the debate concerning college financing. Finally, because our experimental design randomizes both incomes-share obligations and flat monthly payments, we are able to disentangle moral hazard from liquidity effects on earned income, in

[1] Karamcheva, Perry and Yannelis (2020) provide a discussion of recent trends in IDR plans.

a fashion similar to Chetty (2008). Disentangling these effects is important, because they hold different implications regarding the distortionary effects income-contingent financing.

The remainder of this paper is organized as follows. Section 2 describes our experimental design and the setting where it will take place. Section 3 provides a description of the data we will use and some preliminary results from a pilot experiment currently in the field. Section 4 concludes.

2 Experimental Setting and Design

Institutional Setting

Income-Share Agreements

ISAs are a form of equity financing for higher education. These contracts, first proposed by Friedman (1955), link an individual's payments to their income in exchange for college costs.[2] ISAs have three key advantages. First, like traditional student loan contracts, they alleviate credit constraints and allow individuals to make investments in human capital. Second, unlike traditional student lending contracts, ISAs provide insurance to borrowers. If they are unable to secure employment after graduation, or if their income is lower than expected, payments decline. Finally, ISA are administered by institutions, they can align incentives between schools and students, as students with higher incomes end up paying more.

Despite many potential benefits, the functioning of ISAs may be impaired by information asymmetries. Adverse selection, or riskier borrowing sorting into more generous contracts, has been noted as a potential concern with ISAs since at least Nerlove (1975). Since ISAs tie payments to income, in this context adverse selection means lower-income individuals selecting into more generous contracts.

[2]ISAs are distinct from income-driven repayment (IDR) plans, a common feature of many existing student loan programs. Unlike ISAs, IDR plans do not have an equity component. Rather, they are debt contracts with an insurance component, and borrowers do pay more than the principal plus accrued interest.

Lumni

We study an experiment conducted by Lumni, a US-based firm that offers income-share agreements to post-secondary students. Since its founding in 2002, Lumni has arranged financing through ISAs to more than 10,000 students in the United States and Latin America, including Chile, Colombia, Mexico and Peru.[3] In Colombia, where our intervention took place, Lumni currently manages more than 3,400 contracts valued at over $20 million and estimates 1,000 additional contracts in 2021. Lumni manages investment funds, which provide the capital funding the students. Unlike typical debt financing, selected students must pay an annual "income-share obligation" (typically between seven and twenty percent of earnings) for a predetermined period of time after graduation (typically between two and five years).[4]

Lumni finances students in a wide variety of higher education institutions in Colombia, including top private and public schools, less selective institutions, and alternative programs such as bootcamps. The average value of Lumni's current financing is about $5,000, with a standard deviation of $3,700, reflecting a wide range of financing needs for students attending a mix of public and private institutions. For comparison, the average Colombian borrower in ICETEX, the country's largest student loan provider, carries a student-debt balance of approximately $4,000.[5] A typical Lumni ISA contract is for six years, or 72 monthly payments. Students pledge on average 18% of their income. College graduates earn about $10,000 per year in Colombia, where GDP per capita in 2019 was approximately $6,500.[6]. If individuals are unemployed, they make a small "culture of payment" contribution amounting to $10-$20 a month.

A contract will stipulate the percentage of gross income and the number of payments signers are obligated to pay before the contract comes to an end. The number of payments is fixed, the time it takes for making those payments is variable, up to a maximum, as explained below.

[3]Lumni's ISAs vary in their specifics throughout the different jurisdictions in which the company contracts (Chile, Colombia, México, Peru, and the US). For instance, whereas in the US ISAs are technically debt contracts, in Colombia Lumni's ISAs are aleatory contracts, contracts where the future value of the obligations acquired by the parties is uncertain. For this reason we focus on Colombia's ISAs, where the experiment was conducted.

[4]These types of contracts are rare. While alternative ISA programs exist, their enrollment volume is typically fewer than one thousand. We are not aware of any company other than Lumni that services ISA agreements at the scale necessary to conduct a randomized control trial.

[5]Data from ICETEX's website states the value of its loans were $1.546 Billion, converted using the official exchange rate on December 31, 2019, of 3,277 COP/USD, spread over 387,892 direct current borrowers.

[6]GDP and population data from the World Bank's country data

The contract's roughly 20 pages delve into definitions of income and contingencies designed to ameliorate the moral hazard present in such contracts, of which under reporting of income is perhaps the most important.

Income is defined as global gross income from all productive efforts, including work as an employee, self-employed, and entrepreneur. To verify employment income, Lumni uses paystubs and, once a year, reconciles against records received from the Colombian equivalent of the social security administration (Sistema General de Seguridad Social en Salud). Social security records are independent from tax records, as Colombia's tax system is heavily tilted towards taxing corporations rather than individuals, resulting in a majority of the population not having to fill tax forms or pay income taxes aside from those retained by their employers. Income information is reviewed every three months, though a signee can update it at any point time so as to adjust their payments. Once a year, a reconciliation process takes place contrasting annual data from social security sources against the reported income by the student the previous year.

To provide a floor for under reported income, the contract stipulates procedure for imputing income in case income documentation is lacking. The procedure uses data from from Observatorio Laboral, an entity of the Colombian Ministry of Labor charged with collecting and publishing data. Observatorio Laboral publishes annual income information by field of study and institution, at graduation and 5 years post graduation. The contract states imputed income will be calculated from the 70 percentile in the income distribution, and income growth will be imputed from a linear interpolation using graduation and 5th year post graduation income data. When graduates are self-employed, a minimum income calculation is used. This calculation uses the same data source but establishes the minimum income will be the average for graduation and 5th year income for the 10th percentile of the distribution.

Payment amounts are capped at a high amount, in accordance with usury laws. The cap is expressed as a maximum cost, measured as an internal rate of return, that the contract can have. Following current usury limits, the maximum cost faced by our subjects is 26.31% Effective Annual Rate but can vary every month. This cap also defines the amount a signee can pay at any point in time to end their obligation. Our intervention did not change any of the conditions in the contract, except for modifying the percentage of income a signee has to

pay, and adding a fixed payment when they are employed.

