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Economic Scarcity and Consumers' Credit Choice*

Marieke Bos Chloé Le Coq Peter van Santen

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Abstract

This paper documents that increased scarcity right before a payday causally impacts credit choices. Exploiting a transfer system that randomly assigns the number of days between paydays to Swedish social welfare recipients, we find that low-educated borrowers behave as if they are more present-biased when making credit choices during days when their budget constraints are exogenously tighter. As a result, their default risk and debt-servicing cost increase significantly. Access to mainstream credit or buffer stocks cannot explain our results. Our findings highlight that increased levels of economic scarcity risk reinforcing the conditions of poverty.

JEL Classification Codes: G02, G23, D14, D81

1 Introduction

"Poor *(adjective)*: too much month at the end of the money" - Billy Hill, 1989.[1]

Credit access facilitates households' ability to smooth consumption in the face of unexpected liquidity shocks. However, excessive borrowing bears the risk of reinforcing the conditions of poverty. This risk is especially large when low-income households rely on alternative financial services outside the mainstream banking system to satisfy their credit needs. As

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[1]From the album: 'I Am Just a Rebel'.

borrowers in these markets tend to refinance their loans for multiple pay cycles, they end up putting a large share of their income toward servicing their debt.

The literature that has studied this borrowing behavior has theorized that consumers rationally adjust to their circumstances[2] or behave in ways that predispose them to overborrow (undersave) relative to the standard neoclassical benchmark.[3]

More recently, however, it has been argued that certain behavior by the poor could stem simply from scarcity itself. Shah, Mullainathan, and Shafir (2012) and Mani, Mullainathan, Shafir, and Zhao (2013) propose that, given a fixed brain bandwidth, (pressing) scarcity limits cognitive functioning. In turn, this limitation could lead to suboptimal decision-making and seemingly shortsighted behavior as individuals engage more deeply in solving some problems (that are more acute) while neglecting others. Gabaix and Laibson (2017) present a model where agents who are unable to think carefully about an intertemporal tradeoff, for example due to a high cognitive load, will exhibit more discounting, even though agents are patient. Bernheim, Ray, and Yeltekin (2015) show theoretically that low levels of assets undermine the individuals' capacity for self-control by diminishing the effectiveness of self-imposed punishments.

The idea that scarcity affects consumers' choices has mainly been studied by measuring cognitive abilities, time preferences and risk aversion via surveys and computer games administered either in the laboratory or the field (see Shah, Mullainathan, and Shafir (2012), Mani et al. (2013), Carvalho, Meier, and Wang (2016)). In this paper, we take on the challenge of investigating whether behavior observed in an experimental set-up is a good indicator for behavior observed in the real world as we investigate whether scarcity has a causal impact on credit choices by low-income households in Sweden. Specifically, we contribute to the literature by analyzing real credit choices, both in the mainstream (bank) and alternative (pawn) credit markets, made by low-income individuals over their pay cycles. Given that the average annual fees paid by pawn borrowers in Sweden represent a large share of their income, uncovering mechanisms that can explain changes in the likelihood to participate in this credit market have substantial economic implications for these low-income households.

As a starting point, we find that the number of days since payday is positively correlated with the probability to take credit.[4] This relationship, however, is likely to provide a biased estimate of the causal effect. First, credit decisions affect the level of economic

[2]See for example Morse (2011), Bhutta, Marta Skiba, and Tobacman (2015), Agarwal and Bos (2014).

[3]The most relevant behavioral biases studied in this context include but are not limited to: i. inconsistent time preferences (Laibson, Repetto, and Tobacman (2003), Meier and Sprenger (2010)), ii. biased price perceptions (Gabaix and Laibson (2006), Bertrand and Morse (2011)), iii. tendency towards optimism (Brunnermeier and Parker (2005)), iv. reliance on crude heuristics (Stango and Zinman (2014)). See Bos, Carter, and Skiba (2015) and Schilbach, Schofield, and Mullainathan (2016) for an overview of this topic.

[4]An individual's probability of taking a pawn loan increases, on average, by 2% per day since payday.

scarcity (reverse causality). Second, individuals who take alternative credit are probably also more likely to experience scarcity (omitted variables). In order to identify the causal part of the correlation between scarcity and consumers' credit choice, we make use of a detailed administrative panel dataset that matches alternative and mainstream consumer credit decisions with their education level and tax records. We combine this dataset with an exogenous source of variation in scarcity that enables us to hold the two other effects constant.

The ideal experiment to identify the effect of increased economic scarcity before payday on credit decisions would consider two identical groups of low-income households, treated and control, who make credit decisions. In that experiment, income would randomly be paid out late to treated households, and any difference in credit choices between the two groups would be causally assigned to this change.

We approximate this idealized setting by exploiting a particular feature of the Swedish social transfer recipients' payment scheme, which creates quasi-experimental variation in the number of days within a pay cycle (see Figure 1 for an illustration). In Sweden, government social transfers are typically paid out on the same date of each month: on the 18th if the recipient was born before the 16th of any month ("early-born"), and on the 19th if the recipient was born on or after the 16th ("late-born"). Furthermore, these respective paydays are moved to the closest working day whenever the assigned date falls either on a weekend or a holiday. Hence, if the 18th falls on a Saturday (e.g. as it did in June 2011), the early-born group receives its transfer on Friday the 17th, while the late-born group gets paid on Monday the 20th, creating a gap of three days between the two groups' receipt of their payments. As the nominal amount of pay is constant over time, the late born, in this example, are more likely to experience a short-lived reduction in financial resources, which we define as an increase in scarcity. Note that in the next month, the late-born recipients have fewer days between paydays relative to the early born. Thus, similarly to the ideal experiment, early and late-born groups are randomly assigned to treatment and control within a given pay cycle, and will switch between treatment and control over time.

As Carvalho, Meier, and Wang (2016) point out as well, it is likely that our borrowers anticipate the timing of their payday and thus our analysis applies to the effects of a short-lived variation in financial resources that is anticipated and anticipated to be temporary. Thus, for a fully rational consumer without credit constraints, one would expect a smooth consumption pattern independent of the length of the payday cycle.

However, previous studies have documented that expenditures and caloric intake increase sharply at payday (Stephens (2003), Stephens (2006), Shapiro (2005), Mastrobuoni and Weinberg (2009), Huffman and Barenstein (2005)). We follow Carvalho, Meier, and Wang (2016) in that we define the seven days before payday as the scarce (post-)period and

the two weeks before that as the non-scarce (pre-)period.

Our initial empirical strategy is therefore a difference-in-difference regression, comparing credit choices early and late within the payday cycle for early and late-born borrowers, where the length of the borrowers' pay cycle is randomly assigned depending on their birthday.

In line with Carvalho, Meier, and Wang (2016)'s findings on real-effort tasks, we find no apparent effect of scarcity on the likelihood to participate in the credit market. This means that the probability of taking a loan late in a pay cycle is the same for a short or long pay cycle.

However, our set-up allows us to go one step further, and analyze the causal impact of scarcity on borrowing decisions when we distinguish borrowers by their level of education.

One particular advantage of pawn borrowing is that it enables us to infer our borrowers' preferences to ultimately retrieve their collateral based on their decision to pawn it, instead of selling it at the gold-to-cash vendor, who typically offers more cash per carat.[5] Put differently, we assume that the consumer's plan is to repay the loan. We then formulate a simple framework based on the insights of O'Donoghue and Rabin (1999), where borrowers with biased time preferences differ in their level of sophistication. Fully sophisticated borrowers perfectly foresee their future self-control problems and will want to use a commitment device, i.e. an action that limits the negative consequences of their self-control problem. In contrast, a fully naive borrower will never use a commitment device, as she is unaware of potential self-control problems.

We hypothesize that, if a sharp but short-lived drop in financial resources before payday (i.e. an increase in scarcity) itself induces shortsighted behavior, as suggested by e.g. Shah, Mullainathan, and Shafir (2012) and Gabaix and Laibson (2017), then the fully sophisticated ones, who are aware of their bias, would like to ensure repayment in order to retrieve their gold and therefore commit to this by borrowing *less* at the end of the month in a long pay cycle. In contrast, the naive consumers' borrowing behavior is unaffected by increased scarcity since they are unaware of any change in their shortsightedness. Thus, relative to fully sophisticated borrowers, the naive will "overborrow". As in, for example, Ru and Schoar (2016), we proxy the level of sophistication with the borrowers' education. We classify individuals with more than high school as high educated (*sophisticated*) and less than high school as low educated (*naive*). As education correlates with income, wealth and preferences, we discuss alternative interpretations below.

Utilizing this framework, we combine the two empirical strategies within a pay cycle –

[5]The lion's share of pawn loans (more than 80%) in the full sample are secured by gold (see Bos, Carter, and Skiba (2012)), and we limit our sample to pawn loans collateralized by gold, in order to calculate the loan to value ratio. A pawn loan contract is typically three to four months long and thus the pawn broker is exposed to the risk that the price of gold will fall during this time. Furthermore, the pawnbroker has to bear the cost of administering the loan and storing the gold. The gold-to-cash servicer can, in theory, resell the gold immediately with a lower administrative burden.

early versus *late-born* and *high* versus *low-educated* borrowers – for identification. We track how the probability of participating in the pawn credit market changes for these groups over the pay cycle. Our approach is therefore a triple difference identification strategy, where the coefficient of interest can be interpreted as the causal effect of increased economic scarcity on credit decisions by less sophisticated poor consumers.

We find that borrowing by the high-educated individuals is reduced, while borrowing by low-educated individuals is *unaffected* when their budget constraints are exogenously tighter. Consistent with our framework, where the high-educated borrowers are more sophisticated, we interpret this lack of response by low-educated borrowers as an increase relative to the benchmark behavior by the high-educated.

Specifically, compared to the high-educated, the low-educated borrowers are 0.02 percentage points more likely to take pawn loans during days of increased scarcity. Relative to their non-scarce mean of 0.22 percent, this constitutes an economically significant increase of 10.7 percent in borrowing propensity. The low-educated borrowers also take loans with a higher Loan to Value (LTV) ratio (+10.9 percent) during periods of increased scarcity. Furthermore, we find that they are 4 percentage points more likely to default on the loans taken during the days with elevated levels of scarcity. Finally, we find no evidence that this additional credit helped them to avoid default outside the credit market.

Our findings on both the extensive (participation) and the intensive (amount borrowed) margin of credit are in line with the notion that more naive borrowers do not anticipate self-control problems, implying they do not adjust their borrowing to ensure repayment of a loan taken during days of increased scarcity. A back-of-the-envelope calculation suggests that the additional borrowing due to increased economic scarcity translates into a 11.6 percent increase in pawn credit costs.

Importantly, consistent with our identification assumption, we find a monotonic increasing relationship between the size of the treatment – e.g. one day difference between early and late-born within a payday cycle, two days difference for another payday cycle, etc. – and the probability of participating in the credit market as well as the LTV of the loan for low-educated individuals relative to their high-educated counterparts.

In a series of robustness checks, we explore whether our results indicate a difference in access to liquidity between the low and high-educated borrowers, working through the budget constraint rather than through time preferences. Note first that, if anything, one would expect the low-educated borrowers, who have lower income and wealth, to respond to delayed payments by borrowing more when liquidity constraints bind in long payday cycles. Instead, we find a precisely estimated zero effect for the low-educated borrowers. Secondly, our empirical set-up allows us to absorb level differences in liquidity between low and high-educated borrowers (the first difference) over their respective pay cycle (the second

difference) and isolate the effect of increased scarcity in long versus short months (the third difference) while controlling for individual, calendar and event time fixed effects. Third, when running a 'horse-race' between education and various measures of liquidity, we find no evidence that our results are driven by differential access to liquidity or buffer stocks between the high and low-educated borrowers. Nor can age, family composition or spousal income differences explain our findings.

Our results highlight that temporal increases in economic scarcity risk reinforcing the conditions of poverty, since our setting and empirical strategy credibly identify a causal effect from increased scarcity to credit choices, manifesting itself via education. Indeed, the difference in education could sort borrowers into their differential awareness about their biased time preferences (Ru and Schoar (2016)), but also their difference in financial literacy (e.g. van Rooij, Lusardi, and Alessie (2011)), forecasting abilities (e.g. Gabaix and Laibson (2017)), attentiveness (e.g. Sims (2003), Karlan et al. (2016)) or risk aversion (e.g. Benjamin, Brown, and Shapiro (2013)). These cognitive abilities and preferences are difficult to disentangle, and our use of education as a measure of sophistication should be viewed as representing this broader set of traits.

Our contribution to the literature is threefold. First, we document that increased scarcity right before a payday causally impacts credit choices. Therefore, our findings speak to the partly contradicting results of Mani et al. (2013) and Carvalho, Meier, and Wang (2016) plus the ongoing policy debate on decision-making by the poor. Secondly, establishing a causal link between scarcity and credit choice has implications for the literature that studies the financial well-being of borrowers who rely on alternative financial services more generally (Morse (2011), Melzer (2011), Zinman (2010)) and the appropriate scope of regulating such lenders in particular (CFPB (2013), CFPB (2016)). Our results lend support to policies that aim to smooth fluctuations in scarcity by harmonizing the timing of income and bill receipt (Parsons and Van Wesep (2013)). Lastly, we show evidence that this seemingly present-biased behavior increases default risk and debt-servicing cost in the credit market while not reducing default risks in other markets, hence highlighting that increased levels of economic scarcity risk to cause a poverty trap (Bertrand, Mullainathan, and Shafir (2004)).

