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Scarcity and consumers' credit choices

Marieke Bos[1,2,3] · Chloé Le Coq[4,5] · Peter van Santen[6]

Abstract

We study the effect of scarcity on decision making by low income Swedes. We exploit the random assignment of welfare payments to study their borrowing decisions within the pawn and mainstream credit market. We document that higher educated borrowers borrow less frequently and choose lower loan to value ratios when their budget constraints are exogenously tighter. In contrast, low-educated borrowers do not respond to temporary elevated levels of scarcity. This lack of response translates into a significantly higher probability to default and an 11.6% increase in borrowing cost. We show that a difference in access to liquidity and/or buffer stocks cannot explain our results. Instead a framework, where the awareness of self-control problems is positively correlated with education can explain that high-educated consumers choose a lower LTV as a commitment device to increase their likelihood to repay. Analogously, low-educated with less awareness of their future self-control problems, do not tie themselves to the mast and thus ignore the consequences of their credit decisions when focusing on solving acute liquidity problems. Our findings highlight that increased levels of scarcity risk reinforcing the conditions of poverty through overborrowing.

Keywords Poverty · Decision making · Consumer credit · Time preferences

Extended author information available on the last page of the article

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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 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 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 studies such borrowing behavior theorizes that consumers either 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 et al. (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.[4]

In this paper we test, in a quasi-field experiment, the hypothesis by examining whether consumers who experienced more scarcity borrow more. We find that high-educated consumers borrow less frequently and choose a lower loan to value (LTV) ratio when their budget constraints are exogenously tighter. In contrast, low-educated borrowers do not respond to temporary elevated levels of scarcity. To show this, we exploit the random timing of welfare payments embedded in the Swedish social welfare system, which makes some welfare cycles exogenously longer than others. For nearly 40,000 welfare recipients, we observe their pawn loans on a daily basis. By pawning rather than selling the collateral, we infer our borrowers' intention to repay their credit,[5] which we compare to actual repayment

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

[2] See for example Morse (2011), Bhutta et al., (2015), Agarwal & Bos (2014).

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

[4] Other recent papers come to a similar conclusion with alternative mechanisms, for example: 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 et al. (2015) show theoretically that low levels of assets undermine the individuals' capacity for self-control by diminishing the effectiveness of self-imposed punishments.

[5] Borrowers reveal this preference to repay and ultimately retrieve their collateral when they decide to pawn their gold, instead of selling it at the gold-to-cash vendor. The lion's share of pawn loans (more than 80%) in the full sample are secured by gold (see Bos et al. (2012)), and we limit our sample to pawn loans collateralized by gold, to calculate the loan to value ratio. A pawn loan contract is typically 3–4 months

or default decisions. We use a daily pawn credit panel merged with data from the Swedish credit registry and detailed income and demographic records from Statistics Sweden. Our sample of pawn borrowers is well suited to measure the effects of scarcity on consumers credit decisions, because it consists of individuals who typically live from 'paycheck to paycheck' and thus additional days between paydays matter. Moreover, borrowing costs represent a large share of their income. As a result, if there is a cost due to scarcity the individuals in our sample are likely to bear it.

Our objective is to measure the causal impact of scarcity on consumers credit decisions. However, the positive correlation that we can find between the number of days, since payday and the probability to take credit is likely to provide a biased estimate of the causal effect due to reverse causality and/or omitted variables.[6] For instance, credit decisions affect the level of scarcity, and individuals who take alternative credit are probably also more likely to experience scarcity. To identify the causal part of the correlation between scarcity and consumers' credit choice, we exploit an exogenous source of variation in scarcity that enables us to hold the two other effects constant.

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, the "early-born", and on the 19th if the recipient was born on or after the 16th, the "late-born". The separation of paydays by date of birth has existed for many years, and was presumably introduced not to overburden the payment system in older times. Furthermore, these respective paydays are moved to the closest working day whenever the assigned date falls either on a weekend or a holiday, yielding an early versus late-born difference in the number of days between paydays. As the nominal amount of pay is constant over time, either the early or late-born are more likely to experience a short-lived reduction in financial resources for a given payday cycle, which we define as "scarcity". Thus, early and late-born are randomly assigned to treatment and control groups within a given pay cycle, and will switch between treatment and control over time.

As Carvalho et al. (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. In line with the life-cycle permanent income hypothesis, a fully rational consumer without credit constraints would smooth consumption independent of the length of the payday cycle. However, previous studies have documented that

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Footnote 5 continued

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 service can, in theory, resell the gold immediately with a lower administrative burden.