The contract provides two special provisions while the signee is not working. The first one is the requirement of a small payment, and the second is a limit to the time the signee has to make the required number of payments. The small payment follows a best practice from the microlending industry, which finds that frequent engagement with borrowers, many of whom have no credit history nor experience paying bills, results in lower delinquency. This small payment is due whenever the signee is not engaged productively in the workforce and is typically roughly a sixth of what payments are expected to be once the signee joins the workforce.

A maximum limit in the time available to make the agreed number of payments prevents gaming of the contract where a signee never joins the workforce (or never reports joining the workforce). This is similar to deferment and forbearance programs in the United States. When the maximum limit is reached Lumni evaluates the particular circumstance and can choose to extend the unemployment period or, if the signee is choosing to not participate in the labor force, to demand payment up to the cap. As of this writing, this last condition had been applied four times out of roughly eight thousand contracts signed in Colombia. The maximum limit typically allows for 2 years of uninterrupted unemployment. This period does not include time in which signees are out of the workforce while studying.

Empirical Strategy and Experimental Design

The goal of our experiment is to identify adverse selection, moral hazard, and liquidity effects by randomly varying ISA contract terms and studying how take-up and labor market outcomes vary with these terms. Specifically, we offer randomly chosen ISA participants different discounts to income-share obligations in exchange for an additional flat monthly payment. Comparing borrowers who faced different menus of offers but ultimately chose the same contract terms identifies adverse selection; both groups ultimately face the same terms, but those who choose the higher income-share obligation despite the option of paying for a lower one will have lower realized income under adverse selection. For example, if borrowers who decline to pay a small monthly fee for a 5pp income-share reduction eventually earn lower incomes

than those who never received the offer, that finding would suggest borrowers are strategically selecting contracts based on their expected earnings potential.

At the same time, because treatment contracts independently vary both earnings disincentives (income-share reduction) and liquidity benefits (flat monthly payment), a standard treatment-on-the-treated estimation allows us to separately identify treatment effects through both moral hazard and liquidity effects. By using experimental group assignment as the first stage in a two-stage least-squares regression, we identify the casual effect of lower shares among the respective complier populations—those who would accept a given treatment's contract. Then, we separately identify moral hazard and liquidity effects by comparing how treatment effects vary over contracts with the same income-share reduction but different flat monthly payments. If treatment borrowers' earnings increase with reduced income-share obligation regardless of monthly payment, that finding would suggest moral hazard is driving some of the treatment effects. If treatment effects decrease with monthly payments, holding income-share reductions constant, that would suggest liquidity constraints are at play.

To formalize this logic, consider a single-treatment version of our experiment, in which individual i earns realized outcome Y_i after accepting or declining any experimental contract offers. Let Y_{1i} denote the outcome that would be realized if person i holds the experimental contract and Y_{0i} denote the same outcome under the counterfactual that person i remains on the standard contract. We primarily focus on income, which determines repayment under an ISA. Observed income Y_i is given by

$$Y_i = D_i Y_{1i} + (1 - D_i) Y_{0i}, \tag{1}$$

where D_i is an indicator for whether i accepts the experimental contract offer. We define experimental offer assignment, Z_i , so that $Z_i = 0$ denotes the control group (no revised offer, $D_i = 0$) and $Z_i = 1$ denotes the treatment group (choice between $D_i = 0$ and $D_i = 1$).

The difference in income between experimental contractees ($D_i = 1$) and standard con-

tractees ($D_i = 0$) among those in the treatment group can be decomposed as:

$$\begin{aligned} & E[Y_i|D_i = 1, Z_i = 1] - E[Y_i|D_i = 0, Z_i = 1] \\ = \; & \underbrace{E[Y_{1i} - Y_{0i}|D_i = 1, Z_i = 1]}_{\text{Treatment Effect}} + \underbrace{E[Y_{0i}|D_i = 1, Z_i = 1] - E[Y_{0i}|D_i = 0, Z_i = 1]}_{\text{Adverse Selection}}. \end{aligned} \tag{2}$$

This difference is the sum of both treatment effects and adverse selection into the standard contract, which cannot be separated using solely observations of the treatment group because we cannot observe $Y_{0i}|D_i = 1$.[7] However, because randomized assignment implies $E[Y_{i0}|Z_i = 0] = E[Y_{i0}|Z_i = 1]$, we can identify adverse selection by comparing between *control* borrowers and treated borrowers who decline the contract offer:

$$\begin{aligned} \text{Adverse Selection} \; & \equiv \; (E[Y_{0i}|D_i = 1, Z_i = 1] - E[Y_{0i}|D_i = 0, Z_i = 1]) \\ & = \; \frac{E[Y_i|Z_i = 0] - E[Y_i|D_i = 0, Z_i = 1]}{\pi}, \end{aligned} \tag{3}$$

where $\pi \equiv Pr(D_i = 1|Z_i = 1)$, the probability an individual takes the contract conditional on offer assignment. This simple single-treatment version of our experimental design is illustrated in Figure 1. The control group, by construction, is subject to the default contract ("Contract C_0"), while the treatment group is offered an alternative contract ("Contract C_1"), which lowers their income-share obligation for some price. Adverse selection is identified by comparing the control group ($D = 0, Z = 0$) to the non-compliers in the treatment group ($D = 0, Z = 1$) who did not opt-in to Contract C_1.