Our paper is most closely related to Mani et al. (2013), who find that Indian farmers, pre-harvest, borrowed more and performed worse on cognitive tests relative to themselves post-harvest, and to Carvalho, Meier, and Wang (2016), who find mixed results administering online tests with two ongoing internet panels, sampling low-to-moderate-income Americans. The latter find that before-payday survey participants behave as if they are more present-biased when making choices about monetary rewards. However, they find no effects when choices concern real-effort tasks, and no evidence for cognitive decline under economic stress.

They suggest, but cannot directly measure, that liquidity constraints might explain their pecuniary findings. We find no support for this explanation, despite the fact that our data allows us to observe, in great detail, access to both mainstream and alternative credit and income shocks.[6] Moreover, when we rerun their analysis utilizing their online data, adding heterogeneity in education, we find that their survey participants with more than a high school education are significantly less present-biased in the real effort tasks before payday, in contrast to no difference in the behavior of low-educated participants before payday, in line with our findings.[7]

Furthermore, our work is also related to liquidity constraints and budgeting mistakes and their consequences for credit uptake. In a theoretical paper, Parsons and Van Wesep (2013) show that, if the timing of wage payments matches the timing of workers' consumption needs, employers could reduce wages when workers have self-control problems. Leary and Wang (2016) test these predictions in a recent working paper and show empirically that payday borrowing is procyclical with liquidity over the pay period and that payday lending is significantly higher in long payday cycles when there is a potential mismatch between the timing of payday and recurrent bills.

Finally, our analysis also relates to the growing literature that studies the effect of stress in a more general sense on economic decision-making, including research in which stress is induced through exposure to cold water, the injection of stress hormones or public speaking.[8] The literature studying the effect of stress in the laboratory on financial decision-making and preferences has mixed results, finding either that stress does have a temporary effect or no effect at all (see e.g. Delaney, Fink, and Harmon (2014), Porcelli and Delgado (2009), Haushofer et al. (2013)).

The remainder of the paper is organized as follows. Section 2 provides a simple framework to understand how economic distress may affect credit decisions depending on borrower sophistication. Section 3 describes our empirical setting and identification strategy to uncover the effects of scarcity on credit decisions. The results are in Section 4. Section 5 interprets the results and Section 6 concludes.

2 A Simple Framework

This section provides a simple framework to illustrate the possible effect of scarcity on credit decisions. Online Appendix C provides further details.

[6] We observe, among other things, the borrowers' mainstream credit applications, balances and limits of their credit cards and installment loans, and arrears.

[7] Online Appendix B presents further details.

[8] See Haushofer and Fehr (2014) and especially their Supplemental Appendix for a comprehensive literature review on the effects of stress on risk-taking and discounting.

2.1 The Timing of Credit Decisions

The timing of consumers' credit decisions within the pawn credit market are illustrated in Figure 3. In period 0, the consumer owns an illiquid asset (e.g. gold jewelry) and decides whether to use it as collateral for a loan from a pawnbroker or to sell her gold at a gold vendor instead (i.e. the participation constraint). When the consumer decides to take a pawn loan, she also decides how much she wants to borrow. Note that the pawnbroker will lend up to a maximum fraction of the resale value of the collateral in order to hedge against price fluctuations during the duration of the loan contract. This fraction is smaller than the fraction offered by the gold vendor, who typically is located in the proximity of the pawnbroker, since the gold vendor can resell the gold quickly. Given this price difference, we infer that a consumer pledging her gold at a pawnbroker intends to redeem the asset in the future period and thus to repay her loan.[9]

Given a loan taken in period 0, the consumer decides in period 1 to either redeem her collateral by paying back the principal and interest due or to postpone repayment and rollover her loan by paying a fee and interest.[10] A third alternative is to do nothing and default on the loan. When the consumer defaults, she loses ownership of her pledged asset. By redeeming or defaulting, the loan contract ends in period 1, but if the loan is rolled over instead, the consumer has again to decide in period 2 to either repay or default.

Time Preferences

In period 0, the consumer simultaneously estimates her ability to save for repaying the loan in the next period as well as whether and how much to borrow. Following the behavioral finance literature stressing the importance of time inconsistency to explain credit decisions, we assume quasi-hyperbolic preferences as in Phelps and Pollak (1968) and Laibson (1997):

$$U_t = u(c_t) + \beta \sum_{\tau=1}^{T-t} \delta^\tau u(c_{t+\tau}) \tag{2.1}$$

In this utility function, β is the parameter of short-run discounting and δ the parameter of long-run discounting. When $\beta = 1$, consumers are 'rational' and discount the future exponentially. However, when $\beta < 1$, consumers are 'present-biased' and have time-inconsistent preferences.

[9] The option value of repurchasing the asset in a future period makes the consumer accept the lower LTV threshold.

[10] Reflecting the rules of the pawnshops in our data, borrowers need to take explicit actions (pay first the fee and interest charges) in order to roll over the loan. In particular, the fee and interest cannot simply be added to the loan amount, increasing the size of the debt. Partial pre-payment is possible, but rarely observed, and therefore not modeled.

Scarcity and Time Preferences

In recent papers, Shah, Mullainathan, and Shafir (2012), Mani, Mullainathan, Shafir, and Zhao (2013) and Bernheim, Ray, and Yeltekin (2015) argue that poverty (economic scarcity) itself might induce short-sighted behavior. In order to test this hypothesis, we allow β to depend on the level of scarcity and assume that as economic scarcity increases, β subsequently decreases. In our empirical analysis, economic scarcity is defined as an exogenous increase in the number of days between two subsequent paydays.

2.2 Empirical Predictions

2.2.1 Rational Consumer, $\beta = 1$

As a benchmark, we consider the case of $\beta = 1.$, i.e. a fully rational low-income borrower with quasi-hyperbolic preferences. She is able to perfectly estimate her ability to save for repaying her loan and stick to her consumption plan as decided in period 0 (which is, to choose a credit contract with the intention to repay).

Impact of Scarcity

An exogenous and unanticipated increase in the number of days between two paydays, holding all else equal, increases the liquidity constraints of a rational consumer and thereby increase her demand for credit.

Prediction 2.1. *An unanticipated exogenous increase in scarcity increases the demand for credit.*

However, if a shift in the timing of her payday can be anticipated, a fully rational consumer smooths her consumption accordingly. Put differently, a fully rational consumer will never face scarcity induced by a shift in the timing of her payday and thus her behavior remains unchanged.

Prediction 2.2. *A shift in the timing of payday has no effect on the credit decision of a fully rational consumer.*

2.2.2 Consumer with Self-Control Problems, $\beta < 1$

If a consumer is *not* fully rational, but instead suffers from some degree of self-control problem,[11] then a discrepancy arises between what the consumer plans in period 0 and

[11] This assumption is supported by empirical evidence in the literature; see, for instance, Laibson et al. (2017) and Fang and Silverman (2009), who estimate a short-run discount factor of β= 0.5 and β = 0.3, respectively. Meier and Sprenger (2010) show that present-biased agents are more likely to borrow on their

what she ends up doing in period 1. In period 0, the consumer estimates her future ability to repay the loan and decides whether and how much to borrow accordingly. However, when period 1 arrives, she rather not repay the principal and consume instead. Put simply, the consumer believes she will repay the loan tomorrow, but when tomorrow comes, repaying the loan suddenly seems less attractive.

As credit facilitates immediate consumption while postponing the cost, it appeals to a present-biased consumer. Thus, holding all else equal, we expect a consumer with time-inconsistent preferences to demand more credit than her fully rational counterpart.

Impact of Scarcity

Even if scarcity were fully anticipated, a consumer with self-control problems will have trouble sticking to her plan to consume less and save more in order to repay the loan that enabled her to smooth consumption during the scarce period. Hence an exogenous increase in scarcity will increase the demand for credit by a consumer with self-control problems. On top of this, if scarcity makes the consumer even more present-biased, then the demand for credit will be even higher.

Prediction 2.3. *An anticipated exogenous increase in scarcity increases the demand for credit of a consumer with self-control problems.*

2.2.3 Heterogeneity in Awareness of Self Control Problems: $\beta \leq \hat{\beta}$

Following O'Donoghue and Rabin (1999), we consider different degrees of awareness (sophistication) about self-control problems. Specifically, given some degree of self-control problems ($\beta < 1$), consumers can have different beliefs ($\hat{\beta}$), about their true β. A fully aware (sophisticated) consumer has correct beliefs ($\beta = \hat{\beta}$), whereas a fully unaware (naive) consumer believes her preferences are time-consistent ($\hat{\beta} = 1$). In turn, this implies that a sophisticated consumer will anticipates a deviation from her repayment plan in period 1. In order to commit to her plan and repay the loan, she demands a smaller loan. In the empirical analysis, we focus on the loan to value (LTV) ratio. If the asset is indivisible, demanding a smaller loan implies a lower LTV ratio, which increases the cost of default, which is another way to commit to repaying her loan. Note that a fully aware (sophisticated) consumer with a strong present bias may even refuse to take a loan.

credit card and have revolving balances. Heidhues and Kőszegi (2010) show that suppliers of credit are likely to introduce fees for late repayment, if some consumers are naive about their present-biased time preferences. Ru and Schoar (2016) present supporting evidence for this finding.

Impact of Scarcity

An exogenous increase in scarcity has very different implications for a naive or sophisticated consumer's behavior. As economic scarcity increases, and β subsequently decreases, a fully naive consumer will still assume she does not suffer from self-control problems (i.e. she believes her $\hat{\beta}$ remains equal to 1). This unawareness of her true β will thus make it impossible for her to adjust her credit decisions accordingly.

Prediction 2.4. *An exogenous increase in scarcity has no effect on the credit decisions of a consumer who is unaware of her self-control problems.*

In contrast, a fully aware consumer realizes that, during scarcity, her behavior might become more shortsighted (i.e. β is smaller). To make sure that she will credibly stick to her future repayment scheme, she reduces her demand for credit. Note that, for a given value of the asset, a lower LTV implies a higher loss given default. This, in turn, implies a greater cost of default. So, taking a smaller loan can be a way to credibly commit to repay the loan and avoid the higher cost of defaulting. Furthermore, by realizing that only a smaller loan size will ensure repayment, her probability of participating in period 0 will decrease, as the smaller cash amount can fix a smaller set of liquidity problems.

Prediction 2.5. *An exogenous increase in scarcity reduces the demand for credit of a consumer that is fully aware of her self-control problems.*

Finally, since self-control problems lead to overborrowing, we predict a higher probability of default for a consumer unaware of her biased time preferences.

Prediction 2.6. *An exogenous increase in scarcity increases the probability of default for loans taken by a consumer who is unaware of her self-control problems.*

3 Measuring the Effect of Scarcity on Credit Choices

Here we describe our empirical setting and baseline identification strategy to uncover the effects of scarcity on credit decisions.

3.1 Setting and the Swedish Social Transfer Payment System

Swedish Social Transfer Payments

In Sweden, social transfers are typically paid out on the same day each month. If you are born before the 16th of any month (from now on early born), you are typically paid on the 18th and if you are born on or after the 16th (from now on late born) you are paid on the 19th. However, as illustrated in Figure 1, this payday is moved to the closest working

date whenever this date falls on a weekend and is moved forward if a payday is a holiday. For instance, take the payday cycle ending in June 2011. As June 18 was a Saturday, the early-born group was paid on Friday June 17th (and again on July 18th), while the late born were paid on Monday June 20th (and again on July 19th). This payday shift yields 31 days between paydays for the early born, and 29 days for the late born, i.e. a difference of two days between the early and late-born groups. As another example, June 19th 2009 coincided with Midsummer, a bank holiday. As a result, the late born received their transfer on Monday June 22 instead, yielding 34 days in the May-June payday cycle for the late born, while the early born were not affected and had 31 days in the same cycle.

These payday shifts provide significant variation in the number of days between two paydays, ranging from 28 to 34 days in general, but also varying between the early and late born within pay cycles. Figure 2 displays the variation between early and late-born individuals per pay cycle across years ranging between zero and three days.

Identification Intuition

We aim to identify the causal effect of increased levels of scarcity on low-income households' credit choices. A perfect experiment to identify this effect would consider two identical groups of low-income households, treated and control, who make credit decisions. In that experiment, one group would randomly be paid out late, and any difference in credit choice between the two groups would be causally assigned to this change.

In our empirical setting, we use the variation in the number of days within payday cycles between early and late-born groups induced by the interaction of the timing of birth and the timing of payday on weekend days or holidays to approximate this idealized setting. For a population of borrowers at the margins of the formal credit market, a few days extra between paydays matters greatly. We denote as treated payday cycles those months where the number of days between paydays differs between the early and late-born groups, and hence the early born serve as the control group for the late born, or vice versa.

As liquidity is initially high just after borrowers receive the transfer, we track how the probability of taking a pawn loan changes during the seven days before the next payday (post = 1) relative to the two weeks before that (post = 0).[12]

Our approach is therefore a difference-in-difference identification strategy, where the coefficient of interest can be interpreted as the causal effect of increased levels of scarcity on

[12]There are at least three reasons for a seven-day cutoff. Firstly, expenditure needs may differ depending on the day of the week, so we ensure that all weekdays are in the post-period. This is especially relevant as the pawnbroker is typically not open on Sunday, which constrains participation for either the early or late born when their payday is moved. Secondly, the trends until seven days before payday are parallel, after which divergence occurs (see Figure 4). Lastly, we follow Carvalho, Meier, and Wang (2016), who also define the last week before payday as the scarce period. We demonstrate robustness to this choice of cutoff in Online Appendix A, Table A5.

credit decisions. The identification assumption is that any difference in borrowing behavior in scarce periods relative to non-scarce periods is driven only by the difference in the degree of scarcity before payday. In Section 4.1 we provide evidence that supports this assumption.

