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Experimental Evidence on Credit Constraints

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Abstract

Credit constraints are central to development economics theory. However, there is scant direct evidence that supports the existence of such constraints. Traditional tests observe how consumption changes after an unexpected income shock. Such changes can also result from myopic behavior or precautionary savings. This study uses a randomized control trial to explore the effects of enabling savings as a tool to smooth consumption, keeping income constant. The study focuses on community instructors in Mexico. Instructors have to deal with idiosyncratic shocks and shocks related to settling in to new communities. For a group of instructors participating in this study, administrators switched 34 percent of monthly payments to quarterly payments. The switch reduced abandonment of service from 23 to 18 percent. This behavior is consistent with the standard model with credit constraints. It is not consistent with a model without credit constraints or one with myopic individuals.

Keywords: Credit constraints, education, teachers, compensation
JEL codes: D91, H52, J33, O12, O16

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1. Introduction

The poor are generally assumed to be credit constrained. However, evidence on the existence of such market imperfection is scarce (Berg, 2013; Karlan and Morduch, 2010). Testing for the existence of credit constraints is difficult. Traditional approaches do not allow for disentangling other factors that influence behavior. Consider the traditional intertemporal choice model. It states that consumption should not respond to expected income changes. On the other hand, consumption is sensitive to consumption (Angeletos et al., 2001; Banerjee and Duflo, 2004; Berg, 2013; Browning and Collado, 2001). Some researchers interpret this empirical fact as evidence of credit constraints. However, it is also consistent with competing explanations such as bounded rationality, myopic behavior, and precautionary savings.

It is essential to assess if the poor are subject to credit constraints in order to understand the implications of a wide range of policies to promote development and welfare. Credit constraints limit the ability of the poor to manage cash flows, cope with risk, and accumulate capital (Collins, et al., 2009; Karlan and Morduch, 2010). Where credit has been provided to the poor, it has resulted in benefits for some, but not in all cases (Karlan and Morduch, 2010). As a result, there has been debate as to the extent to which the poor can plan (Bertrand, Mullainathan, and Shafir, 2004; Munro, 2009). What is clear is that to facilitate effective policies, it is essential to have a better understanding of the capabilities of the poor and the limitations they face.

Efforts have been made to identify credit constraints by checking asymmetries in predictions on consumption and savings responses. Berg (2013) observed that consumption for credit-constrained individuals should respond to increases in expected income but not to decreases. He observed changes in consumption in households that became eligible for a pension program and households that lost their eligibility for a child grant in South Africa. He used responses in consumption to reject myopic behavior. He also observed that savings increased for households that became eligible for the pension program. As a result, he ruled out precautionary savings in favor of a forward-looking model with credit constraints.

Other studies have observed that the elasticity of credit is positive. Many have interpreted this empirical fact as indirect evidence of the existence of credit constraints (Banerjee and Duflo, 2004; Karlan and Zinman 2009). However, myopia, a shift from the informal to the formal market, and other factors that influence investment decisions also influence the demand for credit (Karlan and Morduch, 2010). As a result, empirical evidence that attempts to prove the existence of credit constraints is scarce. The challenge that remains is to identify credit constraints that affect other potential behavioral changes. This study aims to contribute to this body of work.

A randomized control trial in Mexico undertaken for this study allowed for observing individual responses to the relaxation of credit constraints. There were no changes to income certainty, transfer labels, or choices on production technology. Community instructors typically

receive a monthly payment for teaching in rural communities. In addition, they become eligible for a scholarship at the end of the school year.

Service abandonment rates have historically been consistent with high adjustment costs early in the school year and exposure to idiosyncratic shocks. Therefore, instructors in the treatment group received three payments: the first at the beginning of the school year, the second after the winter break, and the third after the spring break. Advance payments of 34 percent of the monthly wage in three installments resulted in lower abandonment rates. The change in the structure of the payments allowed instructors to switch from credit to savings, enabling them to transfer resources over time.

Community instructors come from households with limited resources. This suggests that the poor have the capacity to plan forward and can benefit from access to credit. Indeed, instructors forced to wait for month-to-month payments had higher abandonment rates. Therefore, credit constraints can be costly. As a result, programs aiming to relax credit constraints are likely to improve welfare.

This study is novel because of its evidence for three study setting characteristics. First, a randomized control trial provides a counterfactual to impose credit constraints. This feature allows for causal identification. Second, individuals had a contract with the government for the schedule of transfers. Therefore uncertainty about future income and precautionary savings was significantly reduced. Third, the treatment focused solely on the timing of income transfers. All transfers were equally labeled across participants and directed to the same beneficiary. In addition, the experiment was carried out in a real setting and not in a laboratory environment. These features allowed for overcoming some potential behavioral challenges, including responses biased because of hypothetical scenarios, and the limitations associated with the mindset of separate accounts. The fact that the recipient was always the same allowed for avoiding intra-household dynamics effects. These challenges have limited the capacity of previous studies to test for the presence of credit constraints.

Providing evidence on credit constraints is important. It allows for better understanding the decision-making of the poor. The evidence in this study supports the notion that credit constraints may play a role in the sensitivity of consumption to anticipated income changes. As a result, it provides supporting evidence for a rich set of studies. For example, some studies find welfare gains among beneficiaries following expected increases to income. Others find welfare gains to decreased costs to credit, although that cannot rule out alternative explanations. Finally, this study may motivate more research, as it explores the use of design in the scheduling of government transfers to relax credit constraints and improve recipient welfare at a low cost. More research may be useful in this area.

2. A Test for the Existence of Credit Constraints

2.1. Why Testing for the Existence of Credit Constraints Is Difficult

Credit constraints are difficult to test because it is hard to disentangle the ability of individuals to transfer resources over time from their capacity to plan forward, optimize resource allocation, and manage risk. Two strands in the literature aim to prove the existence of credit constraints. The first is by observing changes in consumption and saving resulting from changes in expected income, and the second is by estimating credit demand. This section discusses these two approaches.

The main approach to testing for credit constraints is to observe how consumption and savings respond after households experience a change in expected income. The permanent income hypothesis states that if credit constraints do not bind, then consumption should not respond to changes in expected income. Empirically, expected changes in income are associated with changes in consumption in developing countries (Angeletos et al., 2001; Banerjee and Duflo, 2004; Berg, 2013; Browning and Collado, 2001; Edmonds, 2006; Galiani, Gertler, and Bando, 2016; Hsieh, 2003; and Lindskog, 2013). A test for credit constraints based on the sensitivity of consumption to expected income faces two main challenges. First, an increase in expected income may lead to a decrease in income uncertainty. As a result, a decrease in precautionary savings will increase consumption even in the absence of credit constraints (Aiyagari, 1994; Brumberg, 1956; Kazarosian, 1997; Ragot and Challe, 2011). The quantification of precautionary savings is challenging because behavior is likely to be heterogeneous (Lusardi, 1998; Ventura and Eisenhauer, 2005).