Note that while this Figure 1 demonstrates the simple case of one treatment group, the experiment features several treatment groups facing different offered contract terms. Drawing comparisons across multiple groups will allow us to identify non-linearities and potential confounding effects. For example, estimating selection effects across treatment groups with multiple contract options could be particularly useful for identifying how adverse selection varies with the menu of available contracts, and estimating treatment effects across contracts with identical income-share obligations but different monthly payments can help identify liquidity constraints. Moreover, the presence of a "pure discount" contract with a monthly payment of

[7] Note that, for pre-offer outcomes, treatment effects' are zero, so selection on observables *can* be identified by the within-treatment difference, $E[Y_i|D_i = 1, Z_i = 1] - E[Y_i|D_i = 0, Z_i = 1]$.

only 1,000 peso ($0.25) will allow us to separately identify selection by hassle costs, as the offered contract should be strictly preferred by everyone in the absence of take-up frictions.

Figure 2 illustrates the variety of selection margins we can investigate in a multiple-treatments framework. Comparing individuals in the control group to individuals who chose to remain on Contract A in Treatment 2 will allow us to investigate how selection changes as we add two alternative contracts (B and C) to the set of options. Likewise, we can compare Treatment 1 individuals choosing either Contract A or Contract B to their respective counterparts in Treatment 2 to estimate adverse selection as we add a third alternative (Contract C) to the menu of two contract options.

Implementation

The experiment was carried out in December 2020. The study sample consisted of 126 Lumni ISA participants with twelve or more pending installments. From this study sample, we randomly allocated a total of 80 individuals into three treatment groups, each of which offered members a single revised contract offer. Treatment assignment is summarized in Table 1. 40 individuals were assigned to Treatment 1, offering a reduction of 5 percentage points in exchange for 70,000 pesos per month. 30 individuals were assigned to Treatment 2, which offered a more generous reduction of 10 percentage points in exchange for 70,000 pesos each month. 10 individuals were assigned to Treatment 3, which offered a reduction of 5 percentage points in exchange for 1,000 pesos a month, the most generous experimental offer on a income-share-per-peso basis.[8] Experimental offers were sent as both postal letters and email messages notifying individuals of a special offer to reduce their monthly income-share obligation for a flat monthly fee.[9] Individuals receiving offers were given a two-week deadline to contact Lumni to accept new plan terms. If they took not action, they continued under their existing plans. New plan terms took effect beginning with their next month's payment, typically in January 2021.

Lumni's databases are updated with revised contract terms as well as payments (and earnings) through their information system, which use pay stubs and social security records to

[8] In December 2020, one US dollar was equivalent to approximately 3,500 Colombian pesos.
[9] Appendix A provides sample letters sent to borrowers.

verify income. These data will are periodically de-identified and transferred to researchers. Note that these data are collected as as a part of Lumni's normal operations and thus include the entire study population. Our design therefore effectively rules out non-compliance from the experiment because a borrower is "intended-to-treat" so long as they receive notice of their treatment group's contract offering and appear in these de-identified data.

Table 2 presents a randomization check for treatment-group assignment. Given that ISA participants are randomly assigned into treatment groups, we would expect that treatment group status should not predict any predetermined outcomes. Table 2 shows that this is indeed the case. The table regresses the log of income an indicator of whether an individual reports any income, an indicator of unemployment, graduation date, an indicator of being female, or degree type indicators on indicators of belonging to each treatment group. In all cases, the observed relationships are insignificant at conventional levels, consistent with the randomized experiment.

The timing of our experimental interventions is critical to interpreting estimated parameters. For example, borrowers are offered alternative contracts after they have left college and begun repayment. They may therefore have more private information about their earnings potential than they would in choosing contracts before or during college. Moreover, note that the effects of changing an individual's ISA contract depends on the years they have remaining on their ISA, so treatment effects are expected to vary by cohort.

3 Main Results

We first use Lumni's historical data to measure selection on observables. Specifically, we compare the past incomes of borrowers who did and did not opt into their respective treatments' offered contract terms. The comparison is provided in Table 3. Within treatment groups (columns), those who opted into less income-contingent treatment contracts have higher past salaries than those who declined the treatment offer. Unlike post-contract income, within-treatment differences in *past* income can be attributed to selection, as it cannot be influenced by experimental treatments.

Across treatment groups (rows), the past salaries of non-compliers decrease with the income-

contingency of the revised terms; only the lowest income borrowers are unwilling to pay for a generous decrease in their income-share obligations. Table 4 reports the same selection-on-observables findings in regression form. Regressing pre-treatment salary and unemployment against offered and accepted contract terms finds that pre-offer monthly income among non-compliers decreases by $18 and pre-offer unemployment increases by two percentage points for every one-percentage-point reduction in the alternative contract's income share.

Figure 3 presents similar information graphically. Specifically, the figure shows mean pre-offer monthly salaries, along with a 95% confidence interval. In all three treatment groups, individuals who accept the offer have higher salaries. This is consistent with individuals who have lower incomes choosing fixed payments.

While our results strongly point to selection on observables, we are waiting further data to explore other information asymmetries. When realized income data becomes available, we explore both selection on unobservables (expected income) and treatment effects through moral hazard and liquidity.

Model

Let θ_i be individual i's ex-ante beliefs about income absent treatment, y_{0i}. We assume beliefs are unbiased, so $E[\theta_i] = E[y_{0i}]$). With log income as the outcome, we can rewrite 1 as:

$$\log y_i = \log \theta_i + \rho D_i + \epsilon_i, \tag{4}$$

where ρ denotes the treatment effect of accepting the experimental contract offer, ($D_i = 1$), and ϵ_i is a homoskedastic mean-zero expectational error term.

After forming their beliefs, individual i receives an experimental contract offer consisting of income-share reduction δ and flat monthly payment κ. Utility is concave in income, so individuals will accept the offer if and only if

$$E\left[u\left((1-\lambda+\delta)\, y_i - \kappa\right)\right] \geq E\left[u\left((1-\lambda)\, y_i\right)\right], \tag{5}$$

where λ denotes the monthly share of income the individual owes under their baseline contract.