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

[7] Stephens (2003, 2006), Shapiro (2005), Mastrobuoni and Weinberg (2009), Huffman and Barenstein (2005).

households are more likely to face financial shortfalls during longer pay periods [see Baugh and Wang (2018)] and that expenditures or caloric intake increase sharply at payday.[7]

We, therefore, expect borrowing decisions to be influenced by payday effects. Our initial empirical strategy is 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 et al. (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, when we distinguish borrowers by their level of sophistication (using education as a proxy for sophistication) we do find an effect of scarcity on consumers credit decisions. This approach to separate consumers by their level of awareness of their self-control problems is motivated by the findings of, for example Heidhues and Kőszegi (2010), Skiba and Tobacman (2008), and Kuchler and Pagel (2018), who highlight the importance of this distinction in understanding consumers' financial decision making.

The underlying mechanism through which scarcity impacts credit decisions in our empirical setup can be summarized as follows. In line with the recent behavioral literature [e.g., Shah, Mullainathan, and Shafir (2012) and Gabaix and Laibson (2017) or Haushofer and Fehr (2019)], a sharp but short-lived drop in financial resources before payday (i.e., an increase in scarcity) is likely to strengthen borrowers' time inconsistency. The effect of scarcity (through a stronger present bias) depends on the degree of sophistication. In scarce periods (i.e., a long pay cycle), the sophisticates make their credit decision by taking into account their sudden increased present bias. Compare to non-scarce periods, they choose a lower loan to value ratios to make sure that they will, in the next period, retrieve their pawned item. 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."

Using borrowers' education as a proxy for the level of sophistication [supported by, e.g., Agnew et al. (2003), Bilias, Georgarakos, and Haliassos (2010), Calvet et al. (2007), Calvet et al. (2009), Campbell (2006), Black et al. (2018), Brown et al. (2016), Dhar and Zhu (2006), Goetzmann and Kumar (2008), Urban et al. (2020), and Ru and Schoar (2016)], we combine two empirical strategies within a pay cycle— early versus late-born and high versus low-educated borrowers—for identification.[8] We track how loan to value ratios change for these groups over the pay cycle. Our main specification is, therefore, a difference-in-difference regression with heterogeneity in the level of education, where the coefficient of interest can be

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[7] Stephens (2003, 2006), Shapiro (2005), Mastrobuoni and Weinberg (2009), Huffman and Barenstein (2005).

[8] As education correlates with income, wealth and preferences, we discuss alternative interpretations below.

interpreted as the causal effect of increased scarcity on credit decisions by less sophisticated poor consumers.

We find that when their budget constraints are exogenously tighter, high-educated individuals are less likely to take pawn loans and with lower loan to value ratios. In contrast, low-educated individuals do not respond to elevated levels of scarcity. This lack of response translates into a 10.7% higher borrowing propensity and 10.9% higher loan to value ratio for low-educated individuals, relative to the high-educated counterparts. Furthermore, we find that low-educated borrowers are 4% points more likely to default on the loans taken during the days with elevated levels of scarcity. These defaults are costly, not least since they violate the individuals intention to repay by pawning their gold rather than selling it for more cash. A back-of-the-envelope calculation suggests that increased scarcity translates into a 11.6% increase in borrowing costs of low-educated consumers. Finally, we find no evidence that this additional credit helped them to avoid default outside the credit market. Our results highlight that temporal increases in scarcity risk reinforcing the conditions of poverty.

Importantly, consistent with our identification assumption, we find a monotonic increasing relationship between the size of the treatment—the additional number of days between paydays—and the borrowing propensity and LTV ratios 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 over their respective pay cycle and isolate the effect of increased scarcity in long versus short months while controlling for individual, time and days until payday 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.

The difference in education could sort borrowers into their differential awareness about their biased time preferences, but also their difference in financial literacy [see Hastingset al. (2013) for a review], forecasting abilities (e.g., Gabaix & Laibson, 2017), attentiveness [e.g., Sims (2003), Karlan et al. (2016)], aspiration levels [e.g., Dalton, Ghosal, and Mani (2016)] or risk aversion (e.g., Benjamin et al. (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 et al. (2016) plus the ongoing policy debate on decision-making by the poor

(Bertrand et al., 2004). Secondly, this paper also relates to the literature stressing that awareness of biased time preferences is crucial for understanding financial individual decisions [e.g., Kuchler and Pagel (2021) who show that sophisticated borrowers repay their credit card debt in line with their plan, unlike the naive borrowers]. It contributes to establishing that there is a demand for a costly commitment device by sophisticated present biased agents in the credit market complements the literature focusing on commitment devices utilized aimed to increase savings (Ashraf et al., (2006; Beshears et al., 2020; Kuchler & Pagel, 2021). In a survey experiment, Allcott et al. (2020) also find that experienced payday borrowers are willing to pay a premium for an incentive to avoid future borrowing.[9]

Lastly, the 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). Our results lend support to policies that aim to smooth fluctuations in scarcity by harmonizing the timing of income and bill receipt (Parsons & Van Wesep, 2013).