Second, if households are myopic, then an increase in income may cause an increase in consumption. This change will take place even in the absence of credit constraints. Experiments show that individuals can have time-inconsistent preferences (Thaler, 1981). Indeed, hyperbolic discounting can explain the observed excessive reaction in terms of consumption to changes in expected income. It can also explain other behaviors such as procrastination, addiction, and lack of exercise (Angeletos et al., 2001; Della Vigna and Malmendier, 2006; Gruber and Oszegi, 2001; O'Donoghue and Rabin, 2001).

An alternative explanation to myopia is bounded rationality (Deaton, 1992; Simon, 1955). Evidence shows that individuals give more weight to the dimensions of scarcity (Mullainathan and Thaler, 2000). Thaler and Sunstein (2008) reviewed the literature and concluded that individual decisions are influenced by anchoring and status quo bias, availability and representativeness heuristics, and herd mentality. The bounded rationality assumption is such a concern that its implications on the formulation of public policy are under study (Bertrand, Mullainathan, and Shafir, 2004; Munro, 2009).

Another departure from myopia is the influence of other mechanisms dictated by the context. For example, Duflo and Udry (2004) showed that resource allocation is dependent on

the transfer recipient. In addition, Adams et al. (2014) contrasted individual versus collective choice, Duflo (2006) and Banerjee (2003) studied how poverty influences decision-making, and Bertrand, Mullainathan, and Shafir (2006) studied how the context influences decision-making among the poor. They all conclude that policy interventions that take into account the decision-making process of the poor can lead to welfare improvements.

Berg (2013) noted that credit constraints cannot bind when the agent faces an anticipated decrease in income because the technology required is savings and not credit. He ruled out bounded rationality by noting the lack of symmetry in consumption response to changes in expected income. He then ruled out precautionary savings by noting that savings did not decline upon the reduction of income uncertainty through pension fund eligibility. Berg (2013) then rejected the hypothesis of nonrationality or precautionary savings in favor of credit constraints.

The second group of studies aims to prove the existence of credit constraints by estimating the slope of the credit demand curve. Examples of studies that show an increased use of credit when supply increases for a given price are Karlan and Zinman (2010), Karlan and Zinman (2009) and Banerjee and Duflo (2004). For Mexico, Karlan and Zinman (2013) estimated a price elasticity that varies from –1.1 in year one to –2.9 in year three when allocating interest rates randomly through the largest micro lender in the country. Karlan and Morduch, (2010) noted two main limitations to this approach. First, most microcredit lending studies involve decision-making with productivity and risk aversion to mediate effects. As a result, the differentiation between the ability to transfer resources over time and the ability to make investment decisions is not clear. Investment decisions are also subject to concerns related to personality traits that may influence optimal lending for consumption. In addition, trustworthiness or the probability of incurring a negative shock influence investment decisions (Karlan and Morduch, 2010). Another challenge to identify credit constraints is that formal and informal markets interact. As a result, observing responses in the formal market alone does not provide information on the existence of a market failure (Karlan and Morduch, 2010).

The present study differs from previous approaches in that transfers to individuals change exogenously. The changes allow individuals to save rather than borrow, which requires less dependence on others to transfer resources over time and decreases issues related to information problems. Our study contributes to the literature by providing evidence that suggests the presence of credit constraints. This is important because, in the words of Karlan and Morduch (2010, 4708), " There have been few fully convincing studies of impacts and little rigorous investigation of whether the very poor can benefit from financial access to the same degree as the less poor – or perhaps whether the very poor will benefit more than others." The authors emphasize that clearer data on impacts is necessary for weighting major public policy issues.

2.2. Conceptual Framework

The test for credit constraints here consists of exploiting the asymmetric predictions of the standard intertemporal choice model. We explore predictions in three scenarios according to the main factor driving individual responses. The scenarios are as follows: one with the presence of credit constraints, a second with no credit constraints, and a third with myopia. Data limitations in this study do not allow for the direct observation of consumption or savings. However, there are sufficient data to observe labor choices. This section describes a model to provide testable predictions. The model describes how the timing of payments affects dropout patterns. It models behavior of a population exposed to income shocks and considers three alternative scenarios: myopic; forward-looking and credit constrained; and forward-looking and not credit constrained. We empirically observe how dropout rates respond to the timing of payments and then learn which model better fits the data.

The model proposed here closely follows the model proposed by the seminal work of Ando and Modigliani (1963). Assume an individual lives two periods. Assume that the individual has a utility function in each period $U(C_t)$ where U is continuous and C_t denotes consumption at time *t*, $U'(.) > 0$ and $U''(.) < 0$. Assume that during each period the individual receives income $Y + \varepsilon_t$ where ε_t is a shock that is i.i.d. and ε_t~N(0,σ). For clarity and tractability, assume that the interest rate is zero. Assume the individual chooses consumption so as to maximize lifetime utility. Under these assumptions, the maximization problem for the individual at the beginning of period 0 is:

$$E_0[U(C_0) + \delta U(C_1)], \tag{1}$$

subject to:

$$E_0[C_0 + C_1] \leq 2\mathrm{Y} + E_0[\varepsilon_0 + \varepsilon_1] \tag{2}$$

$$C_t \geq 0 \qquad \forall\, t = 0{,}1 \tag{3}$$

Equation (2) is the regular budget constraint restriction and equation (3) requires positive consumption. An internal solution to this problem is given by:

$$E_0[U'(C_0^*)] = \delta E_0[U'(2Y - C_0^* - \varepsilon_0 + \varepsilon_1)] \tag{4}$$

$$E_0[C_1^*] = E_0[2Y - C_0^* - \varepsilon_0 + \varepsilon_1] \tag{5}$$

Assume that individuals are forced to drop out when there is no solution such that constraints shown in equations (2) and (3) are met. In the absence of credit constraints, the share

of instructors who will survive until the end of the year is $P = \Phi(2Y)\mathrm{E}[\Phi(2Y - C_0^* - \varepsilon_0)] = \Phi(2Y)\Phi\left(\frac{2Y - C_0^*}{\sqrt{2}}\right)$.[1] In this scenario, the probability of survival is not affected by the timing of payment. The probability to survive with a transfer *2Y* upfront P_A is equal to the probability to survive with payments *Y* during every period P_T, therefore $P_A = P_T$. If the probability of survival changes with the timing of payments, then two scenarios are possible: individuals are credit constrained or myopic.