For small contracts, condition 5 implies

$$\frac{E\left[u_y\right]}{E\left[u_y e^{\epsilon}\right]} \leq \frac{\delta}{\kappa}\theta_i \tag{6}$$

where u_y is the marginal utility of income.[10] The left-hand side of inequality 6 measures the risk premium individuals are willing to pay over the actuarially fair cost of insuring one dollar of income. This implied value of insurance increases with income uncertainty and decreases with risk aversion, so that it equals one under complete information or risk neutrality. The right-hand side measures the price of the contract offer normalized by individual i's expected income. It measures the expected income multipler individual i would receive if they accepted a contract to reduce their income-share obligation by δ and pay a flat $\$\kappa$ per month.

We seek to estimate individuals' insurance value implied by the pattern of demand observed in our experiment. To do so, we assume CRRA utility, which implies constant individual risk premium over expected income, $\gamma \equiv \frac{E\left[u_y\right]}{E\left[u_y e^{\epsilon}\right]}$.[11] We can therefore write our demand condition as

$$D_i = \mathbf{1}\left\{\theta_i \geq \gamma p_i\right\}, \tag{7}$$

where $p_i \equiv \frac{\kappa^{T_i}}{\delta^{T_i}}$, the price of individual i's offered income-share reduction in dollars-per-income-share.

Estimating γ is difficult because θ_i is unobserved, but our experimental design allows us to do so. Once realized outcomes data become available, we can exploit variation in prices p_i to identify the average realized marginal income-to-price ratio for the "marginal decliner," the person for whom $\theta_i = \gamma p_i$.

4 Concluding Remarks

Under the current system, students from poor families often must finance their education with loans, exposing them to considerable risk if their post-graduate income is uncertain. Wealthy students, by contrast, can cover tuition costs and/or loan payments with their parents' income,

[10] Proof in Appendix. Note that, because inequality 6 is a linear approximation, it describes demand for the first dollar of contract $\frac{\delta}{\kappa}$. As such, it effectively rules out second-order effects like selection on moral hazard.

[11] Proof in Appendix.

providing implicit insurance against low post-graduate earnings. A public ISA policy allowing a college attendee's financial obligation to rise and fall with his or her post-graduate income can help balance the scales, offering poor students the same kind of insurance. As with any social insurance program, however, income-contingent college financing can distort incentives. A careful accounting of these distortions is necessary to design the optimal policy. Policymakers must know how contract terms influence the selection of potential student borrowers to determine how much the program should be subsidized. Likewise, if moral hazard induces inefficiently low labor supply or suboptimal career choices, the costs of these inefficiencies must be balanced against welfare benefits of insurance.

Our results using experimental evidence suggest that adverse selection can play a role in ISAs, potentially hampering the effective functioning of these programs. We find that individuals with lower earnings select into more generous contract terms– a potential reason why these contracts do not arise in private markets. It is important to caveat that our results are for a relatively small sample of Latin American participants in ISAs, and there exists substantial scope for heterogeneity across countries and major types. Future work should focus both on the optimal design of human capital investment systems using income share agreements versus traditional debt contracts, and what roles borrower heterogeneity play in designing these systems.

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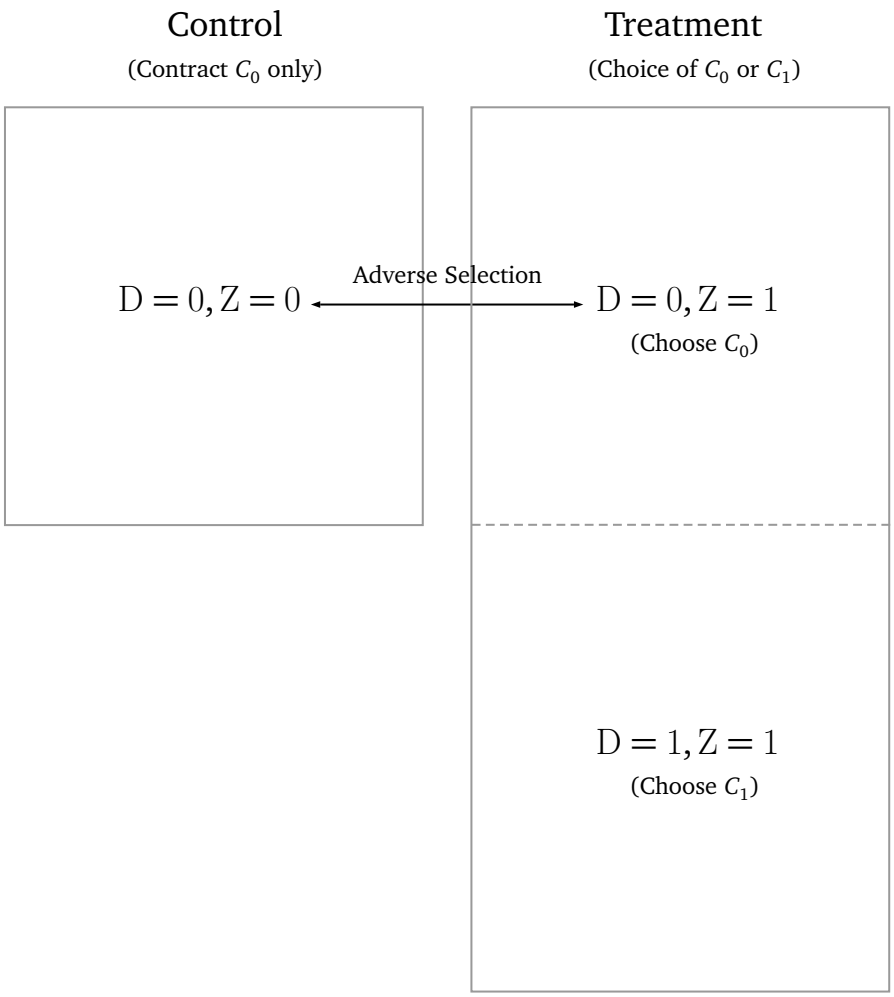
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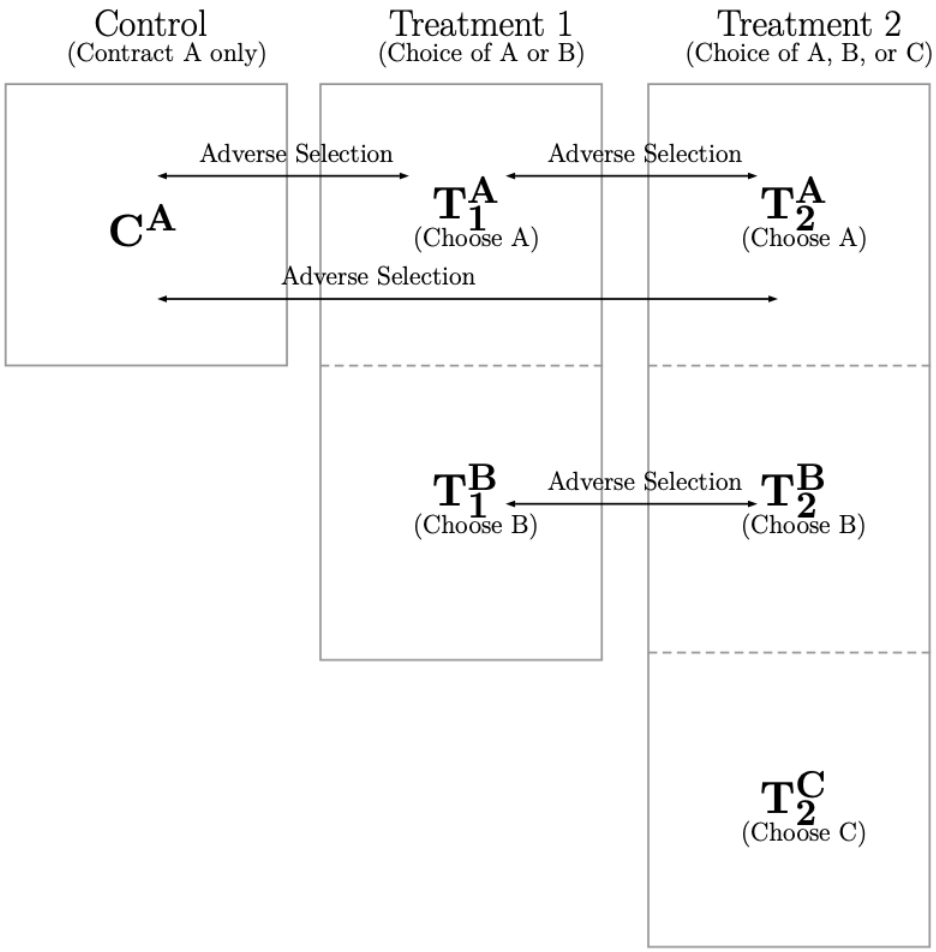
Figures and Tables