Pawn Credit Market

The individuals that we study are making credit decisions within the Swedish pawn and mainstream credit markets. The pawn credit industry and its customers in Sweden are surprisingly similar to those in the US.[13] Pawn credit involves a relatively simple transaction: the broker makes a fixed-term loan to a consumer in exchange for collateral. There is no upfront fee. The pawnbroker supplies credit based only on the value of the collateral, not on (unobserved) borrower characteristics, avoiding the sample selection in consumer credit where borrower creditworthiness rather than the collateral determines access.[14]

For this study, we focus on borrowers who hand in gold as collateral to minimize subjectivity in the reported value of the collateral. Around 83 percent of the pawn borrower population pledges gold as collateral. In Sweden, the standard fixed contract term is three to four months. In our data, we observe stable interest rates across pawnbrokers of approximately 3.5 percent per month. Customers choose how much to borrow and thereby their loan to value (LTV) ratio. The average LTV ratio in our sample is around 76 percent (see Table 2). If the customer repays the loan, the interest and all required fees, the pawnbroker returns the collateral to the customer. If the customer does not repay the loan by the end of the duration of their contract, the collateral becomes the property of the broker, the customer's debt is extinguished and the collateral is sold at an auction or in the store. The borrower can renew her contract and avoid the auction by paying a fee and the accumulated interest, after which the debt is rolled over and the repayment date is moved three to four months into the future.

In Sweden, like in the US, approximately 4 percent of the adult population takes a pawn loan on a regular basis. The members of the Swedish pawnbroking association, who represent 99 percent of the market, generously shared their registry data with us. During the window of our panel, the average principal loan amount is around 4000 SEK (approximately 470 USD), with an average duration of 180 days and finance charges of 1000 SEK, amounting to an annual percentage rate of around 60 percent. Hence, the mechanisms behind the decision to participate in this credit market can have substantial economic implications for low-income borrowers.

[13] See Bos, Carter, and Skiba (2012) for a comparison of the Swedish and US pawn industries and their customers.

[14] In addition, trust does not play a role, as the asset is physically handed over to the pawnbroker, avoiding costly liquidation or bankruptcy procedures.

3.2 Data

For this project, we utilize a sample of Swedish pawn borrowers. The pawn register data contains information about all transactions (going back to the 1990s) by an individual within the pawn credit industry on a daily frequency, including credit contract choice, their pledge and repayment behavior. We construct a daily panel for four years from 2008 to 2011, with indicators for taking a pawn loan and the corresponding LTV ratio[15] as outcomes of interest. For these four years, we also observe the full credit reports on the first of every month from the leading Swedish credit bureau. Unlike in the US, Swedish credit bureaus have access to registered data from the Swedish tax authority and other government agencies. In addition to all their outstanding consumer credit within the mainstream banking sector, we also observe borrowers' age, marital status and annual income before and after taxes. Furthermore, we observe each individual's credit score, which reflects the default risk from 0 to 100 where a low number refers to a low default risk.[16]

In order to determine the type of income (social transfers or income from work), we match the credit bureau data with information obtained from Statistics Sweden (SCB). This data enables us to observe whether, and if so, what share of their income comes from social transfers. For the purpose of our analysis, we focus on the group of individuals that have no income from work, which includes people on welfare, the unemployed and the retired (we drop those above 75 years). Furthermore, we observe for all individuals their exact date of birth, which enables us to classify each borrower into early or late-born social transfer payment dates. Other variables included are the individual's education level, disposable income and family composition. Our final sample consists of pawn credit borrowers that receive only social transfers[17] and who use gold as collateral, resulting in a daily balanced panel of 39,489 individuals, with just over 27 million person-day observations.

3.3 Empirical Strategy

We exploit the payment system that shifts the typical payday of the early and late born when it falls on a weekend or holiday to identify the causal effect of increased scarcity before payday on credit choices. Our identification strategy relies on comparing the probability of taking a pawn loan for the early and late born during the seven days before payday in a long (treated) and short (control) payment period. We control for baseline differences in the likelihood of taking a pawn loan by comparing their likelihood in the 21 to 8 days before

[15] We calculate the LTV ratio using the gold price at the time of the loan origination and the grams of gold we observe in the dataset.

[16] The probabilities of default are estimated by the credit bureau, with a model based on data from the whole population of Sweden aged 18 and above. The model specifications are proprietary.

[17] As we use borrower fixed effects in our regression, adding all social transfer recipients that do not take pawn loans to our estimation sample does not affect the quantitative results.

payday (the pre-period) in both the long (treated) and short (control) payday periods. Finally, through the inclusion of individual fixed effects as well as year, month, year × month, days until payday and day-of-the-week fixed effects, we are able to filter out individual unobserved heterogeneity, seasonality, and time trends to analyze differences in borrowing decisions between early and late-born individuals within a specific payment period.

We denote the treatment payday cycles with the variable $treated_{i,t}$, which equals 1 (0) for the early born (late born) if the payday cycle of early-born individuals is longer than the payday cycle for late-born individuals. Similarly, $treated_{i,t}$ equals 1 (0) for the late born (early born) if the payday cycle for the late born is longer than that of the early born. We interact $treated_{i,t}$ with the dummy variable $post_\tau$ which equals 1 during the seven days before payday, and 0 during the 21 to 8 days before payday. In that sense, the variable $post_\tau$ is measured in event time, that is, days until next payday. We estimate the following regression:

$$\begin{aligned} 1(takepawnloan_{i,t,\tau} > 0) &= \theta_i + \theta_t + \theta_\tau + \gamma treated_{i,t} \times post_\tau \\ &\quad + \mu treated_{i,t} + \varepsilon_{i,t}. \end{aligned} \tag{3.1}$$

Note that the event time fixed effect θ_τ absorbs the baseline coefficient of $post_\tau$. The coefficient γ, which we report with our regression output below, measures the differential probability of participating in the pawn credit market during the treated and control payment periods, during the seven days before the next payday.

Next, we exploit the richness of our data to dig deeper into the relationship between scarcity and consumer credit choices. We classify individuals with at least some college education as high educated and those with high school degree or less as low educated, and use education as a proxy for the sophistication of the borrowers to test predictions 2.4 and 2.5. As in Ru and Schoar (2016), the high educated are labeled as being aware of their biased time preferences, whereas the low educated are labeled as unaware of their time-inconsistency problems.

As before, we exploit the variation in the number of days between paydays to estimate the effect of scarcity. Our main specification is the following triple differences regression:

$$\begin{aligned} 1(takepawnloan_{i,t,\tau} > 0) &= \theta_i + \theta_t + \theta_\tau + \gamma treated_{i,t} \times loweducated_i \times post_\tau \\ &\quad + \delta treated_{i,t} \times post_\tau + \eta loweducated_i \times post_\tau \\ &\quad + \kappa loweducated_i \times treated_{i,t} + \mu treated_{i,t} + \varepsilon_{i,t}. \end{aligned} \tag{3.2}$$

Note that the borrower fixed effect θ_i absorbs the baseline coefficient of $loweducated_i$, and the event time fixed effect θ_τ absorbs the coefficient on $post_\tau$. The coefficient γ, which is

our main outcome and which we report with our regression output below, measures the differential probability of participating in the pawn credit market during the treated and control payment periods, for low-educated individuals relative to high-educated individuals, during the seven days before the next payday. The coefficient η captures differences in credit uptake between high and low educated individuals during the seven days before payday. The coefficients κ and μ measure differences for a long *(treated)* payment period relative to a short *(control)* period, for low versus high-educated individuals. Finally, δ captures differential trends in the probability of taking pawn credit for all non-scarce *(control)* payment periods during the seven days before the next payday.

The key assumption we need in order to establish a causal effect is that the difference in the probability of taking pawn credit by low versus high-educated individuals close to payday in a short payment period can serve as a counterfactual for the same difference close to payday in a long payment period. While this assumption is untestable, we show in Section 4.1 that the behavior of low-educated individuals, relative to their high-educated counterparts, is similar in treated months to that in control months prior to scarcity.

Finally, the difference in the length of the payday cycle between early and late-born individuals (ranging from zero to three days) suggests an additional test of our identification strategy: the effect of scarcity on credit choices should (monotonically) increase in the number of extra days between two paydays. In Section 4.3 we provide evidence that is consistent with this notion.

3.4 Summary Statistics

Before presenting the regression output, we discuss selected summary statistics of our outcome variables. Table 1 contains definitions of both our dependent and independent variables of interest, and Table 2 provides the summary statistics of our outcome variables during the non-scarce (pre-)period split by the early and late born. In line with the notion of randomly-assigned treatment and control groups, we find no significant differences between the early and late-born individuals' borrowing behavior or individual characteristics. We find that, during the pre-period, the daily probability of taking a pawn loan is around 0.20 percent with an LTV ratio of around 0.14 percent. While these numbers sound rather low, note that these are unconditional averages, i.e. including the zeroes of the consumers who decided to not take a pawn loan on a particular day.

Conditional on taking a loan, the average LTV ratio equals 76 percent. Nearly a quarter of all loans end up not being repaid, and more than a quarter of all loans are rolled over at least once.

As we focus on the Swedish population that lives on the margins of formal credit markets, it is no surprise that the average credit score (interpreted as a probability of default) is rather

high, around 28 percent. Monthly income is low by Swedish standards, at around 10,000 SEK (1,175 USD) per month.

4 Results

In this section, we analyze the effect of scarcity on the decision to take a pawn loan and on the LTV ratio. We first show the evolution of the participation decision over the payday cycle graphically, and then document our regression results.

4.1 Graphical Evidence

The identification assumption for regressions 3.1 and 3.2 is that, in the absence of scarcity induced by the variation in length of a payday cycle, the propensity to take pawn credit (for the low and high-educated individuals), in the period after the last payday up till a week before this payday, would evolve in parallel. We provide evidence that supports this assumption in Figure 4.

Panel A of Figure 4 shows the average probability of taking a pawn loan and the LTV ratio, in short and long cycles, over the payday cycle. In line with our identification assumption, the probabilities in short versus long payday cycles move in tandem in the pre-period, which starts three weeks before payday and ends one week before payday. Panel B shows the same averages split into low and high-educated groups. The graph shows that the low educated have a near-constant average probability of taking out loans over the pay-cycle, independently of scarce periods or long pay cycles. This behavior is consistent with the notion that the low-educated borrowers are less aware (naive) of their potential short-sighted behavior in general or any scarcity-induced increase in their behavior specifically. This unawareness inhibits this group of consumers from adjusting their behavior according to their true β (see empirical prediction 2.4 in Section 2). In contrast, the high-educated are thought to be more aware of their scarcity-induced short-sighted behavior and thus have the possibility of attempting to ensure future repayment by exploiting a commitment device. Figure 4 shows that borrowing by high-educated borrowers trends down over the course of the payday cycle.

Panel C most clearly shows our identification strategy at work, by differencing between low and high-educated borrowers, separately for long and short payday cycles. Until approximately seven days before payday, the respective probabilities of participating in the pawn credit market in long and short months move in tandem, supporting our claim that the differential likelihood of taking a pawn loan in a short month serves as the counterfactual for the same probability in a long month. Previewing the regression findings, in the last week before payday, the differential probability of taking loans increases in long payday

cycles, consistent with the low-educated increasing their pawn credit uptake under distress relative to their high-educated counterparts.

4.2 Main Results

4.2.1 Pooled Sample

We quantify whether borrowers in long payday cycles have a significantly higher probability of taking loans before payday using regression 3.1, pooling the high and low-educated borrowers. Table 3 presents the estimates of γ from this regression. Column 1 shows that the additional days between paydays do not lead to increased participation in the pawn credit market. This result remains when we look only at payday cycles with a difference in the number of days between early and late born in order to have more contrast between treated and control, as well as when we use a specification linear in the number of days between early and late born.

While the extensive margin of credit does not seem to be affected by scarcity, it could still be the case that borrowers take larger loans during scarcity. The LTV ratio is especially relevant given the collateralized nature of pawn borrowing. To study this intensive margin, we focus on the *unconditional* LTV, i.e. including the nonparticipants for whom the LTV ratio is set at zero. We include these nonparticipants since a regression model using only the sample of participants would likely suffer from selection bias. To make a meaningful pre-post comparison, it is crucial to keep the sample fixed.

Columns 4-6 of Table 3 show the coefficients for unconditional LTV. Note that this regression essentially combines the *extensive* (participation) margin and the *intensive* (amount borrowed) margin. We again find no evidence of scarcity affecting the LTV ratio, using either the baseline treatment, the contrast treatment or linear treatment variables. As the coefficient of interest is insignificant in these regressions, we can immediately conclude that the intensive margin is not affected either.

4.2.2 Low Versus High Educated

Table 4 presents the coefficient of interest of specification 3.2.[18] The low-educated have at most high school education (12 years of schooling), whereas the high-educated have at least some college education. In column 1, we estimate a significant difference in the probability of taking pawn credit between low and high-educated consumers, in the last week before payday of scarce (treated) payment periods. Low-educated individuals are 0.02 percentage points more likely to participate per day, which is statistically significant at the 5 percent level. As the average propensity to take loans in non-scarce periods for low-educated

[18] Tables A1 and A2 show coefficients for all included variables.

individuals is 0.22 percent per day, the effect is economically large: the coefficient implies a (0.02/0.22=) 10.7 percent higher probability of participating for low-educated borrowers under conditions of scarcity.