In the myopia scenario, the discount rate implies that only the first period matters to the instructor. If all payments are transferred during the first period, then instructors can face shocks of up to *2Y*, but will have no resources after this period to face shocks. In this case the probability to survive until the end of the school year is $P_A = \Phi(2Y)\Phi(0)$. On the other hand, if individuals are transferred *Y* every period, then the probability to survive is $P_T = \Phi(Y)\Phi(Y)$. Numerical calculations show that $P_A \leq P_T$ for $Y \geq 0$. The probability of survival in the first period is equal to the noncredit-constrained case. However, the probability is lower in subsequent periods. We note that myopia should lead to asymmetric responses in the probability of survival. On the other hand, a forward-looking model should lead to symmetric responses in the probability of survival.

Now suppose individuals are not myopic but credit constrained. Suppose all payments are transferred during the first period. In this case, the share that survives after the two periods is $P_A = \Phi(2Y)\mathrm{E}[\Phi(2Y - C_0^* - \varepsilon_0)] = \Phi(2Y)\Phi\left(\frac{2Y - C_0^*}{\sqrt{2}}\right)$. When individuals receive *Y* every period, the probability to survive is $P_T = \Phi(Y)\mathrm{E}[\Phi(2Y - C_0^* - \varepsilon_0)] = \Phi(Y)\Phi\left(\frac{2Y - C_0^*}{\sqrt{2}}\right)$. Note that even when individuals save all income in the first period, they are not able to face shocks of the magnitude of the non-income-constrained case. For the latter case, individuals count on income *2Y* in the first period. As a result $P_A \geq P_T$.

The calculations and the model establish the rationale to empirically test which model better fits the data. If the timing of payments affects the dropout rate, then the forward-looking, non-credit-constrained model is rejected in favor of credit constraints or myopia. If the timing of payments causes a decrease in dropout rates, then the model is rejected in favor of a forward-looking model with credit constraints. If the timing of payments causes an increase in dropout rates, then the model is rejected in favor of myopia. Note that both credit constraints and myopic behavior may be playing a simultaneous role in resource allocation. Indeed, we can only test which model better fits the dominating behavior.

[1] In general, $E[\Phi(aX + b)] = \Phi\left(\frac{b}{\sqrt{1+a^2}}\right)$ for a random variable *X* and constants *a* and *b*.

3. Institutional Setting and Data Sources

3.1. Setting

Mexico's National Council for the Promotion of Education (*Consejo Nacional de Fomento Educativo* - CONAFE) is the Ministry of Education's decentralized agency responsible for providing educational services in rural communities with fewer than 500 inhabitants. CONAFE's primary and secondary schools typically have a single multigrade classroom. The class has an average of 15 students and is taught by a community instructor. To become a community instructor, persons must be 15-29 years old and have finished lower secondary school. Community instructors must be willing to move into a rural community to teach for at least a school year. Instructors receive a stipend of MXN$1,427 per month.[2] After one year of service, instructors receive a scholarship of MXN$982 per month for up to 30 months. This scholarship is conditioned on enrolling in a higher education institution. Communities that receive CONAFE services organize a local Association to Promote Community Education (*Asociación Promotora de Educación Comunitaria* - APEC), which is responsible for providing instructors with the accommodations, meals, and security they need to reside in the community (Diario Oficial de la Federación, 2012).

Despite the efforts by the government and the communities, instructors face challenges to teach for the full school year. In the 172 municipalities with the lowest Human Development Index in the states of Chiapas, Puebla, and Veracruz, 23 percent of the instructors abandoned their post before the 2012–2013 school year was over. A study by Bando and Uribe (forthcoming) shows that hardship in the communities is a determinant of abandonment. A survey of those instructors who did not drop out reported that 62 percent of them said the APEC was not organized to provide food and lodging when they arrived. In addition, 46 percent reported having slept in the school, and 62 percent said they spent money on food. What is more, 62 percent of instructors went to communities where communication with their family was not possible. Instructors entered service with the goal to complete it, with 84 percent reporting they started CONAFE to gain access to higher education or to earn a wage. The annual wage for rural workers with a secondary education in 2011 was about MXN$4,320 and the employment rate was 71.7 percent (INEE, 2013). This implies an expected monthly wage of MXN$3,097.

With support from the Inter-American Development Bank (IDB), CONAFE introduced a program to provide a bonus of MXN$750. The aim of the transfer was to reduce service abandonment. Instructors eligible for this bonus were those assigned to a post in prioritized municipalities. CONAFE also piloted an alternative schedule of payments to learn the most effective way to pay the incremental portion of the stipend. The alternative schedule consisted of three installments that coincided with peak attrition months. The 2012–2013 school year started

[2] All quantities are expressed in current 2012 pesos. The average exchange rate used to meet the country's obligations between September 2012 and June 2013 was MXN$1 = US$12.77. Source: Banco de México.

on August 20, 2012 and ended on July 5, 2013. The payment in September of MXN$3,000 aimed to facilitate coverage of expenses to get settled. Some instructors needed to buy blankets, shoes, or other basic needs after moving into the community. The other two payments in January and April of MXN$2,250 were designed to serve as an incentive to return after the winter and spring breaks. The winter break was from December 20 to January 6 and the spring break from March 24 to April 6. The traditional scheme provided MXN$750 per month. Figure 1 shows the resulting accumulated transfers in both schemes. The accumulated transfer in the alternative payment scheme was always larger than that in the monthly payment scheme.

3.2. Data Sources and Sample

This study focuses on the states of Chiapas, Puebla, and Veracruz. The states provided administrative records and operative assistance for evaluation. These states contained 59 percent of instructors who served highly marginalized communities in the 2012–2013 school year. We focus on instructors at the elementary and secondary levels. More specifically, these three states had 702 instructors teaching for the first time. The sample included 60 instructors in Puebla, 36 instructors in Veracruz, and a random sample of 304 instructors from among the 606 instructors in the state of Chiapas. Therefore, the sample consisted of 400 instructors.