Figure 1: Experimental Design (Single Treatments)



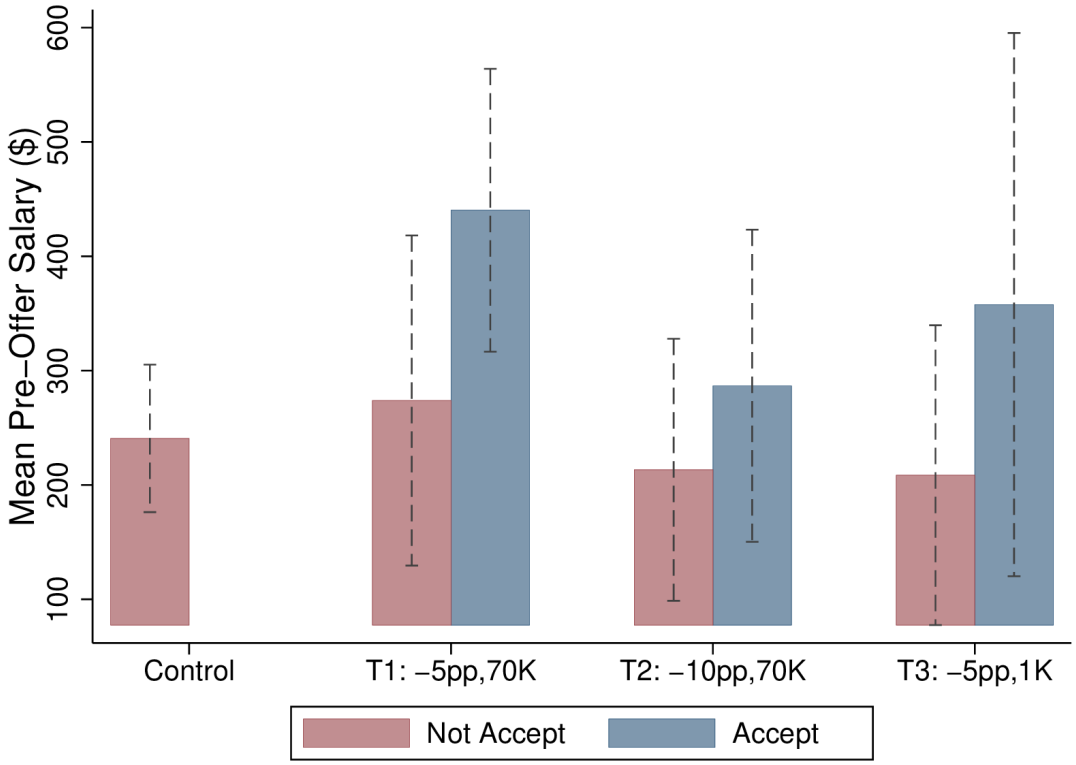
Note: This figure provides a graphical representation of our experimental design with a single treatment arm offering a choice between baseline contract C_0 and experimental contract C_1. The treatment group ($Z = 1$), represented by the right rectangle, is separated into those who accept the revised contract offer ($D = 1$) and those who decline it and stay on their baseline contract ($D = 0$). The solid arrow denotes comparison groups to measure adverse selection—groups that were offered different menus of contracts but ultimately face the same repayment terms.