In column 2, we obtain slightly stronger results when using more contrast between short and long payday cycles by removing from the control group those months without a difference in the length of the payday period between early and late-born borrowers. In other words, the sample in column 2 consists only of months where the early born have more days between paydays than the late born, or vice versa. In this sample, we estimate a 11.8 percent higher probability of participation for low-educated borrowers in periods of scarcity. This result adds confidence to our interpretation that, compared to our benchmark (the high-educated borrowers), the low-educated borrowers adjust their behavior less because they are less aware of their biased preferences and thus more prone to make suboptimal decisions under increased levels of scarcity.

In column 3, we use a specification linear in the number of days between paydays, instead of the treatment dummy. Per extra day between paydays, we estimate a 6 percent higher likelihood of participating in scarce periods by low-educated consumers, relative to the non-scarce period.

Finally, in column 4, instead of the (arbitrary) cutoff between high and low-educated borrowers, we estimate the treatment effect per additional year of schooling, replacing the low-educated dummy with the continuous variable years of schooling. The coefficient of -0.004, significant at the 5 percent level, implies that the likelihood of taking credit during scarce versus non-scarce periods decreases by 1.9 percent per additional year of schooling.[19]

Panel B of Table 4 shows the coefficient of interest for unconditional LTV as an outcome variable, where the LTV ratio is set to zero for nonparticipants. In the baseline regression (column 1), low-educated borrowers increase the LTV by 0.016 percentage points per day, significantly different from zero at the 5 percent level. Given the non-scarce mean of 0.15 percent, the coefficient implies a 10.9 percent higher LTV in scarce periods relative to non-scarce periods. More contrast between treated and control months (column 2) increases the difference to 13.4 percent. Columns 3 and 4 document an increase in LTV by 7.7 percent per extra day between payday periods, and a decrease by 2.3 percent per additional year of schooling.

4.3 Results by Treatment Intensity

Our identification strategy relies on variation in the length of a payday cycle. The regression tests so far show that low educated individuals have a higher probability of taking a pawn

[19]The pre-period mean reported in column 4 is taken over all borrowers, as opposed to the non-scarce mean for low-educated borrowers, given in columns 1-3.

loan in scarce periods relative to non-scarce periods. To further support our identification strategy, we study whether individuals who were *differentially* exposed to scarcity, measured by the number of additional days between two paydays, make different credit decisions.

Figure 5 shows the effect size (i.e. the coefficient $\hat{\gamma}$ scaled by the non-scarce mean) estimated using separate regressions for the difference in payday cycle length between early and late-born borrowers. This categorization induces a monotonic ordering of exposure to the level of scarcity: the intensity of treatment is greater late in a payday period with three extra days, relative to a period with two extra days. The effect is zero without any difference in length of the payday period. Consistent with our identification assumption, the measured effect is stronger for individuals who were exposed to more days between paydays. Further, the pattern is monotonic in extra days of scarcity: two days of scarcity corresponds to an increase of 11.9 percent in the likelihood of taking pawn loans, while three days of scarcity corresponds to an increase of 14.1 percent. Panel B of Figure 5 is suggestive of a monotonic relationship between the length of payday periods and the LTV ratio as well.[20]

4.4 Maturity Choice

During our sample period, some pawnbrokers increased the menu of contracts available to their borrowers. They introduced a new contract with 2 months maturity, while the standard contract in Swedish pawn shops has a maturity of four months. Other than maturity, the contracts differ in terms of their LTV ratio, with the shorter contract allowing higher LTV levels. Recall that pawnbrokers use an LTV limit to hedge against gold price fluctuations. A shorter maturity reduces the risk of gold price decreases. Importantly, the contracts differ in terms of their LTV limit, but the consumer still decides how much to borrow (subject to this limit). The shorter contract with higher LTV will appeal to present-biased consumers in particular, since it yields more money to consume today. We therefore expect that low-educated borrowers, relative to their high-educated counterparts, will be more likely to choose the short contract with higher LTV in periods of scarcity.

Table 5 displays the results from regressions 3.1 (column 1) and 3.2 (column 2), using the probability of taking a long contract as the outcome variable of interest. Naturally, we need to condition on participation in this regression, as one cannot choose a maturity on loans not taken. Hence, the sample is subject to negative selection into participation.[21] Column 1 shows no difference in the likelihood of taking long loans in scarce and non-scarce

[20] A different way of studying the intensity of treatment would be to consider two (or more) consecutive long payday cycles. However, this pattern hardly occurs in our panel: Only 3 (1) months out of 48 were long for the early- (late-) born after the previous month being long as well.

[21] We also limit our sample to pawn shops where at least 5% of all loans in the full sample had a maturity of 2 months, which we define to be the shops offering the menu of contracts. The results are very similar to using different cut-offs.

periods, parallel to our results on participation and LTV. Instead, column 2 shows that low-educated borrowers are 4.7 percent less likely to take long contracts relative to their high-educated counterparts in scarce periods.

4.5 Repayment and Debt-Servicing Costs

Short-term consumer credit can help overcome liquidity problems, and therefore prevent greater problems moving forward. On the other hand, as interest rates and fees are high, borrowing costs typically accumulate and taking credit may, in fact, cause problems down the road. In this section, we investigate the consequences, inside and outside the pawn credit market, of the credit decisions that are made during periods of scarcity. Firstly, we analyze the final outcome of the loans taken within the pawn credit market. In particular, we observe whether and how many times the loan is rolled over before the consumer eventually either redeems (and thus pays back the principal fees and interest cost) or loses her collateral (and thus defaults on the loan). Secondly, since (pawn) credit taken during periods of scarcity aims to solve an acute liquidity problem, we also investigate whether this impacts the likelihood to default outside the pawn credit market. In Sweden, arrears, defined as being 60 or 90 days late on a payment, are administered by the leading national credit bureau and include any bank or non-bank claim (including, for instance, electricity and parking bills).

Consequences Within the Pawn Credit Market

Table 6, panel A, looks at the differential likelihood to default on pawn loans taken during periods of scarcity. We estimate a linear probability model for default, explained by a full set of interactions between dummy variables for low-educated borrowers, long payday cycles and scarce periods. In addition, we control for the same borrower, days until payday, day-of-the-week and year-month fixed effects. Note that we seek to explain the repayment behavior given the conditions at loan origination. That is, we look forward in time on the day the loan is taken out, and use the length of the payday cycle as well as the number of days until the next payday at origination to infer the likelihood of default. Given that a loan lasts for around six months on average, we omit other factors potentially explaining the default decision in the time between origination and final outcome.

Nevertheless, we find that loans taken in scarce periods of long months by low-educated borrowers are significantly more likely to end up in default, relative to loans taken by the same borrowers in non-scarce periods. The coefficient implies that low-educated borrowers are 4 percentage points less likely to redeem loans taken in scarce periods than those taken in non-scarce periods. Relative to the non-scarce mean, the estimated effect size of 17.4

percent is economically large and significant, especially since the borrowers revealed their initial preference to redeem their collateral by their decision to pawn their gold instead of selling it next door.

These findings are consistent with our theoretical predictions (Prediction 2.6 in Section 2), where the naive (in our setup, the low-educated borrowers) fail to insure themselves against future self-control problems due to their lack of awareness of their biased time preferences and expose themselves to a higher default risk compared to sophisticated borrowers. We calculate that the increased likelihood of taking loans, as well as the increased likelihood of defaulting on these loans, translates into a 11.6% increase of the borrowing costs for the low-educated.[22]

We do not find a significant increase in the probability of rolling over the loan for low-educated borrowers (column 2), but we do find a significantly higher likelihood to default for loans taken by low-educated borrowers that are rolled over. Taken at face value, the results imply that low-educated borrowers default in a less cost-effective way by accumulating more rollover fees and interest.

Consequences Outside the Pawn Credit Market

In order to investigate whether the credit taken to fix acute liquidity problems during the period of increased scarcity helped low-income households to avoid defaulting on their electricity bills, we run a hazard model to test the difference in the likelihood of obtaining an arrear. Indeed, low-educated borrowers may have managed to avoid arrears outside the pawn shop by exchanging their illiquid assets for cash.

We test whether there is a difference between low-educated and high-educated consumers under increased levels of scarcity, while controlling for the pre-scarcity difference in their respective likelihood of obtaining arrears. For this purpose, we will run the following Cox proportional hazard model, where x captures all remaining interaction terms:

$$h(t) = h_0(t) \exp\left(\theta_t + \theta_\tau + \gamma treated_{i,t} \times loweducated_i \times post_\tau \times takepawnloan_{i,t,\tau} + \zeta x_{i,t}\right) \tag{4.1}$$

We utilize the credit bureau data that is matched to the pawn credit panel. In Sweden,

[22]The average loan size is around 4,000 SEK. The fees and interest costs per kronor borrowed amount to 0.25 SEK for the 77% of loans that end up being repaid, giving costs of $4,000 \times 0.25 \times 0.77 = 770$ SEK. For the 23% of loans that end up in default, and given the average LTV of 76%, the costs amount to $4,000 \times 0.23/0.76 = 1211$ SEK. During periods of increased scarcity, we estimate a 10.7% increased probability to borrow (Section 4.2) as well as a 4 percentage points higher likelihood of defaulting. The repayment costs and default costs due to scarcity amount to $0.107 \times 4,000 \times 0.25 \times 0.73 = 78$ SEK and $0.107 \times 4,000 \times 0.27/0.76 = 152$ SEK, respectively. Hence, scarcity increases pawn credit costs by $100 \times (78 + 152)/(770 + 1211) = 11.6\%$.

claims that are unsuccessfully pursued by the private collection market will be handed over to the national enforcement agency, Kronofogden. Once the claim is officially registered in Kronofogden's public registry, the credit bureau (which collects this registry data on a daily basis) will register an arrear on the individual's credit report that will remain there for three years.

In column 3 of panel B of Table 6, we present the results of our hazard regression, looking up to six months ahead for every borrower. We find no significant difference between low and high-educated borrowers in the hazard to receive an arrear after participation. Columns 1 and 2 repeat this exercise, using a linear probability model instead, which allows us to control for individual fixed effects. Again, whether looking two or three months ahead, we observe no differences in the likelihood of arrears between high and low-educated borrowers during periods of scarcity.

The conclusion of this exercise is that we do not find evidence that taking pawn credit helped the borrowers avoid arrears outside the pawn credit market, consistent with Bhutta, Marta Skiba, and Tobacman (2015). In addition, low-educated borrowers default more on their pawn loans. Together, these findings suggest that, during periods of increased economic scarcity, the low-educated are more likely to be tempted to on take too much debt in order to solve their acute liquidity problem, ignoring potential long-run consequences.

5 Mechanisms and Additional Findings

5.1 Difference in Liquidity or Present-Bias?

The results so far show that low-educated borrowers are more likely to take a pawn loan with a higher LTV in periods of scarcity, to take shorter-maturity loans, and are subsequently more likely to default on these loans taken during periods of distress. Although these findings are consistent with the predictions derived from the simple framework in Section 2, in which a change in time preferences is the underlying driver, we investigate other potential mechanisms that could generate these results in this section. We start with income and age differences between low and high-educated borrowers, and subsequently analyze differential access to liquidity in the mainstream credit market or buffer stocks between them. Indeed, Carvalho, Meier, and Wang (2016) argue in favor of the liquidity explanation for differences in before and after payday comparisons.

In what follows, we use the following regression specification, including both the interaction terms with the dummy for low-educated individuals as well as variables capturing

liquidity differences:

$$\begin{aligned} 1(takepawnloan_{i,t,\tau} > 0) \quad &= \quad \theta_i + \theta_t + \theta_\tau + \gamma treated_{i,t} \times loweducated_i \times post_\tau \\ &\quad + \gamma_1 treated_{i,t} \times liquidity_{i,t} \times post_\tau + \zeta x_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{5.1}$$

All single and double interactions are captured in the variable x. The idea behind regression 5.1 is to run a 'horse race' between education and potential liquidity differences, to test which of the two competing explanations is the strongest.

We start with income differences between high and low-educated borrowers: high-educated borrowers have on average 5,000 SEK (∼550 USD) higher monthly benefit income in our sample. Column 1 of Table 7 shows that higher-income borrowers are more likely to take pawn loans, and with higher LTV ratios (column 8) in scarce periods. Importantly, the coefficient on the triple interaction with education (γ) is virtually unchanged and still significant. The fact that the coefficient on income is positive and significant does not harm our interpretation. A negative estimate would imply that the income difference between high and low-educated borrowers was driving the relation between borrowing propensity and education. We find no such evidence.

Columns 2 and 9 uses income from capital as a proxy for buffer stocks of savings. In Sweden, interest income on bank or savings accounts are reported directly to the tax authority by the banks. The coefficient on the triple interaction with education remains stable and significant, while buffer stocks do not explain the borrowing decision nor LTV ratio in scarce periods.

In columns 3 and 10, we explore whether differences in age between high and low-educated borrowers drive our results. In our data, the median high-educated borrower is about twelve years older than the low-educated one. However, age does not explain borrowing decisions or LTV ratios in scarce periods. Neither can (unreported) results for marital status and spousal income.[23]

Differences in Access to Mainstream Credit Liquidity

Columns 4-7 (resp. 11-14 for LTV) of Table 7 use measures of access to mainstream credit liquidity. We construct variables for i. having a credit card, ii. having low utilization of the credit card, which we define as using less than 80 percent of the credit limit, iii. the log of the credit score (defined as a probability to default, as estimated by the credit

[23]The results using continuous variables for income and age in the regression are representative for an extensive specification search, using for instance dummies for income deciles or retirees. These results are not reported for brevity.

bureau), and iv. demand for mainstream credit.[24] All these variables are calculated in the non-scarce (pre-)period of every month. Credit card and credit score data are observed at the person-month level, whereas requests for credit are observed daily.