This study has four sources of data. The first is the official school census data that the Ministry of Education collects at the beginning and end of every school year. These data include the number of schools in each state and basic school characteristics such as school size. The second source of data is the instructor dropout month or completion status collected by CONAFE. The third source is the community size and the marginality index, data which are available at the level of the locality. These data were provided by the National Population Council (*Consejo Nacional de Población* - CONAPO).[3]

Finally, a data collection firm surveyed instructors during the last week of training. Instructors traveled to the communities the following week (the week of August 20, 2012). The survey included questions on basic individual characteristics and household assets. Moreover, an asset index was created using principal component analysis to proxy data on consumption, as in Fernald, Gertler, and Neufeld (2008). We retain the first principal component and include data related to radio, television, refrigerators, washers, cars, computers, telephone land lines, cellular

[3] The marginality index measures differences in localities according to the global impact of the population's needs resulting from lack of access to education, inadequate housing, and the lack of goods. It is a weighted average of the following locality characteristics: percentage of illiterate population age 15 and above, percentage of the population age 15 and above who have not completed elementary education, percentage of private homes without piped water, percentage of private homes without sewage or toilets, percentage of private houses with dirt floors, percentage of private homes without electricity, percentage of private homes with overcrowding, and percentage of the employed population with income of less than two times the minimum salary established by the government. Weights are determined by principal component analysis. For a more detailed description please see CONAPO (2012).

phones, and Internet. Appendix 1 shows maps for each state that show the municipalities that provide CONAFE services and the marginality levels.

4. Empirical Strategy

This section describes the strategy to identify the effect of the payment schedule on dropout rates. A comparison of instructors who use credit and savings to those who do not would not be indicative of credit constraints. These behaviors are endogenously determined by individual characteristics such as self-control and loss aversion (Karlan and Morduch, 2010). Random allocation created two groups of community instructors. The allocation mechanism was such that instructors had the same probability within a state to go to treatment (i.e., the alternative schedule of payments). This allocation ensures that any differences between the groups are not systematic. The preliminary sample consisted of 417 individuals present at the training stage. Of the total, three did not complete training. In addition, local administrators assigned 14 instructors to functions other than instructors. As a result, 4 percent of the randomized instructors dropped out of the sample before local administrators announced treatment allocations. The evaluation sample thus consisted of 400 individuals who became community instructors. Within this group, 206 instructors received the alternative schedule of payments (the treatment), and 194 instructors received the traditional monthly schedule of payments (the control). Instructors learned about the scheme of payments they would receive before going to the communities.

Table 1 shows a comparison of instructor characteristics between the two groups at the beginning of the school year. The table also includes service characteristics of both schools and communities. Columns (1) and (2) show averages by groups. Column (3) shows differences between the two. Columns (4) and (5) include p-values for test of equality with and without controls. We cannot reject the null of equal means among the two groups at the 0.10 level. We reject that all characteristics included in the table predict treatment (p-value of 0.784). As a result, the two groups are statistically equal before treatment.

The main specification to compare dropout rates between the two groups for each period is:

$$y_{ist} = \mu_{st} + \beta_t DT_{ist} + \varepsilon_{ist}, \qquad (6)$$

where y_{icst} is a dummy that equals one if community instructor *i*, in state *s*, had abandoned service by period *t* and zero if not. The term *DT* equals one if the instructor received the alternative schedule of payments, and zero if not, and ε denotes an error term. Estimation is carried out separately for each period *t.* Therefore, the term μ_{st} denotes a state fixed effect.

A simple comparison of means in cumulative dropout rates is equivalent to a nonparametric test of differences in survival rates. We avoid parametric survival models in order

to avoid further assumptions to interpret results. The null for behavior consistent with the forward-looking standard model with perfect access to credit is $H_O: \beta = 0$. The [1x10] vector β denotes differences in the survival rates. If we reject this hypothesis, then we test for the null of behavior with a forward-looking model with credit constraints. We reject this null in favor of behavior consistent with myopic behavior.

We estimate differences in abandonment patterns with controls to check for sensibility. If randomization isolated program effects from instructor, community, and school characteristics, then the inclusion of controls should only lead to changes in the accuracy of the estimates (Altonji, Elder, and Taber, 2005). Controls include age, gender, education, and asset index, as well as school size and the marginality index of the community.

5. Results and Discussion

This section describes the differences in accumulated dropout rates between the treatment and control groups. Table 2 shows these differences. Each row represents one month. The dashed lines indicate months where the group with the alternative schedule received a payment. Pay amounts are specified in column (1). Column (2) shows the accumulated dropout rate for the group of instructors that received monthly pay. Column (3) lists the transfers per month to the group receiving differentiated payments. Column (4) shows the estimates of differences in abandonment rates as specified by equation 1. In addition, column (5) shows estimates with additional controls. More specifically, these controls include age, gender, education, asset index, school size, and the marginality index of the community. Estimates with controls are not statistically different from those without its inclusion. This finding shows that estimates are unlikely to be correlated with differences among groups. Figure 2 illustrates dropout rates in treatment and control groups corresponding to columns (1) and (4).

Estimates in Table 2 show that the change in the pay schedule had an effect on abandonment patterns between the two groups. We reject the null of the forward-looking standard model with perfect access to credit at the 10 percent level. Moreover, by the end of the school year, the instructors in the group with alternative payments had an accumulated abandonment rate of 18 percent. However, the instructors in the group paid monthly had an accumulated rate of 23 percent. The rates are different with a p-value of 0.073.

The previous test makes us reject myopia. It is likely that the discount rate differs from one. However, we do not find evidence it offsets the potential benefits of removing credit constraints. In a myopic model, dropout rates should respond to payment transfers in February and May. But dropout rates these months would differ from those from October to January and March to April. In addition, we note that the dropout rates in these two months are not statistically different from the response in other months.[4]

[4] The corresponding p-values for the tests of equality of the effect in October to the effect in subsequent months are $p_{Nov} = 0.523$, $p_{Dec} = 0.683$, $p_{Jan} = 0.183$, $p_{Feb} = 0.138$, $p_{Mar} = 0.321$, $p_{Abr} = 0.427$, $p_{May} = 0.672$, and

Before rejecting both nulls in favor of credit constraints, we note that the change of timing in transfers resulted in a change in the net present value (NPV) of service. We calculate the NPV of future payments for each period. These values allow us to explore if changes in abandonment patterns could result from changes in incentives. These changes are especially important in October and May. We use the interest rate of government bonds of 4.17 percent to discount future payments to present value.[5] The change in the payment schedule results in an increase of the NPV of 0.06 percent in the first period. In subsequent months, the largest difference between the NPV of future payments takes place in October. The difference is –4.8 percent. The next largest difference takes place in May, with a difference of –4.7 percent. Note the absence of increases in abandonment patterns in October or May. Differences in these months would suggest that a change in incentives is driving the effects. Consider the elasticity of turnover with respect to salary in developed countries. It is usually estimated to be on the order of –1 (Clotfelter et al., 2007; Dolton and van der Klaauw, 1995; Hanushek, Kain, and Rivkin, 2004; Murnane and Olsen, 1989). Indeed, if incentive effects are present, then estimates are a lower bound. We conclude that consumption smoothing can be a tool to enable permanency.