Figure 2: Experimental Design (Multiple Treatments)



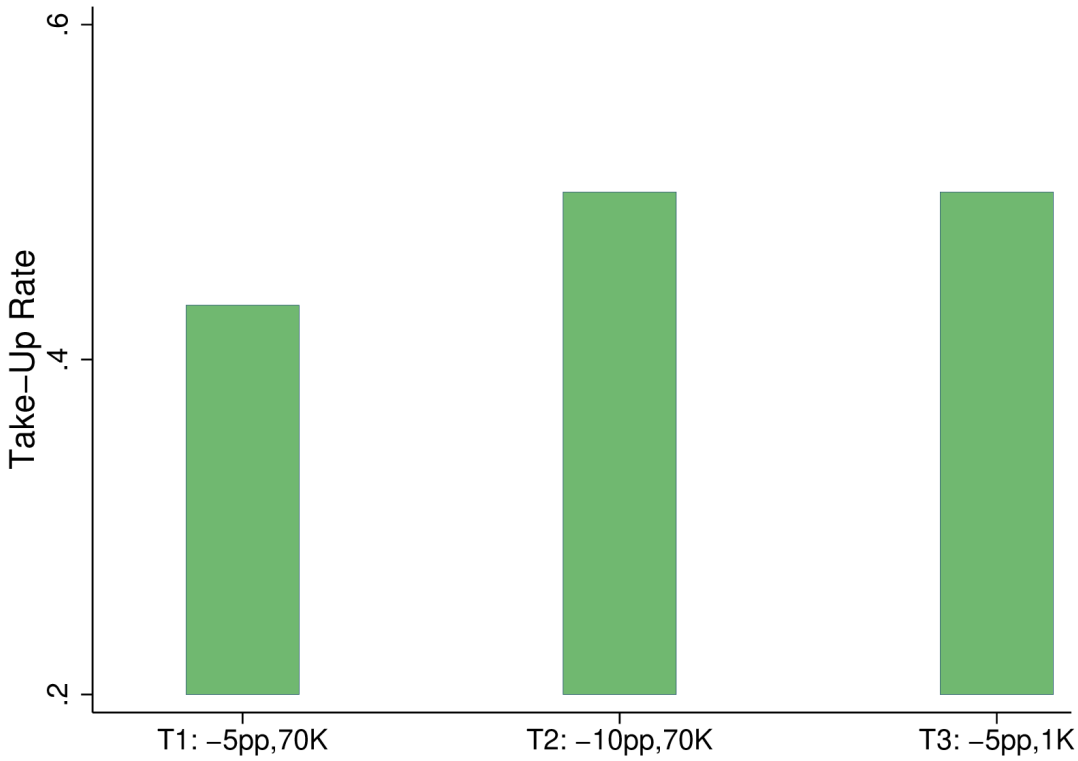
Note: This figure provides a graphical representation of our experimental design with multiple treatment arms. The treatment groups, represented by the middle and right rectangles, are each separated into subgroups based on their chosen repayment terms. The solid arrows denote comparison groups to measure adverse selection—groups that were offered different menus of contracts but ultimately face the same repayment terms.

Figure 3: Pre-Offer Salary: Selection



Note: This figure shows mean pre-offer monthly salaries, along with a 95% confidence interval. Salaries are broken down by the control and the three treatment groups. The treatment groups are further broken down by individuals who accept or do not accept the offer.

Figure 4: Treatment Take Up



Note: This figure shows mean take-up by treatment group. The y-axis measures the share of borrowers in each group who chose to accept the that group's offered contract terms.

Table 1: Pilot Experiment

Experimental Group	Income-Share Reduction	Flat Monthly Payment	Group Size
Control	-	-	$N = 46$
Treatment 1	5 percentage points	70,000 Pesos	$N = 40$
Treatment 2	10 percentage points	70,000 Pesos	$N = 30$
Treatment 3	5 percentage points	1,000 Pesos	$N = 10$

Note: This table reports treatment parameters for the pilot experiment launched in December 2020. All borrowers are one to five years into repayment on existing income-share agreements. Borrowers in each of the three randomly assigned treatment groups are offered optional revised contract terms given by "income-share reduction" and "flat monthly payment." In December 2020, one US dollar was equivalent to approximately 3,500 Colombian pesos.

Table 2: Pre-Determined Covariation and Treatment Status

	(1) Ln(Income)	(2) Inc.>0	(3) Unemployed	(4) (Grad. Dt.	(5) Female	(6) Eng.	(7) Econ	(8) Soc. Sci.
Treatment Group 1	0.264	0.0283	0.00277	−80.58	−0.0418	−0.0631	0.0116	0.0592
	(0.165)	(0.0872)	(0.0322)	(99.88)	(0.108)	(0.105)	(0.104)	(0.102)
Treatment Group 2	−0.0565	0.0476	0.0531	−187.4	−0.0476	0.0595	0.107	−0.0952
	(0.184)	(0.0913)	(0.0435)	(123.2)	(0.117)	(0.120)	(0.118)	(0.0949)
Treatment Group 3	0.108	0.0905	0.0244	−137.3	0.00952	−0.133	0.214	−0.138
	(0.213)	(0.115)	(0.0380)	(157.2)	(0.164)	(0.148)	(0.176)	(0.117)
R-squared	0.893	0.00520	0.0200	0.0248	0.00242	0.0154	0.0200	0.0269
N	117	117	117	117	117	117	117	117

Note: This table reports estimates from a regression of outcomes in the mother prior to the experiment on indicators of belonging to each treatment group. In the first column the dependent variable is the log of income, in the second column the dependent variable is an indicator of whether an individual reports any income, in the third column the dependent variable is an indicator of unemployment, in the fourth column the dependent variable is graduation date, in the fifth column the dependent variable is an indicator of being female, in the sixth column the dependent variable is in indicator of whether the ISA participant pursued an engineering degree, in the seventh column the dependent variable is in indicator of whether the ISA participant pursued an economics or business degree, and in the eighth column the dependent variable is in indicator of whether the ISA participant pursued an social sciences degree. Huber-White robust standard errors are reported in parentheses. ***, **, and *, represent statistical significance at 1%, 5%, and 10% levels, respectively. *** = significant at 1 percent level, ** = significant at 5 percent level, * = significant at 10 percent level.