In each regression, the triple interaction for mainstream credit liquidity turns out to be insignificant, whereas the triple interaction with education remains stable and significant. The conclusion of this exercise is that high and low-educated borrowers differ from each other in a way that is not captured by access to mainstream credit liquidity, income, savings or age, favoring the interpretation that scarcity itself causes a change in borrowing behavior for those more aware of their biased time preferences.

Additional Tests

The panel structure of the data allows us to control for individual trends, i.e. to interact the borrower and time fixed effects, and thereby control for liquidity or any other individual traits that may vary over time. Table A4 shows the results of this more restricted specification, using individual∗year fixed effects in columns 1 and 3, and individual $*$ year $*$ month fixed effects in columns 2 and 4. Note that the remaining variation stems from daily observations within the payday cycle in the latter specification. For both the likelihood to borrow and the unconditional LTV ratio, our main results survive.

The graphical evidence in Figure 4 shows that high-educated borrowers seem to take loans earlier in the month in general, consistent with them being forward-looking. However, we do not find additional shifting when the payday cycle is long (i.e. the coefficient μ on $treated_{i,t}$ is not significantly different from zero (see Tables A1 and A2 in Online Appendix A).

5.2 Robustness

In Online Appendix A, we present several tests to ensure the robustness of our findings. First, we provide a placebo test. Second, we show that the results are not particular to the specific choice of the cutoff for the start and end of the pre-period. Third, we demonstrate that the results are not sensitive to the exclusion of pay cycles that are considered particularly expensive (Christmas and Midsummer).

Placebo Treatment

The treatment variable exploits the specifics of the payment system in combination with the birthday of borrowers. As a robustness test, in Internet Appendix Table A3 we present

[24] Again, we have used a battery of other specifications for these variables (continuous, dummies etc.) which all gave similar results.

the results of running our main regression test on a sample where we randomly assign individuals to either the early or late-born group. All estimated coefficients of interest are not significantly different from zero at conventional levels, which supports the assumption that our main results are not driven by differential secular borrowing trends of social benefit recipients.

Sensitivity to Cut-Offs

An empirical choice that we made in our main analyses was to define the pre-period as the penultimate two weeks before the next payday. To verify that the results are not unique to the specific choice made, in Panel B of Appendix Table A5 we vary the starting point of the pre-period from 21 days before payday (the baseline) to 14 days before payday, and show that the effects we document barely change with the choice of pre-period. In addition, Panel A shows that the results are also robust to ending the post-period either 6, 7 (baseline) or 8 days before payday. For even shorter post-periods, the coefficients become smaller and significance is lost, mainly due to limited observations in the remaining 3-4 days of scarcity.

Expensive Months

Finally, as expenditure needs may differ depending on holidays, panel C of Table A5shows that our main results are not sensitive to excluding some payday cycles which are considered expensive. We exclude the payday cycles ending in December, January and June, motivated by additional expenditures for Christmas and Midsummer, and find qualitatively no changes in the results.

6 Conclusion

We combine detailed pawn and mainstream credit data with background information on the income and education levels of low-income borrowers to investigate whether scarcity affects low-income households' credit decisions. We exploit a social transfer system that randomly assigns the number of days between paydays, to detect episodes of scarcity that are orthogonal to borrower characteristics.

We find that low-income borrowers with low levels of education are 10.7 percent more likely to participate in the credit market and take loans with a 10.9 percent higher loan to value ratio than their high-educated counterparts during periods of increased economic scarcity. An additional day between paydays increases the likelihood of participating by 6 percent and increases the LTV by 7.7 percent. Furthermore, we find that these results cannot be explained by differential access to liquidity through the credit market or buffer stocks nor can age, family composition or spousal income explain our findings.

Finally, low-educated borrowers are 4 percentage points more likely to default on their pawn loans taken in periods of distress than their high-educated counterparts. We do not find any evidence that this increased credit uptake during periods of distress by the low-educated borrowers helps them to avoid a default either in or outside the credit market.

The increased likelihood of borrowing and the greater likelihood of defaulting on these loans due to scarcity translate into an increase in borrowing cost for the low-educated borrowers of 11.6%.

We interpret our findings by a model where consumers have biased time preferences, with varying degrees of awareness of this bias. In such an environment, increased levels of scarcity do not impact the behavior of naive consumers, who are unaware of their self-control problem. In contrast, the sophisticated consumers, who are aware of their self-control problem, exploit a commitment device and reduce their demand for credit during a period of increased scarcity.

As education correlates with borrower sophistication, our findings are consistent with the notion that, during periods of increased economic scarcity, the low-educated borrowers are more likely to ignore longer-run consequences when they are occupied with solving acute liquidity problems right before payday, compared to the benchmark borrowing behavior of the high-educated borrowers. It is an open question whether it is only sophistication that drives our findings. Other factors that can contribute to the observed behavior include financial literacy, forecasting ability, attentiveness or risk preferences. In any case, our paper adds to the understanding of why low-income households make seemingly inferior decisions that might create a poverty trap.

Our analysis highlights the possibility that governments and regulators might have an alternative route to travel when they aim to reduce the negative consequences of high interest rate borrowing that does not involve regulating credit markets themselves. To reduce fluctuations in the levels of scarcity, wages and social transfers could be paid out at a regularly-spaced, high(er) frequency. Furthermore, the mismatch between the timing of (regular) bills and income could be minimized by requiring more flexibility in the payment of bills. Lastly, education could focus on low-income households' awareness of their potential time-inconsistent preferences and the financial consequences that these biased time preferences could entail.

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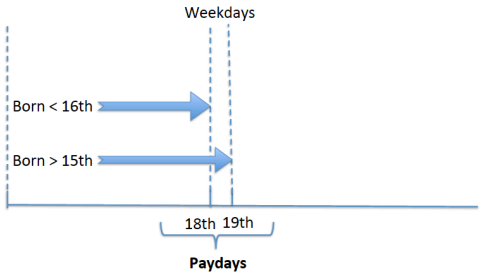
Figures

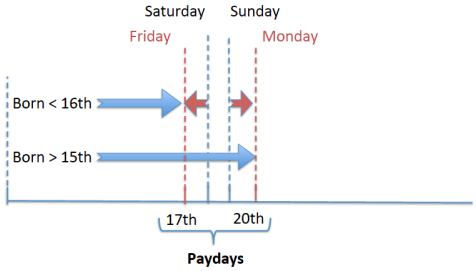
Figure 1: Shifts in Payday Between Early and Late-Born due to Weekends and Holidays

These figures illustrate a particular feature of the Swedish social transfer payment scheme, which creates quasi-experimental variation in the number of days within a pay cycle. Panel A shows the default payday for early and late-born respectively. Social benefits are normally transferred on the 18th of each month for individuals who are born before the 16th of a month (the "early" born) and on the 19th for the individuals who are born on the 16th or later (the "late" born). Panel B is one example when both default paydays fall on a weekend and are shifted to the nearest weekday. Panel C illustrates how early and late-born individuals will shift from treated to control and vice versa. Panel D shows an example of shifts forward due to the Easter holidays.

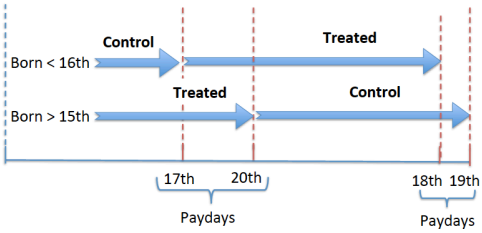
Panel A:



Panel B:



Panel C:



Panel D:

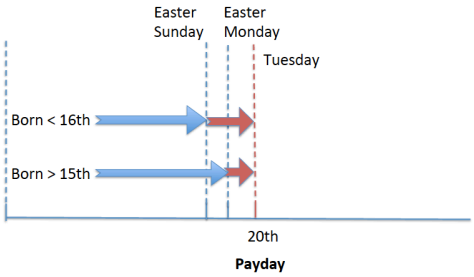


Figure 2: Variation in the Number of Days Between Paydays

This figure depicts the absolute value of the difference in the number of days between the early and late-born groups within each payday cycle. Variation in the number of days between two consecutive paydays is provided by a shift away from the regular payday due to the payday falling on a holiday and/or weekend. Social benefits are normally transferred on the 18th of each month for individuals who are born before the 16th of a month (the early-born) and on the 19th for the individuals who are born on the 16th or later (the late-born). A specific payday cycle is considered *long* when the number of days within a payday cycle between early and late-born is greater than zero. Early and late-born individuals will switch between long (treatment) and short (control) over time.

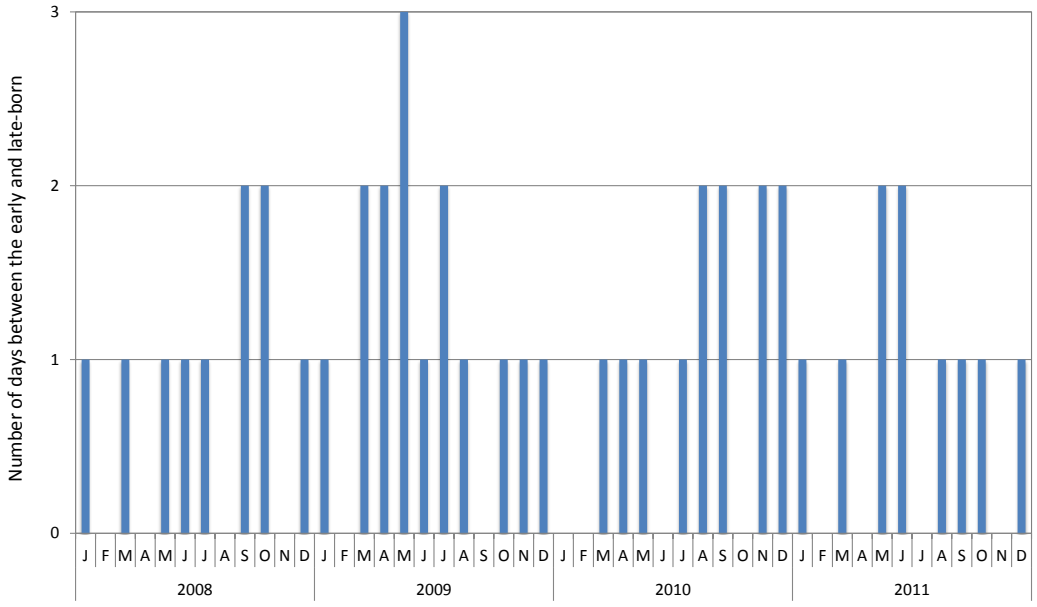


Figure 3: The Timing of Credit decisions

This figure depicts the timing of credit decisions in the pawn credit market.

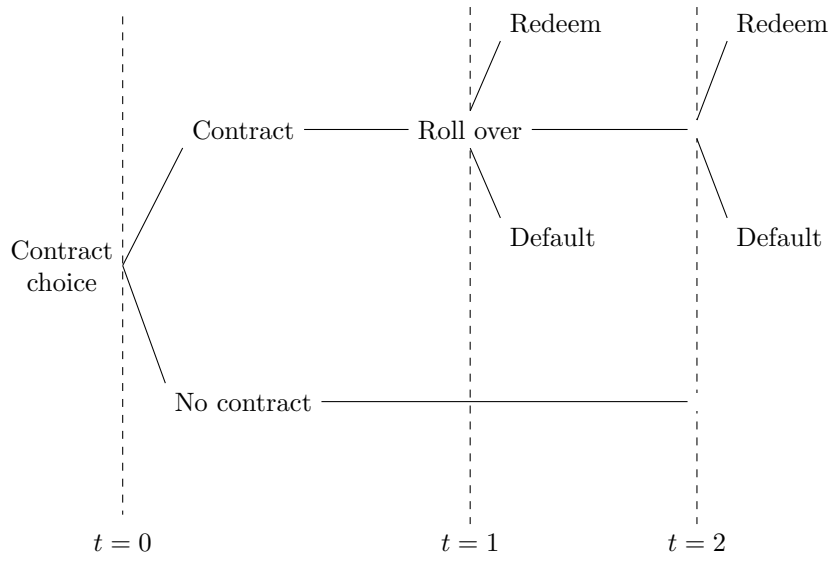
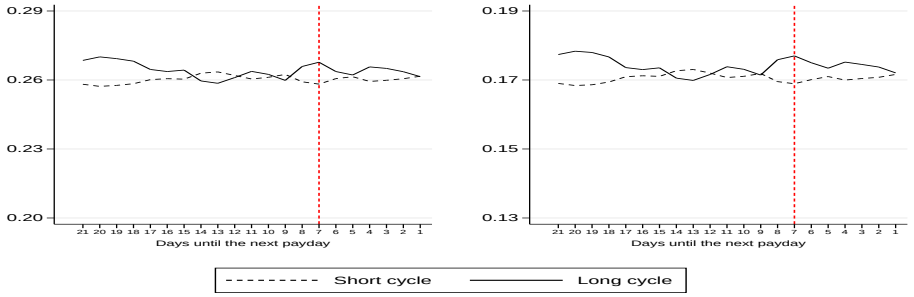


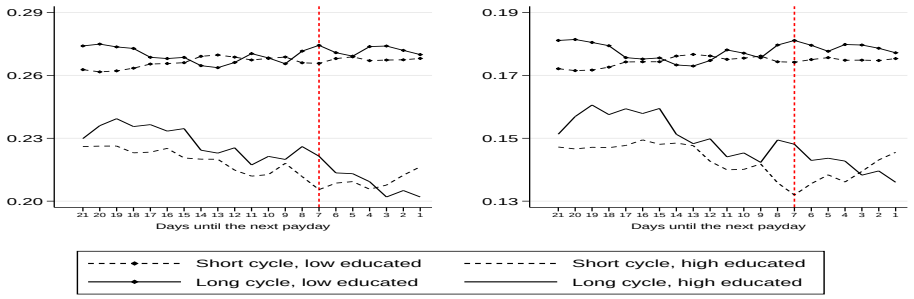
Figure 4: Pre-Trends for the Probability of Participating and Loan to Value Ratio in the Pawn Credit Market

Panel A shows the average probability of participating (left) and loan to value (LTV) ratio (right) in long (*treated*) versus short (*control*) (dashed) payday cycles in the three weeks before the next payday, reflection regression 3.1. Panel B shows the same variables split by borrower education. Panel C shows the difference between the low and high-educated in long *(treated)* and short *(control)* payday cycles during the three weeks before payday. Panel C thus reflects regression 3.2: a triple difference of (1) high versus low-educated; (2) three weeks (the pre-period) versus one week (the post-period) before payday; (3) in a long *(treated)* versus short *(control)* payday cycle.