The results show that community instructors are unable to perfectly transfer resources over time. Instructors may face credit constraints for three reasons. First, they come from households with limited resources; second, some do not qualify to access formal credit; and third, credit for those who do qualify is costly. Those three reasons are described in more detail below.

Regarding the first reason why instructors face credit constraints, they come from a population living in poverty. Most instructors teach to earn funds to continue studying. This implies they cannot afford higher education. In addition, their poverty is implied by household assets and education. An analysis of assets shows that only 41 percent of instructors have a refrigerator at home, only 60 percent have a bathroom with toilet and shower exclusively for members of the household, and only 43 percent have a gas or electric stove. This suggests a limited ability to provide collateral. Therefore access to formal credit is likely limited.

Second, 12 percent of the community instructors in our sample had not turned 18 years old when they started service. The legal age to obtain a loan is 18. Indeed, the legal system does not provide support to enforce contracts for under-age individuals. As a result, it is costly for commercial banks to provide credit to instructors.

Third, instructors faced high costs to access the formal credit market. Mexico's Federal Procurement Consumer Office (*Procuraduría Federal del Consumidor* - PROFECO) estimated the annual total cost for credit from pawnshops at 120 percent in March 2011.[6] As of April 2015,

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$p_{Jun} = 0.903$.

[5] The annual rate for two of the largest banks for a savings account as of April 22, 2015 is as follows: a savings account in Banco Azteca offers total annual earnings of 3.42 percent yearly, and a savings account in Banco de Mexico offers total annual earnings of 3.12 percent before taxes conditional on having at least MXN$5,000 in savings. The interest rate for government bonds is that of September 6, 2012 according to the Central Bank of Mexico (CETES, 28 days). The interest rate for these bonds decreased to 3.01 percent on March 5, 2015.

[6] Source: http://www.profeco.gob.mx/encuesta/brujula/bruj_2011/bol192_pagosfijos.asp (accessed on March 5,

two of the most popular individual loans were Credimax and Elektra, both provided by Banco Azteca (Azteca Bank). Their interest rates were 130.9 percent and 165 percent, respectively.[7]

The high cost to access credit likely led instructors to rely on informal credit markets, but those markets are unlikely to provide perfect access to credit. This is shown by our results and evidence from other studies (Berg, 2013; Browning and Collado, 2001; Galiani, Gertler, and Bando, 2016; Hsieh, 2003; Lindskog, 2013; Rothstein, 2011).

Changes in consumption and savings are not observed, so we cannot disentangle the mechanisms that allowed instructors to complete service. However, data on asset ownership and service-related expenditures were collected for those instructors who did not drop out at the end of the school year. Instructors who did not abandon service were more likely to own a laptop and to increase expenditure on communications, conditional on access. Indeed, some communities do not have the infrastructure to enable the use of cellphones or radios. Moreover, these instructors were more likely to report expenditures on teaching materials. Treatment instructors were less likely than those in the control to report travel expenditures. This evidence seems to suggest that relaxing credit constraints allowed instructors to acquire durables. They may have switched consumption patterns to improve conditions in the community. Therefore, they may have reduced trips home on weekends. However, these differences could be the result of selective attrition. We acknowledge the limitations imposed by the data. Appendix 2 shows estimates.

6. Conclusions

This study has focused on a randomized control trial setting for the timing of government transfers to instructors in Mexico. The study found that individuals living in poverty allocated resources in a way consistent with a credit-constrained, forward-looking model. Instructors received a monthly payment for teaching in rural communities. However, service abandonment rates were consistent with high costs early in the school year. In addition, instructors faced idiosyncratic shocks. Relaxing credit constraints resulted in a decrease in service abandonment from 23 to 18 percent. The change consisted of a switch of 34 percent of monthly payments to three payments. Instructors received a first payment at the beginning of the school year, a second payment after the winter break, and a third payment after the spring break. The study focused on the 2012–2013 school year.

The findings of this work have important implications. The lack of access to credit imposes significant costs on young people living in poverty. Credit markets often prevent the

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2015.

[7] Sources: For information based on a loan of MXN$2,500 from Credimax, see http://www.bancoazteca.com.mx/PortalBancoAzteca/publica/credito/prestamos.do?method=inicioPersonales; for information based on a loan of MXN$2,000 from Elektra, with repayment in 39 weekly payments, see http://www.elektradinero.com/prestamos_personales/prestamos_personales_facil_y_rapido.html (both links accessed on March 5, 2015).

poor from smoothing consumption. This implies individuals are vulnerable to shocks over time and are likely to engage in precautionary savings. The poor have limited opportunities to borrow, which has long-term consequences on income. This study presented a specific example showing that an increase in credit constraints prevented young people from accessing financing for higher education. Credit constraints imply that individuals cannot optimize the allocation of resources over time. Such constraints also restrict the acquisition over time of durables or other consumption items that optimize utility. In this context, policies that enable individuals to borrow may have the potential to improve welfare.

Credit markets do not provide credit to the poor. High transactional costs and information asymmetries imply higher costs to provide such loans. Informal credit suffers from information problems, so it imposes high costs on borrowers. As a result, development specialists propose innovative mechanisms to provide credit. Moreover, they propose a credit subsidy to ameliorate this market failure. However, access to credit alone has not always been the key out of poverty. We need to better understand the decision-making process of individuals and the constraints they face. Indeed, credit constraints are not the only potential reasons that keep individuals from smoothing consumption over time. Alternative explanations include a limited ability to plan forward and allocate resources efficiently. This study has shed light on these competing explanations and contributes to understanding how credit policies can promote development among the poor.