Table 3: Average Past Salaries by Treatment Offer and Accepted Terms

	Treatment Group (Offered Terms)				
Accepted Share Reduction (pp)	Control	T1: -5pp,70K	T2: -10pp,70K	T3: -5pp,1K	Group Mean
-0pp	$240.72	$273.88	$213.25	$208.57	$242.56
-5pp		$440.23		$357.73	$420.58
-10pp			$286.77		$286.77

Note: This table reports mean past salaries across treatment group and accepted contract terms for our pilot experiment. Cell means are reported in US dollars. Treatment group definitions are provided in Table 1.

Table 4: Regressions of Pre-Offer Salary against Treatment Group and Accepted Contract Terms

	(1) Log Pre-Offer Salary	(2) Pre-Offer Unemployment
Offered Share Reduction (pp)	−0.0770**	0.0193**
	(0.0356)	(0.00785)
Offered Monthly Payment ($)	0.00598*	−0.000597
	(0.00342)	(0.000587)
Accepted Share Reduction (pp)	0.0641**	−0.0200***
	(0.0265)	(0.00536)
R-squared	0.0767	0.159
N	98	117

Note: This table reports coefficients for OLS regressions of realized pre-offer salary against treatment group and accepted contract terms.*** = significant at 1 percent level, ** = significant at 5 percent level, * = significant at 10 percent level.

Appendix

A ISA Participant Notifications

Below are sample letters to borrowers, sent in December 2020 to experiment participants.

Notification Letter

REF. Invitation to participate in a lottery for a partial reduction in your entry-sharing agreement

Dear Diana Lopez,

We hereby want to inform you that the Talent Fund has received resources for the purpose of offering a partial scholarship to some of the participants in this fund. The scholarship will result in partial reductions in the terms of shared income agreements like the one you have. Graduates who will benefit from this scholarship will be selected through a lottery and those selected will have the option to:

-Pay a fixed amount for each missing repayment fee and reduce your committed income percentage by 5 or 10 percentage points until you complete the remaining payments in the contract. For example, if you are committed to 20% of your income today and are selected, you could reduce this obligation to 15% or 10% of your income.

To participate in this sweepstakes we invite you to register by clicking here. The response deadline is Wednesday, December 02, 2020 at 6:00 p.m.! If you agree to participate and are favored in the lottery, we will send you a proposal with new conditions for your approval. This proposal will specify how much your monthly obligation will be reduced, and what the monthly payment will be to be favored. At that time you can accept or reject the offer. In case of rejecting the offer your contract will continue without any changes.

If you do not wish to participate, click here and please note that your contract will continue without modification.

If you have any questions and concerns, please contact xx@lumni.net or cell number x.

Description of Contract Terms

REF. Notification of opportunity to reduce conditions of your entry-sharing agreement

Dear Diana Lopez,

Congratulations! We are contacting you to let you know that you have been selected to receive a reduction in your monthly payments from your Income Share Agreement.

Here are the conditions we offer you to modify your Shared Income Agreement with the Talent Fund 1: As of January 2021, your repayment fee will be reduced from 20.00% (current commitment) of your monthly income to 15.00% and also a fixed amount of COP $70,000.

Remember: in periods of unemployment your commitment is the “culture of payment.”

Review the table at the end of this release for clarity on the proposal. If you would like to change the terms of your contract to the proposed terms, click here. If you do not wish to change your contract, please click here. The response deadline is Tuesday, December 15, 2020 at 6:00 p.m.!

If you have any questions or concerns, please contact the X@lumni.net or cell number X.

Bogotá D.C., miércoles 25 Noviembre de 2020

Diana López

REF. Invitación para participar en un sorteo para una reducción parcial en tu acuerdo de ingreso compartido

Estimado/a Diana López,

Por medio de la presente te queremos informar que el Fondo Talento ha recibido recursos con el propósito de ofrecer una beca parcial a algunos de los participantes en este fondo. La beca se traducirá en reducciones parciales en las condiciones de los acuerdos de ingreso compartido como el que tú tienes. Los graduados que se beneficiarán de esta beca serán seleccionados a través de un sorteo y quienes sean seleccionados tendrán la opción de:

-Pagar un monto fijo por cada cuota repago que te falte y reducir tu porcentaje de ingresos comprometido en 5 o 10 puntos porcentuales hasta completar los pagos restantes en el contrato. Por ejemplo, si hoy en día tienes comprometido el 20% de tus ingresos y eres seleccionado/a podrías reducir esta obligación a un 15% o un 10% de tus ingresos.

Para participar en este sorteo te invitamos a que te inscribas haciendo clic aquí. **¡La fecha límite de respuesta es el miércoles 02 de Diciembre de 2020 a las 6:00 pm!** Si aceptas participar y sales favorecido en el sorteo, te mandaremos una propuesta con nuevas condiciones para tu aprobación. Dicha propuesta especificará en cuánto se reducirá tu obligación mensual, y cuál será el pago mensual por ser favorecido. En ese momento podrás aceptar o rechazar la oferta. En caso de rechazar la oferta tu contrato continuará sin novedad.

Si no quieres participar, haz clic aquí y ten en cuenta que tu contrato continuará sin modificación alguna.

Si tienes dudas e inquietudes, comunícate al siguiente correo xx@lumni.net o al número celular x.