Panel A: The probability of taking a pawn loan (the left figure) and LTV ratio (the right figure) in short and long pay cycles.



Panel B: The probability of taking a pawn loan (the left figure) and LTV ratio (the right figure) in short and long pay cycles, split by low and high-educated borrowers.



Panel C: The difference in the probability of taking a pawn loan (the left figure) and LTV ratio (the right figure) in short and long pay cycles between low and high-educated borrowers.

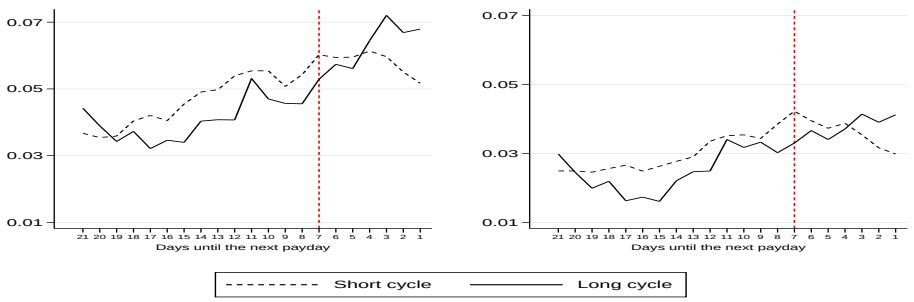
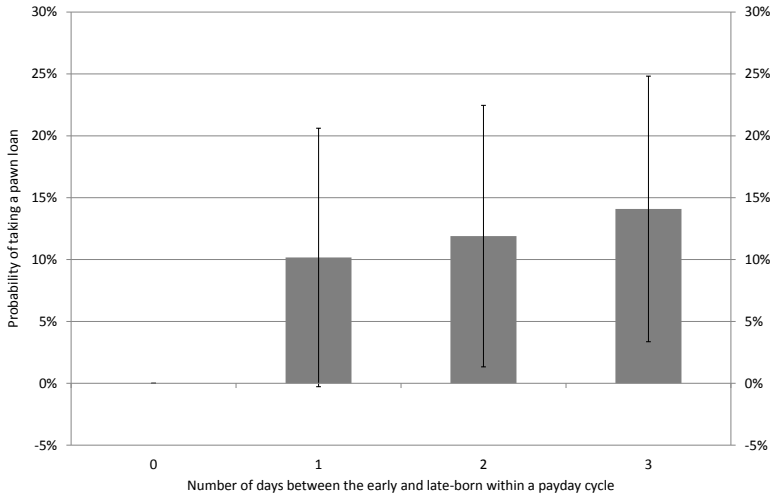


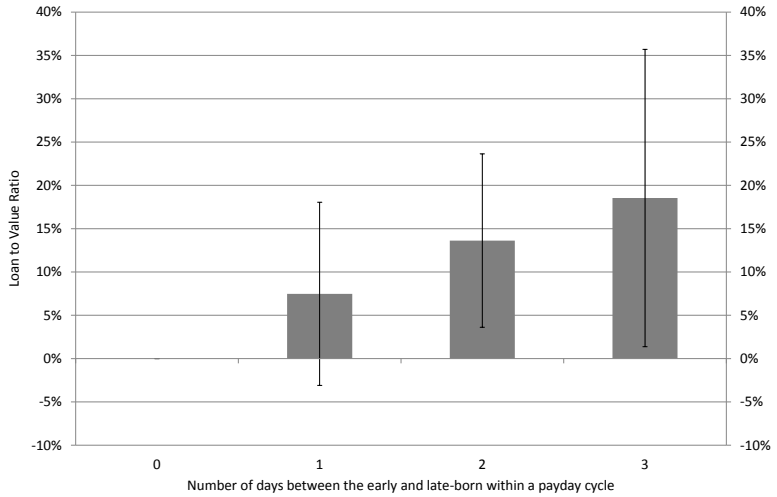
Figure 5: Scarcity Exposure and Credit Decisions

This figure displays evidence of a monotonic relationship between an additional day in a payday cycle and the likelihood of taking a pawn loan (panel A) and the loan to value ratio (panel B). The graphs show the estimated coefficients, scaled by the non-scarce mean, plus 90% confidence intervals, of separate regressions of our baseline model 3.2 for any possible difference in the number of days within a payday cycle between the early and late-born.

Panel A: The probability of taking a pawn loan



Panel B: The pawn loan to value ratio



Tables

Table 1: Variable Definitions

This table presents the definition of the independent and dependent variables in our regressions.

Panel A: Independent variables	
Treated	equals 1 (0) for the early-born (late-born) if the early-born's month is longer than the late-born's month, and vice versa if the late-born's month is longer than the early-born's month.
Treated_contrast	equal to Treated, dropping months without a difference in the number of days between early and late-born
Linear treatment	the number of days within a payday cycle between early and late-born
Post-period	equal to one in the last 7 days before next payday, and zero from 21 until 8 days before next payday
Years of schooling	the number of years of schooling obtained by the borrower
Low-educated	equal to one, if years of schooling <= 12 and zero otherwise
Panel B: Dependent variables (daily frequency)	
Pawn credit market	
Take pawn loan	equal to one, if the borrower takes a new pawn loan
Loan to value	ratio of loan size to the value of the grams of gold (evaluated at time of origination)
Default	equal to one, if the borrower is 60 days late on their pawn credit repayment
Rollover	equal to one, if the borrower only pays the interest costs and fees
Redeem	equal to one, if the borrower repays the principal, interest costs, and fees
Long contract	equal to one, if the borrower chooses a contract with 4 month maturity, and equal to zero if the contract's maturity is 2 months.
Panel C: Mainstream credit market variables (monthly frequency)	
Credit score	credit bureau's estimate of borrower 12-month default risk
Credit applications	equal to one, if a mainstream financial institution requests the borrower's credit report (daily frequency)
Has credit card	equal to one, if the borrower has a credit card
Utilization credit lines	ratio of outstanding credit balances to credit limits across all uncollateralized loans (credit cards, lines of credit)
Arrear	equal to one, if the borrower receives a new arrear (90 days late) on his/her credit report

Table 2: Summary Statistics

This table presents summary statistics split by early and late-born borrowers in the pre-period (before scarcity), which corresponds to the period from 21 to 8 days before payday.

Pre-period statistics	Early-born			Late-born		
	Average	Median	SD	Average	Median	SD
Panel A: Pawn credit market ($N = 39,489$)						
Take pawn loan (%) (per day)	0.207	0	4.54	0.218	0	4.66
Loan to value (%) (per day)	0.138	0	3.37	0.144	0	3.44
Conditional on participation ($N = 11,578$)						
Loan to value (%)	75.9	77.2	23.1	75.5	77.0	23.4
Default (%)	22.5	0	41.8	22.7	0	41.9
Rollover (%)	27.1	0	44.5	26.9	0	44.3
Redeem (%)	77.5	100	41.8	77.3	100	41.9
Conditional on participation in a shop with maturity menu ($N = 5,182$)						
Long contract (%)	95.9	100	19.7	96.9	100	17.4
Panel B:Individual Characteristics ($N = 39,489$)						
Age	52.2	53	13.6	52.4	53	13.7
Education (years)	10.1	10	2.67	10.2	10	2.56
Monthly benefits income (SEK)	10,492	9,900	9,604	10,718	9,987	10,938
Annual capital income (SEK)	3,659	0	59,804	4,597	0	80,326
Panel C: Mainstream Credit Market ($N = 39,489$)						
Has Credit Card (%)	44.2	0	49.7	42.1	0	49.4
Utilization credit lines (%)	75.0	100	38.2	75.2	100	38.2
Utilization $> 80\%$ (%)	73.5	100	44.2	74.3	100	43.7
Credit score (P.D.)	28.3	19.2	28.4	28.3	19	28.6
Credit applications (per month, %)	3.3	0	17.9	3.3	0	17.9
Receiving Arrear (%)	9.9	0	29.9	9.9	0	29.9

Table 3: Baseline Results: The Effect of Scarcity on Borrowing

This table shows that increased scarcity before payday does not significantly increase the likelihood of taking pawn credit or the loan to value (LTV) ratio. Columns 1 and 4 show the coefficient γ of regression 3.1, for participation and LTV, respectively. Columns 2 and 5 estimate the same regression, where the treatment dummy is replaced by the treatment_contrast dummy, which drops the payday cycles with no difference in days between early and late-born individuals. Columns 3 and 6 displays the coefficient γ of the same regressions as above, where the treatment dummy is replaced by the continuous variable, measuring the number of additional days between early and late-born individuals. Standard errors are clustered at the individual level. *, **, and *** represent 10, 5, and 1 percent significance levels, respectively. All coefficients are in percentage terms (scaled by 100).

	(1)	(2)	(3)	(4)	(5)	(6)
	Prob(Take Pawn Loan)			Loan to Value		
post∗treated	-0.001	-0.005	-0.002	-0.001	-0.003	-0.001
	(0.004)	(0.004)	(0.002)	(0.003)	(0.003)	(0.002)
sample	baseline	treated contrast	linear treatment	baseline	treated contrast	linear treatment
Observations	27,142,473	19,234,533	27,142,473	27,142,473	19,234,533	27,142,473
R^2	0.0003	0.0004	0.00034	0.0003	0.0003	0.0003
Individuals	39,489	39,489	39,489	39,489	39,489	39,489

Table 4: Heterogeneity: The Effect of Scarcity on Borrowing, by Education

This table shows that increased scarcity before payday causally increases pawn credit uptake (panel A) and loan to value (LTV) ratio (Panel B) by low-educated individuals relative to their high-educated counterparts. Column 1 shows the coefficient γ from regression 3.2. Column 2 displays the coefficient γ from the same regression, where the treatment dummy is replaced by the treatment_contrast dummy, which drops the payday cycles with no difference in days between early and late-born individuals. Column 3 displays the coefficient γ of the same regression, where the treatment dummy is replaced by the continuous variable, measuring the number of additional days between early and late-born individuals. Column 4 replaces the low-education dummy by the continuous variable years of schooling. Standard errors are clustered at the individual level. *, **, and *** represent 10, 5, and 1 percent significance levels, respectively. All coefficients and pre-period means are in percentage terms (scaled by 100).

Panel A: Probability of taking a pawn loan

	(1)	(2)	(3)	(4)
			Prob(Take Pawn Loan)	
low_educ∗post∗treated	0.023**	0.026**	0.013**	
	(0.010)	(0.011)	(0.006)	
yearsschooling∗post∗treated				-0.004**
				(0.002)
pre-period mean	0.22	0.22	0.22	0.22
% diff. in probability	10.7%	11.8%	6.0% p. extra day	-1.9% p y. schooling
sample	baseline	treated contrast	linear treatment	linear education
Observations	27,142,473	19,234,533	27,142,473	27,142,473
R^2	0.0004	0.0004	0.0004	0.0004
Individuals	39,489	39,489	39,489	39,489

Panel B: Loan to Value Ratio

	(1)	(2)	(3)	(4)
			Loan to Value	
low_educ∗post∗treated	0.016**	0.020**	0.011***	
	(0.008)	(0.009)	(0.005)	
yearsschooling∗post∗treated				-0.003**
				(0.0012)
pre-period mean	0.15	0.15	0.15	0.15
% diff. in LTV	10.9%	13.4%	7.7% p. extra day	-2.3% p.y. schooling
sample	baseline	treated contrast	linear treatment	linear education
Observations	27,142,473	19,234,533	27,142,473	27,142,473
R^2	0.0003	0.0003	0.0003	0.0003
Individuals	39,489	39,489	39,489	39,489

Table 5: The Effect of Scarcity on Maturity Choice

This table shows that low-educated borrowers are more likely to choose short-maturity contracts during periods of scarcity. The outcome variable is the probability of choosing a 4 month over a 2 month contract, conditional on taking a loan. The 12 shops selected into the regression have more than 5% of their loans having the 2 month maturity. The result is stable for shops with a higher ratio of 2 month contracts. Column 1 uses regression 3.1 with the probability of choosing a long contract as outcome variable. Column 2 uses regression 3.2. Standard errors are clustered at the individual level. *, **, and *** represent 10, 5, and 1 percent significance levels, respectively. All coefficients are in percentage terms (scaled by 100).