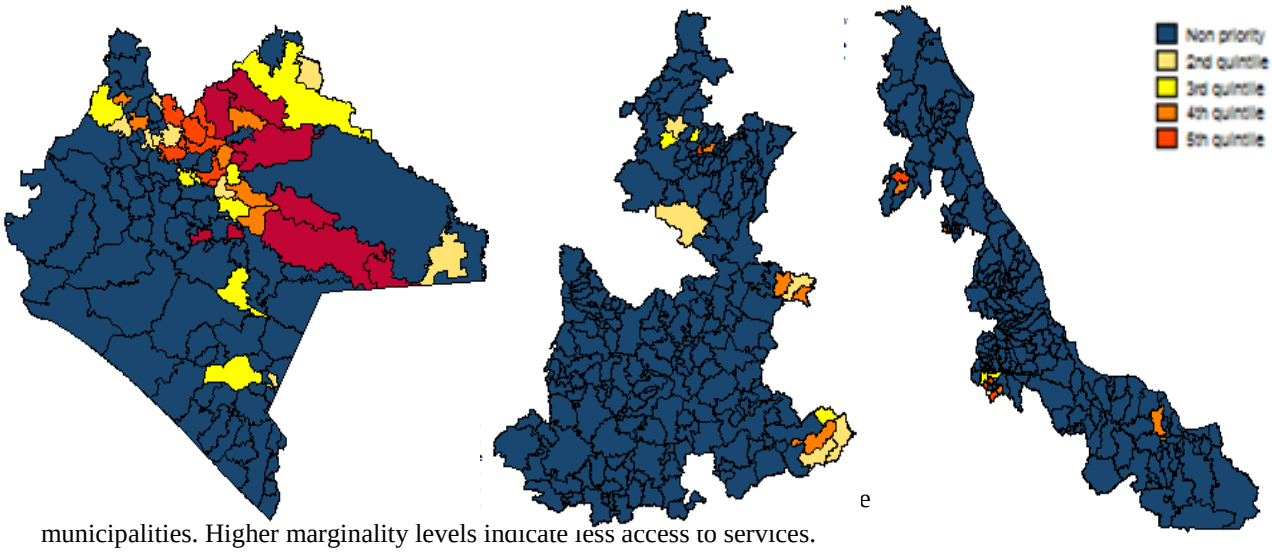
The findings here are indicative of the existence of credit constraints, but the limitations of the study indicate how future work could facilitate a better understanding of credit constraints. Future work could examine consumption and saving patterns, that is, if and how credit constraints affect different groups that may differ in education, ethnicity, and other contextual variables. Our sample is relatively homogeneous, so we do not observe differences in the asset index, education, gender, or age. Future work should also consider testing for credit constraints across a wide range of time periods. Indeed, this study analyzes only a 10-month period. In this context, individuals had set a clear goal and a chosen technology to reach that goal, and had a finite time horizon to reach it. Decision-making over longer periods of time may result in different behaviors. Uncertainty in income fluxes may play a more important role in the longer run. These areas are future research. The answers to these questions have important policy implications, as they may enable policies that help the poor cope with risk, manage cash flows, and accumulate assets.

Appendix 1

Figure A1.1 shows maps with municipal-level political divisions. The yellow, orange, and red shading show municipalities with relative marginality levels. The municipalities in blue are nonpriority municipalities that are not the focus of this study. Therefore, instructors in these municipalities are not eligible to receive the bonus.

Quintiles refer to the distribution of marginality for priority municipalities. Higher levels indicate less access to services. The marginality index measures the global impact of the population's needs. It considers access to education, inadequate housing, and the lack of goods. The index is a weighted average of the following locality characteristics: percentage of the population age 15 and above that is illiterate, percentage of the population age 15 and above that has completed elementary education, percentage of private homes without piped water, percentage of private homes without sewage or toilets, percentage of private houses with dirt floors, percentage of private home without electricity, percentage of private homes with overcrowding, and percentage of the employed population with incomes less than two times the minimum salary established by the government. Principal component analysis determines weights. For a more detailed description, see CONAPO (2012).

Figure A1.1. Marginality by Priority and Nonpriority Municipalities in Chiapas, Puebla, and Veracruz



municipalities. Higher marginality levels indicate less access to services.

Appendix 2

This appendix shows comparisons in categories of expenditures and asset ownership. It is based on surveys conducted from April 23–28, 2013 in the states of Puebla and Veracruz. For Chiapas, data collection took place from June 10–14, 2013. Of the 400 instructors in the study, 86 dropped out during the school year. In addition, 15 were not present during data collection (six were sick and nine were absent for unknown reasons). We exclude eight instructors who live in the community where they teach. We analyzed the remaining 291 instructors surveyed using the specification in equation 1 in the main text to compare instructors in treatment with those in control.

Table A2.1 shows how treatment and control groups differ on the likelihood to spend. It also shows the magnitude of expenditure conditional on a positive value. We find instructors in the treatment group are more likely to report positive pedagogical expenditures. The probability to report such expenditures increases from 0.60 in the control group to 0.65 in the treatment group (p-value = 0.054). Conditional expenditure increases from MXN$178 to MXN$ 246 (p-value = 0.034).

Table A2.2 shows estimates for asset ownership. Instructors in the treatment group report a higher ownership of laptops. The share of instructors with laptops is 13 percent for the treatment group, which is statistically different from the 19 percent of instructors in the control group (p-value = 0.019).

Table A2.3 shows that instructors in the treatment group are less likely to travel. The likelihood to travel decreased from 0.98 to 0.95 (p-value = 0.019).

Table A2.4 shows differences in the likelihood of instructors to report a problem in the community. It also shows the average test scores of the instructors' students. Instructors in the treatment group were less likely to report problems. Indeed, 0.11 of treatment instructors reported a problem, while 0.07 of control instructors reported a problem. The share is statistically different among the two groups (p-value = 0.070). Students with instructors in the treatment group perform better. These students have an advantage of 0.12 standard deviations for mathematics (p-value = 0.041). They also have an advantage of 0.21 standard deviations for Spanish (p-value = 0.033). These results do not change with the introduction of controls, including age, gender, education, asset index, and marginality index.

Consider the case where instructors not observed had lower teaching and communication expenditures. Consider as well that they were more likely to travel. In this case, our estimates would represent lower bounds. When we estimate Manski-Lee bounds we cannot reject the null of no effects. Albeit suggestive evidence, data do not allow us to disentangle treatment effects from differential attrition.