Atentamente,

SYLVIA M. ORTIZ
C.C.: 63.507.080
Fund Manager

Bogotá D.C., Jueves 10 Diciembre de 2020

Diana López

REF. Notificación oportunidad para reducir condiciones de tu acuerdo de ingreso compartido

Estimado/a Diana López,

¡Felicitaciones! Te estamos contactando para comunicarte que has sido seleccionado/a para recibir una reducción en tus pagos mensuales de tu Acuerdo de Ingreso Compartido.

A continuación, te presentamos las condiciones que te ofrecemos para modificar tu Acuerdo de Ingreso Compartido con el Fondo Talento 1: A partir del mes de Enero de 2021, tu cuota de repago se reducirá de 20,00% (compromiso actual) de tu ingreso mensual a un 15,00% y además un monto fijo de COP $70.000.

Recuerda: en periodos de desempleo tu compromiso es la cultura de pago.

Revisa la tabla al final de este comunicado para tener claridad de la propuesta. Si deseas cambiar las condiciones de tu contrato por las condiciones propuestas, haz clic aquí. Si no deseas modificar tu contrato, por favor haz clic aquí. ¡La fecha límite de respuesta es el martes 15 de Diciembre de 2020 a las 6:00 pm!

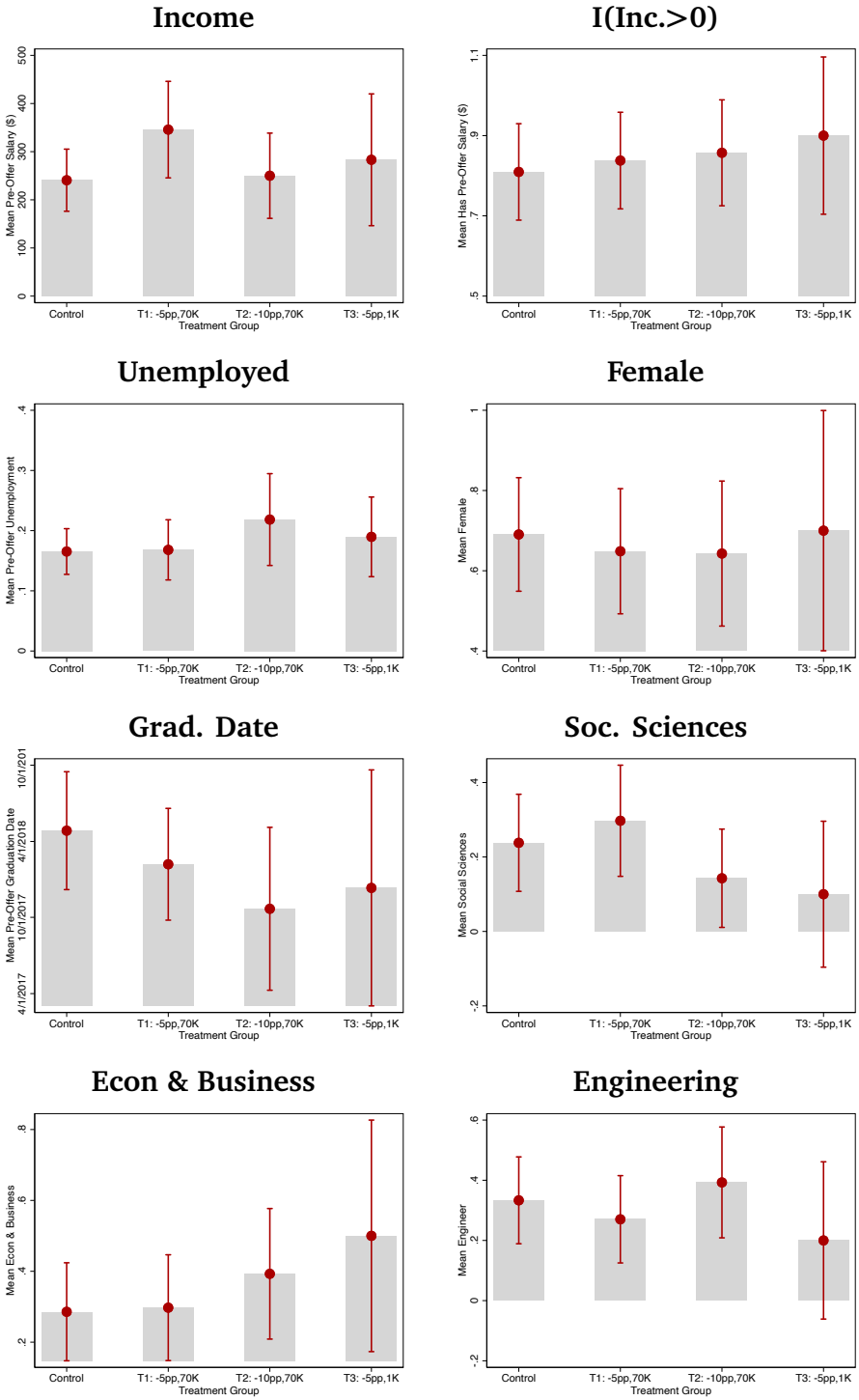
Si tienes dudas o inquietudes, comunícate al siguiente correo X@lumni.net o al número celular X.

Atentamente,

SYLVIA M. ORTIZ
C.C.: 63.507.080
Fund Manager

Opción A	Opción B
Quedarte con tu contrato actual	**Reducir tus pagos mensuales**
Pago mensual 20,00% de tu ingreso mensual	**Pago mensual** 15,00% de tu ingreso mensual + Monto fijo COP $70.000 mensual
Cuotas restantes **27,0**	**Cuotas restantes** **27,0**

Figure A.1: Predetermined Variables Across Treatment Groups



This figure shows means and a 95% confidence interval for perdetermined variable in the control group, and the three treatment groups. Variables are measured in the month prior to the experiment being conducted. Variable names are above each panel. Source: Lumni.