	(1)	(2)
	Prob(Long Contract)	
post∗treated	0.034	
	(0.61)	
low_educ∗post∗treated		-4.7**
		(2.3)
sample	Shops with menu	Shops with menu
observations	16,070	16,070
R^2	0.005	0.005
individuals	5,182	5,182

Table 6: Consequences of Credit Decisions Made during Scarcity: Repayment and Default

Panel A shows that increased scarcity before payday increases the probability to default on pawn loans by low-educated individuals relative to their high-educated counterparts. This panel shows the coefficient γ from regression 3.2 with the outcome variable defined in the respective column, on the sample of pawn loan takers. Panel B shows that increased scarcity before payday has no significant effect on the probability to default outside the pawn credit market for low-educated individuals relative to their high-educated counterparts. This panel shows the coefficient γ from regression 3.2 in columns 1 and 2, using the probability of receiving a new arrear as outcome variable, and the coefficient γ from the Cox hazard model 4.1 in column 3. Standard errors are clustered at the individual level. *, **, and *** represent 10, 5, and 1 percent significance levels, respectively. All coefficients and pre-period means are in percentage terms (scaled by 100).

Panel A: Inside the Pawn Credit Market			
	(1)	(2)	(3)
	Prob(Default Pawn)	Prob(Rollover Pawn)	Prob(Default Pawn)
low_educ∗post∗treated	3.97*	2.33	15.41***
	(2.39)	(2.98)	(5.55)
pre-period mean	22.83	24.71	15.68
% diff	17.4%		98.3%
sample	cond. participation	cond. participation	cond. rolling over
observations	48,735	48,735	11,635
R^2	0.007	0.0171	0.004
individuals	11,578	11,578	5,414

Panel B: Outside the Pawn Credit Market			
	(1)	(2)	(3)
	Prob(Arrear)		Hazard(Arrear)
	60 days ahead	90 days ahead	180 days ahead
low_educ∗post∗treated	0.09	-0.17	
	(0.11)	(0.13)	
low_educ∗post∗treated∗participation			86.6
			(10.3)
sample	baseline	baseline	baseline
observations	27,142,473	27,142,473	6,417,198
R^2	0.0035	0.0024	
individuals	39,489	39,489	39,489

Table 7: Horse-Racing Education with Liquidity

This table shows that our earlier findings indicating that increased scarcity before payday causally increases pawn credit uptake by low-educated individuals relative to their higher-educated counterparts cannot be explained by differential income, buffer stocks, age or access to mainstream liquidity. The table shows the coefficients γ and γ_1 from regression 5.1, with the interaction term x defined in the respective columns. Columns 8-14 use the LTV ratio as an outcome variable instead. Standard errors are clustered at the individual level. *, **, and *** represent 10, 5, and 1 percent significance levels, respectively. All coefficients are in percentage terms (scaled by 100).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				Prob(Take Pawn Loan)			
low_educ ∗ post ∗ treated	0.025**	0.023**	0.023**	0.023**	0.023**	0.024**	0.023**
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
x∗post∗treated	0.003**	0.001	0.000	-0.001	0.000	-0.002	-0.136
	(0.001)	(0.003)	(0.000)	(0.010)	(0.010)	(0.002)	(0.112)
	(8)	(9)	(10)	(11)	(12)	(13)	(14)
				Loan to Value			
low_educ ∗ post ∗ treated	0.018**	0.017**	0.017**	0.016**	0.016**	0.017**	0.016**
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
x∗post∗treated	0.002***	0.004	0.000	0.003	-0.004	-0.002*	-0.079
	(0.001)	(0.003)	(0.000)	(0.007)	(0.007)	(0.001)	(0.088)
interaction term x	log(Income)	log(Capital income)	Age	Has Credit card	High utilization Credit lines	log(Credit score)	Credit request
observations				27,142,473			
individuals				39,489			

A Online Appendix: Additional Results and Robustness Checks

Table A1: Heterogeneity: The Effect of Scarcity on the Likelihood to Participate, by Education (All Coefficients)

This table shows that increased scarcity before payday causally increases pawn credit uptake by low-educated individuals relative to their high-educated counterparts. Column 1 shows all coefficients from regression 3.2. Column 2 displays all coefficients from the same regression, where the treatment dummy is replaced by the treatment_contrast dummy, which drops the payday cycles with no difference in days between early and late-born individuals. Column 3 displays all coefficients of the same regression, where the treatment dummy is replaced by the continuous variable, measuring the number of additional days between early and late-born individuals. Column 4 replaces the low-education dummy by the continuous variable years of schooling. Standard errors are clustered at the individual level. *, **, and *** represent 10, 5, and 1 percent significance levels, respectively. All coefficients and pre-period means are in percentage terms (scaled by 100).

	(1)	(2)	(3)	(4)
			Prob(Take Pawn Loan)	
low_educ∗post∗treated	0.023**	0.026**	0.013**	
	(0.010)	(0.011)	(0.006)	
yearsschooling∗post∗treated				-0.004**
				(0.002)
post∗treated	0.002	-0.001	-0.0007	0.042*
	(0.004)	(0.005)	(0.003)	(0.022)
low_educ∗treated	-0.009	-0.001	-0.005	
	(0.006)	(0.007)	(0.004)	
low_educ∗post	0.007	0.005	0.009	
	(0.007)	(0.009)	(0.007)	
treated	0.001	0.003	0.001	-0.019
	(0.003)	(0.003)	(0.002)	(0.013)
yearsschooling∗post				-0.001
				(0.001)
yearsschooling∗treated				0.002
				(0.001)
pre-period mean	0.22	0.22	0.22	0.22
% diff. in probability	10.7%	11.8%	6.0% p. extra day	-1.9% p y. schooling
sample	baseline	treated contrast	linear treatment	linear education
Observations	27,142,473	19,234,533	27,142,473	27,142,473
R^2	0.0004	0.0004	0.0004	0.0004
Individuals	39,489	39,489	39,489	39,489

Table A2: Heterogeneity: The Effect of Scarcity on the Loan to Value ratio, by Education (All Coefficients)

This table shows that increased scarcity before payday causally increases pawn loan to value (LTV) ratios by low-educated individuals relative to their high-educated counterparts. Column 1 shows all coefficients from regression 3.2, using the LTV ratio as the outcome variable. Column 2 displays all coefficients from the same regression, where the treatment dummy is replaced by the treatment_contrast dummy, which drops the payday cycles with no difference in days between early and late-born individuals. Column 3 displays all coefficients of the same regression, where the treatment dummy is replaced by the continuous variable, measuring the number of additional days between early and late-born individuals. Column 4 replaces the low-education dummy by the continuous variable years of schooling. Standard errors are clustered at the individual level. *, **, and *** represent 10, 5, and 1 percent significance levels, respectively. All coefficients and pre-period means are in percentage terms (scaled by 100).

	(1)	(2)	(3)	(4)
			Loan to Value	
low_educ∗post∗treated	0.016**	0.020**	0.011***	
	(0.008)	(0.009)	(0.005)	
yearsschooling∗post∗treated				-0.003**
				(0.0012)
post∗treated	0.001	-0.000	-0.000	0.035**
	(0.003)	(0.004)	(0.002)	(0.017)
low_educ∗treated	-0.008	-0.010*	-0.005	
	(0.005)	(0.005)	(0.003)	
low_educ∗post	0.002	-0.002	0.002	
	(0.005)	(0.007)	(0.005)	
treated	0.001	0.002	0.001	-0.018*
	0.002	(0.002)	(0.001)	(0.010)
yearsschooling∗post				0.000
				(0.001)
yearsschooling∗treated				0.002**
				(0.001)
pre-period mean	0.15	0.15	0.15	0.15
% diff. in probability	10.9%	13.4%	7.7% p. extra day	-2.3% p.y. schooling
sample	baseline	treated contrast	linear treatment	linear education
Observations	27,142,473	19,234,533	27,142,473	27,142,473
R^2	0.0003	0.0003	0.0003	0.0003
Individuals	39,489	39,489	39,489	39,489

Table A3: The Effect of Scarcity on Borrowing: Placebo Tests

This table shows that our earlier findings indicating that increased scarcity before payday causally increases pawn credit uptake (panel A) and loan to value (LTV) ratios (Panel B) by low-educated individuals relative to their high-educated counterparts cannot be replicated using a Placebo treatment, randomly assigning borrowers to the early-born or late-born group. Column 1 shows the coefficient γ from regression 3.2. Column 2 displays the coefficient γ from the same regression, where the treatment dummy is replaced by the treatment_contrast dummy, which drops the payday cycles with no difference in days between early and late-born individuals. Column 3 displays the coefficient γ of the same regression, where the treatment dummy is replaced by the continuous variable, measuring the number of additional days between early and late-born individuals. Column 4 replaces the low-education dummy by the continuous variable years of schooling. Standard errors are clustered at the individual level. *, **, and *** represent 10, 5, and 1 percent significance levels, respectively. All coefficients and pre-period means are in percentage terms (scaled by 100).

Panel A: Probability of taking a pawn loan

	(1)	(2)	(3)	(4)
			Prob(Take Pawn Loan)	
low_educ∗post∗treated	0.010	0.008	0.007	
	(0.010)	(0.011)	(0.006)	
yearsschooling∗post∗treated				-0.002
				(0.002)
sample	baseline	treated contrast	linear treatment	linear education
Observations	27,142,473	19,234,533	27,142,473	27,142,473
R^2	0.0004	0.0004	0.0004	0.0003
Individuals	39,489	39,489	39,489	39,489

Panel B: Loan to Value Ratio

	(1)	(2)	(3)	(4)
			Loan to Value	
low_educ∗post∗treated	0.007	0.008	0.007	
	(0.008)	(0.009)	(0.005)	
yearsschooling∗post∗treated				-0.002
				(0.002)
sample	baseline	treated contrast	linear treatment	linear education
Observations	27,142,473	19,234,533	27,142,473	27,142,473
R^2	0.0004	0.0004	0.0004	0.0003
Individuals	39,489	39,489	39,489	39,489

Table A4: The Effect of Scarcity on Borrowing: Individual Trends

This table shows that our earlier findings indicating that increased scarcity before payday causally increases pawn credit uptake by low-educated individuals relative to their high-educated counterparts is robust when controlling for individual-specific time fixed effects. Columns 1 and 3 show the coefficient γ from regression 3.2, interacting the borrower fixed effects with year fixed effects, for the probability of taking a pawn loan and loan to value (LTV) ratio, respectively. Columns 2 and 4 display the coefficient γ from regression 3.2, interacting the borrower fixed effects with year∗month fixed effects, for the probability of taking a pawn loan and LTV, respectively. Standard errors are clustered at the individual level. *, **, and *** represent 10, 5, and 1 percent significance levels, respectively. All coefficients are in percentage terms (scaled by 100).

	(1)	(2)	(3)	(4)
	Prob(Take Pawn Loan)		Loan to Value	
low_educ∗post∗treated	0.023**	0.023**	0.016**	0.016*
	(0.010)	(0.010)	(0.008)	(0.008)
Individual ∗ year fixed effects	Yes		Yes	
Individual ∗ year ∗ month fixed effect		Yes		Yes
observations	27,142,473	27,142,473	27,142,473	27,142,473
R^2	0.0233	0.0772	0.0208	0.0756
individuals	39,489	39,489	39,489	39,489

Table A5: The Effect of Scarcity on Borrowing: Robustness Tests

The table shows the robustness of our findings indicating that increased scarcity before payday causally increases pawn credit uptake by low-educated individuals relative to their high-educated counterparts to various empirical choices. Panel A shows the coefficient γ from regression 3.2 for various cut-off levels determining when the scarce (post-) period starts. Panel B shows the same coefficient for various cutoff levels determining when the non-scarce (pre-) period starts. Panel C discards various expensive months around Christmas and Midsummer. Standard errors (not shown) are clustered at the individual level. *, **, and *** represent 10, 5, and 1 percent significance levels, respectively. All coefficients are in percentage terms (scaled by 100).

Panel A: The robustness to the post-period cut-off, by varying how many days before payday the post-period begins.

	(1)	(2)
Cutoff	Prob(Take Pawn Loan)	Loan to Value
10	0.010	0.007
9	0.015	0.007
8	0.021**	0.012
7 (baseline one week)	0.023**	0.016**
6	0.025**	0.019**
5	0.019	0.013
4	0.019	0.012

Panel B: The robustness to the pre-period cut-off, by varying how many days before payday the pre-period begins.

	(1)	(2)
Cutoff	Prob(Take Pawn Loan)	Loan to Value
21 (baseline three weeks)	0.023**	0.016**
20	0.022**	0.015*
19	0.023*	0.015*
18	0.023**	0.014*
17	0.027**	0.016*
16	0.022*	0.013*
15	0.025**	0.015*
14	0.020	0.011

Panel C: The robustness to the exclusion of 'high' cost months and post- 'high'-cost months: Christmas (December, January) and Midsummer (June, July).

	(1)	(2)
Excluding	Prob(Take Pawn Loan)	Loan to Value
None (baseline)	0.023**	0.016**
December	0.023**	0.015*
January	0.023**	0.015*
June	0.021**	0.015*
July	0.027**	0.019**

B Online Appendix: Survey Measures of Discount Rates

Carvalho, Meier, and Wang (2016) (CMW) design a survey eliciting discount rates, risk aversion and cognitive function from a sample of low-to-moderate income Americans. Half of the respondents are randomly assigned to receive the questionnaire one week before payday, allowing an across-respondent identification strategy to recover the effects of financial resources on decision-making. In this section, we use their data as published on the AER website, to study heterogeneity in the estimates by education, as we have done in the Swedish pawn borrowing context. We split the sample by having a college degree, corresponding to 32 percent of the respondents.[25] We use the data collected from the RAND American Life Panel (referred to as Study 1 in CMW), as this study elicits discount rates.[26]

Table B1 documents that low-educated before-payday respondents had fewer financial resources than the after-payday group. On average, the same holds for the high-educated before-payday respondents, although not significantly so given the small sample sizes.