Table A2.1. Differences in Expenditures by Treatment Status

	Mean in Group with Monthly Payments	Treatment Effect	P-value	Treatment Effect†	P-value†
Probability of reporting a positive expenditure per category (equals 1 if positive, 0 if not)					
Food (40.89 percent report no expenditure)	0.564	0.074	.058	0.072	0.112
		(0.019)		(0.026)	
Transportation (9.28 percent report no expenditure)	0.914	-0.009	0.622	-0.015	0.543
		(0.015)		(0.021)	
Communication (64.26 percent report no expenditure)	0.366	-0.018	0.849	-0.022	0.815
		(0.083)		(0.084)	
Teaching-related (35.40 percent report no expenditure)	0.599	0.054	0.028	0.044	0.049
		(0.009)		(0.01)	
Expenditure amount conditional on reporting non-zero expenditure (in Mexican pesos)					
Food	520.633	-72.574	0.384	-60.-01	0.447
		(65.69)		(64.918)	
Transportation	471.576	68.149	0.278	71.405	0.286
		(46.205)		(49.488)	
Communication (64.26 percent report zero)	178.338	68.718	0.034	75.016	0.066
		(13.079)		(20.335)	

Source: Authors' calculations.

† Indicates the inclusion of age, gender, education, asset index, and marginality as controls.

Note: Estimation based on 291 instructors who did not abandon service by the end of the school year. Each row represents a different regression. Standard robust errors are reported in parentheses.

Table A2.2. Treatment Effects on Asset Ownership – Dependent Variable: Owns Asset (1 if yes, 0 if no)

	Mean in Group with Monthly Payments	Treatment Effect	P-value	Treatment Effect†	P-value†
Cell phone	0.764	-0.039	0.443	-0.039	0.420
		(0.042)		(0.038)	
Radio	0.651	-0.027	0.510	-0.028	0.488
		(0.034)		(0.033)	
Computer	0.133	0.061	0.019	0.07	.011
		(0.008)		(0.007)	
TV	0.779	0.002	0.944	0.014	0. 656
		(0.02)		(0.026)	

Source: Authors' calculations.

† Indicates the inclusion of age, gender, education, asset index, and marginality as controls.

Note: Estimation based on 291 instructors who did not abandon service by the end of the school year. Each row represents a different regression. Standard robust errors are reported in parentheses.

Table A2.3. Effects of Treatment on the Probability of Traveling or Communicating with Family or Friends (1 if yes, 0 if no)

	Mean in Group with Monthly Payments	Treatment Effect	P-value	Treatment Effect†	P-value†
Transportation (3.78 percent report not traveling)	0.975	-0.029	0.019	-0.03	0.018
		(0.004)		(0.005)	
Communication (56.7 percent report no communication)	0.395	0.068	0. 194	0.057	0.25
		(0.04)		(0.036)	

Source: Authors' calculations.

† Indicates the inclusion of age, gender, education, asset index, and marginality as controls.

Note: Estimation based on 291 instructors who did not abandon service by the end of the school year. Each row represents a different regression. Standard robust errors are reported in parentheses.

Table A2.4. Working Conditions and Productivity

	Mean in Group with Monthly Payments	Treatment Effect	P-value	Treatment Effect†	P-value†
Report any problem (1 if yes, 0 if no)	0.107	-0.038	0.07	-0.042	0. 102
		(0.011)		(0.015)	
Standardized score in mathematics	-0.032	0.119	0.041	0.132	0.046
		(0.025)		(0.029)	
Standardized score in Spanish	-0.109	0.214	0.033	0.194	0.04
		(0.04)		(0.04)	

Source: Authors' calculations.

† Indicates the inclusion of age, gender, education, asset index, and marginality as controls.

Note: Estimation based on 291 instructors who did not abandon service by the end of the school year. Each row represents a different regression. Standard robust errors are reported in parentheses.

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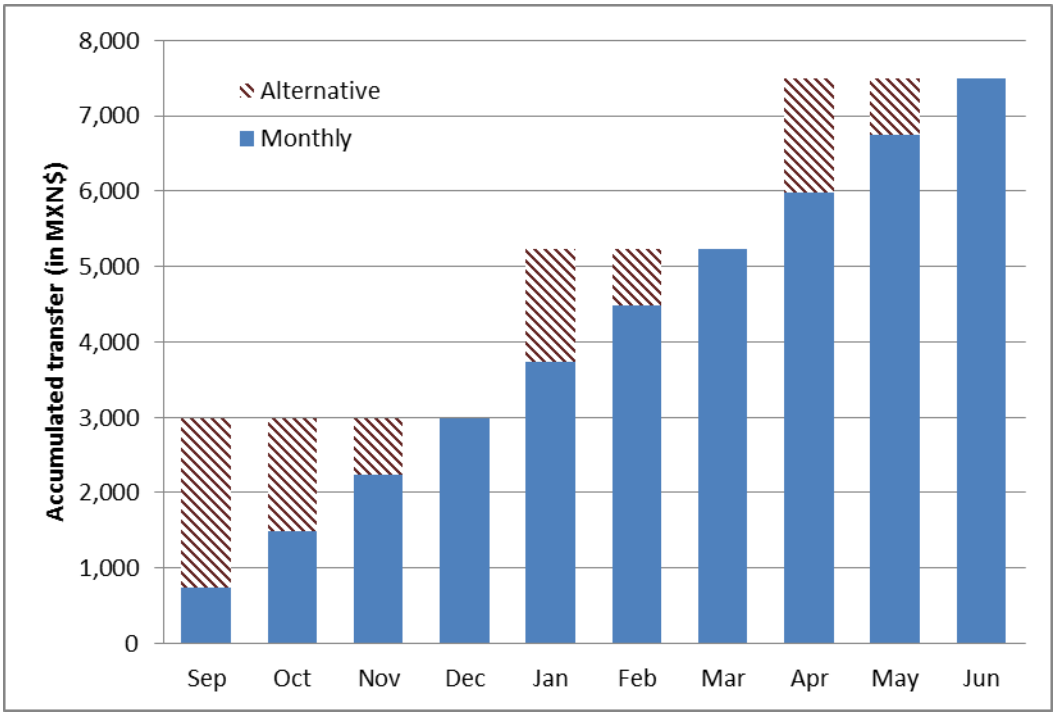
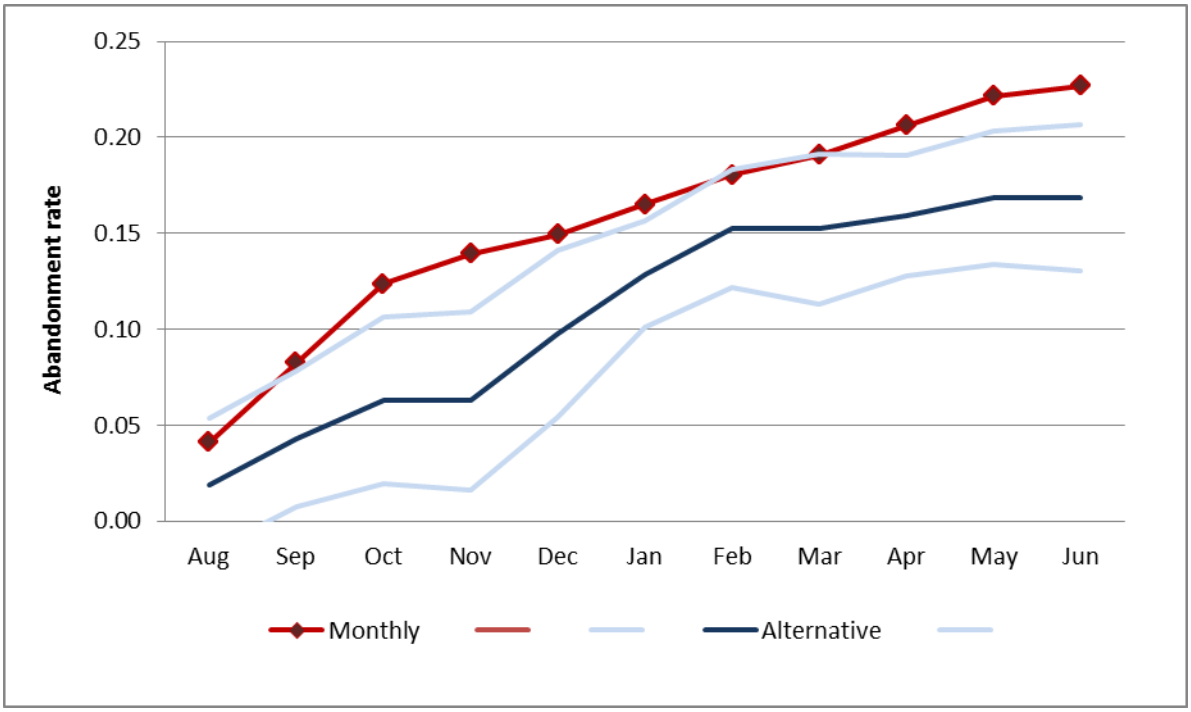
Figure 1. Accumulated Transfers by Groups of Individuals by Payment Scheme



Source: Authors' calculations.

Figure 2. Accumulated Abandonment Rates by Payment Scheme



Source: Authors' calculations.

Note: The light blue lines represent confidence intervals at the 15 percent level without controls. The abandonment rate equals the number of instructors that have abandoned service over the number of instructors present at the beginning of the school year.

Table 1. Baseline Means of Individual and Service Characteristics

	Monthly Scheme	Alternative Scheme	Difference	P (value for test of equality)	P† (value for test of equality)
	(1)	(2)	(3)	(4)	(5)
Individual characteristics					
Age	19.42	19.27	-0.15	0.554	0.526
	(0.18)	(0.19)	(0.26)		
Gender (1 if male, 0 otherwise)	0.61	0.67	0.06	0.225	0.117
	(0.03)	(0.03)	(0.05)		
Education (1 if secondary completed or more, 0 otherwise)	0.83	0.77	-0.06	0.167	0.216
	(0.03)	(0.03)	(0.04)		
Knows community assigned for service at training (1 if yes, 0 if no)	0.35	0.35	0.00	0.936	0.928
	(0.03)	(0.03)	(0.05)		
Speaks an indigenous language (1 if yes, 0 if not)	0.53	0.49	-0.04	0.433	0.260
	(0.04)	(0.04)	(0.05)		
Asset index	-0.01	0.01	0.01	0.888	0.631
	(0.07)	(0.07)	(0.10)		
Service-related characteristics					
School size (number of students)	14.37	15.13	0.76	0.429	0.210
	(0.69)	(0.66)	(0.96)		
Community population (in hundreds)	1.28	1.15	-0.13	0.255	0.131
	(0.09)	(0.07)	(0.11)		
Marginality index	0.96	1.00	0.04	0.620	0.180
	(0.06)	(0.06)	(0.08)		
Observations	194	206			

Source: Authors' calculations.

†Includes state fixed-effects model to take into account that randomization was stratified at the state level. The p-value for joint prediction to allocation to the alternative payments group is 0.784.

Note: P-values are for tests of the null hypothesis of equality of means.

Table 2. Transfers and Cumulative Dropout Rates

	Monthly Payments		Alternative Payments		
	Transfer (in Mexican pesos)	Cumulative Dropout Rate	Transfer (in Mexican pesos)	Difference Relative to the Group with Monthly Payments	
	(1)	(2)	(3)	(4)	(5)
August	0	0.04	0	-0.02	-0.02
		(0.01)		(0.02)	(0.01)
September	750	0.08	3,000	-0.04	-0.04
		(0.02)		(0.02)	(0.01)
October	750	0.12	0	-0.06	-0.06
		(0.02)		(0.02)*	(0.02)*
November	750	0.14	0	-0.08	-0.08
		(0.02)		(0.02)*	(0.02)*
December	750	0.15	0	-0.05	-0.05
		(0.03)		(0.02)	(0.02)*
January	750	0.16	2,250	-0.04	-0.04
		(0.03)		(0.01)*	(0.01)*
February	750	0.18	0	-0.03	-0.03
		(0.03)		(0.01)	(0.01)
March	750	0.19	0	-0.04	-0.04
		(0.03)		(0.02)	(0.02)
April	750	0.21	2,250	-0.05	-0.04
		(0.03)		(0.01)*	(0.01)*
May	750	0.22	0	-0.05	-0.05
		(0.03)		(0.02)*	(0.01)*
June	750	0.23	0	-0.06	-0.05
		(0.03)		(0.02)*	(0.01)*

Source: Authors' calculations.

* Indicate that the estimates coefficient is significantly statistically different from zero at the 0.10 level.

Note: Estimation based on 400 observations. Each row represents a different regression on the cumulative dropout status of an instructor as of the month indicated by the row. Columns (1) and (3) show the bonus transfers in current 2012 pesos. Column (2) reports the average accumulated dropout rate in the group of instructors who receive monthly payments. Columns (4) and (5) report the difference of the dropout rate between the group that receives the alternative schedule of payments and the group receiving monthly payments calculated with a regression including state fixed effects. Estimation in column (5) includes controls for individual age, gender, education, asset index, school size, and the marginality index of the community. Standard robust errors are reported in parentheses.