Panel A of Table B2 turns to survey measures of discount rates. CMW's main result is that discount rates are lower (more present-bias) for a task with monetary rewards, but not so for a real-effort task, suggesting that liquidity constraints are important (rather than scarcity itself). A split by education, however, reveals that the high-educated respondents are similarly present-biased before or after payday in the monetary reward task, and significantly less present-biased before payday in the real effort task. Hence, we find supporting evidence that high-educated individuals have lower discount rates in the real effort task, in line with our findings on reduced borrowing by high-educated social transfer recipients during an exogenous increase in economic scarcity.

Panel B turns to a survey measure of risk aversion. CMW find that before-payday participants are equally risk averse as after-payday respondents. The split by education, however, shows that before-payday high-educated respondents are significantly less risk averse, relative to the high-educated respondents interviewed after payday (consistent with the results of Tanaka, Camerer, and Nguyen (2010)). This result suggests that the willingness to take risks increases when liquidity constraints bind before payday. Taken literally, we would then expect the high-educated to be more likely to take pawn loans before payday, contrary to our findings. In other words, this result suggests that, even though high-educated individuals are less risk averse, some other trait (such as their present bias) weights stronger

[25] The random assignment to receive the questionnaire before or after payday was stratified by education, which results in a relatively large percentage of high-educated respondents, compared to the Swedish pawn borrower population. The results documented below are not robust to including those with some college (but no degree) in the high-edducated group.

[26] Study 2 is based on the GfK Knowledge panel. We have replicated all results in their paper, of both Study 1 and Study 2, without any difficulties, using the computer code posted on the AER website. Results reporting heterogeneity by educational attainment for all of CMW's tables are available on request.

in their decision to reduce the demand for credit. More generally, however, it is difficult to disentangle the coefficient of relative risk aversion from the intertemporal elasticity of substitution, which likely better explains saving and borrowing decisions.

Table B1: Financial Circumstances, by Education

This table replicates results from the experiments of Carvalho, Meier, and Wang (2016), by educational attainment of the respondent. The Published column corresponds to estimates reported in Carvalho, Meier, and Wang (2016), pooling all education levels. The Low resp. High columns estimate the same parameters for the subsample without college degree resp. with college degree.
The table reports results from OLS and quantile regressions (quantile 0.5) of the dependent variables shown in the column headings on an indicator variable identifying participants assigned to the before-payday group and a constant. Robust standard errors in brackets. *, **, and *** represent 10, 5, and 1 percent significance levels, respectively.

	Cash			Checking and Savings			Expenditures		
	Published	Low	High	Published	Low	High	Published	Low	High
OLS									
Before payday	-114**	-97*	-145	-1947	-1812	-1946	-553*	-349	-947
	(52)	(51)	(117)	(1859)	(2607)	(2367)	(328)	(243)	(843)
Median regression									
Before payday	-10**	-13**	0	-230**	-100	-62	-100***	-109***	-100
	(4)	(6)	(10)	(100)	(107)	(314)	(36)	(36)	(70)
Observations	1054	718	336	851	550	301	1056	720	336

Table B2: Intertemporal Choices and Risk Aversion, by Education

This table replicates results from the experiments of Carvalho, Meier, and Wang (2016), by educational attainment of the respondent. The Published column corresponds to estimates reported in Carvalho, Meier, and Wang (2016), pooling all education levels. The Low resp. High columns estimate the same parameters for the subsample without college degree resp. with college degree.
In Panel A, the Monetary $ amount sooner reward column reports results from an OLS regression where the dependent variable is the dollar amount of the sooner payment. Immediate rewards is an indicator variable that is 1 if the mailing date of the sooner payment is today. Delay time is the interval between the sooner and later payments. The sample is restricted to the 1,060 subjects who made all 12 choices in the task with monetary rewards. The non-monetary monthly discount rate column reports estimates from an interval regression where the dependent variable is the interval measure of the individual discount rate (IDR). Two IDRs are estimated for each subject; 1 for each time frame. Immediate task is an indicator variable for the "5 days (sooner) × 35 days (later)" time frame. The sample is restricted to the 1,025 subjects who made all 10 choices in the nonmonetary intertemporal task. Panel B reports estimates from an interval regression where the dependent variable is the interval measure of the coefficient of relative risk aversion. Robust standard errors in brackets. *, **, and *** represent 10, 5, and 1 percent significance levels, respectively.

Panel A. Intertemporal choices

	Monetary $ amount sooner reward			Nonmonetary monthly discount rate		
	Published	Low	High	Published	Low	High
Before payday × Immediate rewards/task	10.6***	11.4**	6.7	-0.03	-0.01	-0.07*
	(3.83)	(4.83)	(6.06)	(0.025)	(0.031)	(0.043)
Before payday × Interest rate	2.7	3.9	-3.4			
	(3.24)	(3.60)	(6.34)			
Before payday × Delay time	-1.4	-0.7	-2.9*			
	(1.06)	(1.34)	(1.72)			
Before payday	-6.3	-16.5	21.5	0.02	0.04	-0.03
	(9.80)	(11.77)	(17.25)	(0.03)	(0.03)	(0.05)
Immediate rewards/task	-5.3*	-1.4	-13.1**	0.09***	0.08***	0.11***
	(2.76)	(3.57)	(4.16)	(0.02)	(0.02)	(0.03)
Interest rate	-47.3***	-40.5***	-60.5***			
	(2.34)	(2.65)	(4.41)			
Delay time	-0.7	-1.2	0.3			
	(0.72)	(0.92)	(1.13)			
Observations	12720	8700	4020	851	550	301

Panel B. Risk preferences

	CRRA parameter		
	Published	Low	High
Before payday	-0.10	0.14	-0.62**
	(0.15)	(0.19)	(0.26)
Observations	1064	727	337

C Online Appendix: A Model of Sophistication and Scarcity

This section provides a simple model to illustrate how economic distress may affect credit decisions.

C.1 Setup

We consider a simple three-period model of borrowing behavior. The timing and actions are as in Figure 3. In period 0, the consumer owns an illiquid asset worth V, and decides whether to use it as collateral to get a loan from a pawnshop broker. The pawnbroker extends credit up to a fraction $\alpha^{max} < 1$ of the collateral value, i.e $L \leq \alpha^{max} V$.

In period 1, the consumer can redeem her collateral by repaying the loan with interest, $(1+r)\,L$. Alternatively, she can rollover the loan, by paying only the interest due, rL, and the rollover fee $c > 0$. A third alternative is to default and forgo the collateral. If the consumer redeems or defaults, the game ends in period 1. Otherwise, she decides between redeeming and defaulting in period 2.[27]

In every period, the consumer receives an income y that can be used to consume and to repay the loan. Following the behavioral finance literature stressing the importance of time inconsistency to explain credit decisions, we assume quasi-hyperbolic preferences as in Phelps and Pollak (1968) and Laibson (1997):

$$U_t = u(c_t) + \beta \sum_{\tau=1}^{T-t} \delta^{\tau} u(c_{t+\tau}) \tag{C.1}$$

In this utility function, β is the parameter of short-run discounting and δ the parameter of long-run discounting. Similarly to Heidhues and Kőszegi (2010)'s setup, $\beta < 1$ generates time-inconsistency.[28] There is no uncertainty over income or the interest rate.

C.2 Credit Contract Choice

We solve the game by backward induction. We start by characterizing the optimal repayment decision in period 2. Given the decision to pledge her gold at a pawnbroker (rather than obtaining the full value at a gold vendor), we assume that the consumer does not want to default, i.e. $V > (1+r)\,L$. This implies that, in period 2, the consumer always redeems. In period 1, the consumer chooses between redeeming immedi-

[27] Period 2 being the final period of the game, rolling over is not possible in that period.

[28] At time $t = 0$, the present value of future utilities is estimated as $u_0 + \beta\delta u_1 + \beta\delta^2 u_2$, while it corresponds to $u_1 + \beta\delta u_2$ and u_2 in repayment periods $t = 1$ and $t = 2$, respectively. Note that the discount factor between periods 1 and 2 is simply δ in period 0, but equals $\beta\delta$ in period 1.

ately, or rolling over the loan and repaying in period 2. The discounted utility of redeeming in period 1 equals $u(y-(1+r)L)+\beta\delta u(y)$. The utility of rolling over once equals $u(y-(rL+c))+\beta\delta u(y-(1+r)L)$.

Rolling over yields higher utility than redeeming if

$$u(y-(1+r)L)+\beta\delta u(y) < u(y-(rL+c))+\beta\delta u(y-(1+r)L)$$

It is easy to see that redeeming becomes more attractive as β increases. The consumer is thus more likely to rollover the loan, the stronger her present bias:

Prediction C.1. *(present bias and repayment behavior) For a given loan size, the consumer is more likely to rollover, the stronger her present bias (the smaller β) is.*

The maximum loan size, $\bar{L}(\beta)$, for which repayment in period 1 is incentive compatible is given by $u(y-(1+r)\bar{L})+\beta\delta u(y)=u(y-(r\bar{L}+c))+\beta\delta u(y-(1+r)\bar{L}$. Hence for any $L\leq\bar{L}(\beta)$, the consumer repays the loan in period 1. Differentiating this expression gives the following relation between $\bar{L}$ and β:

$$\frac{\partial\bar{L}}{\partial\beta}=\frac{\delta\left(u(y)-u(y-(1+r)\bar{L})\right)}{(1-\delta\beta)(1+r)u'(y-(1+r)\bar{L})-ru'(y-(r\bar{L}+c))} \tag{C.2}$$

Note that $\bar{L}(\beta)$ is increasing with β (or $\frac{\partial\bar{L}}{\partial\beta}>0$), whenever $\beta<\frac{1}{\delta}-\frac{u'(y-(r\bar{L}+c))}{\delta u'(y-(1+r)\bar{L})}\frac{r}{1+r}$. This implies that, assuming some (small) degree of present bias such that this last inequality is fulfilled, a stronger present bias (lower β) thus induces a smaller maximum loan size below which the consumer repays the loan in period 1.

Next, we allow for differences in consumers' degree of sophistication. Let $\hat{\beta}$, with $\beta\leq\hat{\beta}$, denote the consumer's belief about β. As $\bar{L}(\beta)$ is increasing with β , $\beta\leq\hat{\beta}$ implies $\bar{L}(\beta)\leq\bar{L}\left(\hat{\beta}\right)$. We distinguish between the contract choice of two types of agents: a sophisticated borrower, who correctly anticipates her preference for immediate gratification (i.e. $\beta=\hat{\beta}$) and a partially naive borrower who underestimates her present bias (i.e.$\beta<\hat{\beta}$).

As commonly assumed in the literature, the consumer chooses the credit contract from the perspective of period 0. In period 0, a consumer intending to repay the loan in period 1 will accept a contract with loan size L only if $L\leq\bar{L}(\hat{\beta})$. As a result, the partially naive consumer mispredicts her repayment behavior and overborrows when $\bar{L}(\beta)<L<\bar{L}(\hat{\beta})$. By underestimating her present bias, a partially naive borrower may thus choose a contract with a too high L that does not maximize self 0's utility and will trigger rolling over in period 1. On the other hand, a sophisticated borrower will correctly predict her own behavior and will only accept a contract with a loan size L such that $L\leq\bar{L}(\beta)=\bar{L}\left(\hat{\beta}\right)$.

Prediction C.2. *(sophistication and contract choice) Given β, a sophisticated consumer*

will choose a contract with a smaller loan size than the one chosen by a fully naive agent.

C.3 Economic Scarcity and Credit Contract Choice

We now consider how economic scarcity may affect the credit contract choice. As hypothesized by Shah, Mullainathan, and Shafir (2012), we assume that consumers behave as if they were more present-biased during periods of increased economic scarcity. Let β' be the present bias parameter during periods of increased scarcity, with $\beta' < \beta$. Note that a naive consumer does not react to a change in her present-bias as, by definition, she is completely unaware of her time-inconsistency. In contrast, a fully sophisticated agent is aware of β', and adjusts her contract choice accordingly. Recall that absent scarcity, any contract with a loan size L such that $L \leq \bar{L}(\beta)$ is an incentive compatible contract and can potentially be chosen by a sophisticated consumer. When a sophisticated consumer experiences scarcity (i.e. $\beta' < \beta$), then any contract with a loan to value L such that $L \leq \bar{L}(\beta')$ is incentive compatible.

Prediction C.3. *(scarcity, sophistication and contract choice) The effect of scarcity (stronger present bias) on contract choice depends on the degree of sophistication. A fully naive consumer does not react, and keeps choosing a contract that offers the largest possible loan. However, a sophisticated consumer will choose a contract that offers a maximum loan of* $\bar{L}(\beta')$*, with* $\bar{L}(\beta') < \bar{L}(\beta)$*.*

From this last prediction, any contract such that $\bar{L}(\beta') < L \leq \bar{L}(\beta)$ will not be chosen by a sophisticated consumer during economic scarcity. Hence, some sophisticated consumers may, during periods of economic scarcity, refuse a contract that they would have accepted otherwise.

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