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 et al. (2016), who find mixed results administering online tests with two ongoing internet panels, sampling low-to-moderate-income Americans. Carvalho et al. (2016) 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.[10] Moreover, when we rerun their analysis utilizing their online data and considering heterogeneity in education, we find that only high-educated survey participants are significantly less present-biased in the real effort tasks before payday.[11]

Furthermore, our work is also related to liquidity constraints and budgeting mistakes. In a theoretical paper, Parsons and Van Wesep (2013) show that, if the

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[9] Note that Allcott et al. (2020) find that three quartiles of the studied payday loan population are sophisticated borrowers. If the lion share of our studied customers would be sophisticated, we would expect a large share of borrowers using a commitment device (i.e., a lower loan to value). This is not what we find. We believe that the main difference between their paper and ours lies in the sample selection. Our identification strategy of exogenous exposure to scarcity only works for the unemployed pawnborrowers receiving welfare benefits every month, that is, the poor people. This selection might explain the smaller share of sophisticated borrowers in our sample compared to Allcott et al. (2020) that sample randomly from a pool of all payday borrowers. In addition, we consider education level as a proxy for sophistication, while Allcott et al. (2020) define the sophistication level as a forecast error (the difference between perceived and actual probability of borrowing in the next 8 weeks). The best proxy for sophistication is ultimately an empirical question on which the literature is still debating.

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

[11] Online Appendix A.1 presents further details.

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) and Baugh and Wang (2018) test these predictions 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.

The remainder of the paper is organized as follows. Section 2 describes our empirical setting and identification strategy to uncover the effects of scarcity on credit decisions. The results are in Sect. 3. Section 4 interprets the results and Sect. 5 concludes.

2 Measuring the effect of scarcity on credit choices

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

2.1 Empirical setting

2.1.1 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 (henceforth early born), you are typically paid on the 18th every month. If you are born on or after the 16th (henceforth late born) you are paid on the 19th. However, as illustrated in Fig. 1, this payday is moved to the closest working day 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 2 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 0 and 3 days.

2.1.2 Identification strategy

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

Fig. 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. **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). **b** One example when both default paydays fall on a weekend and are shifted to the nearest weekday. **c** Illustrates how early and late-born individuals will shift from treated to control and vice versa. **d** Shows an example of shifts forward due to the Easter holidays
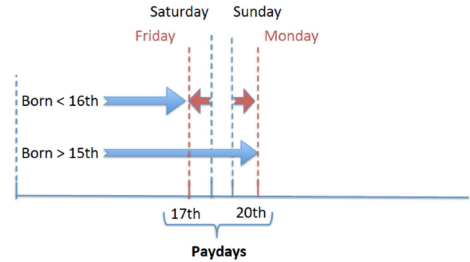
Panel A:
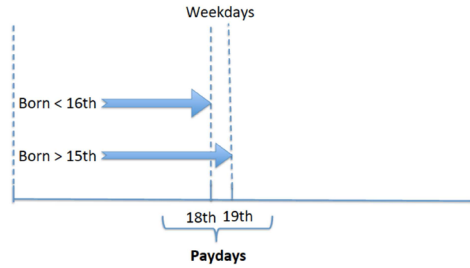
Panel B:

Panel C:
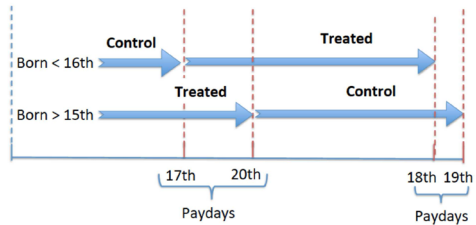
Panel D:
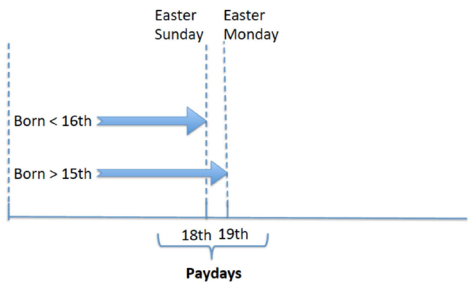
late, and any difference in credit choice between the two groups would be causally assigned to this change.

In our empirical setting, we use the variation in the number of days between early and late-born groups within payday cycles 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
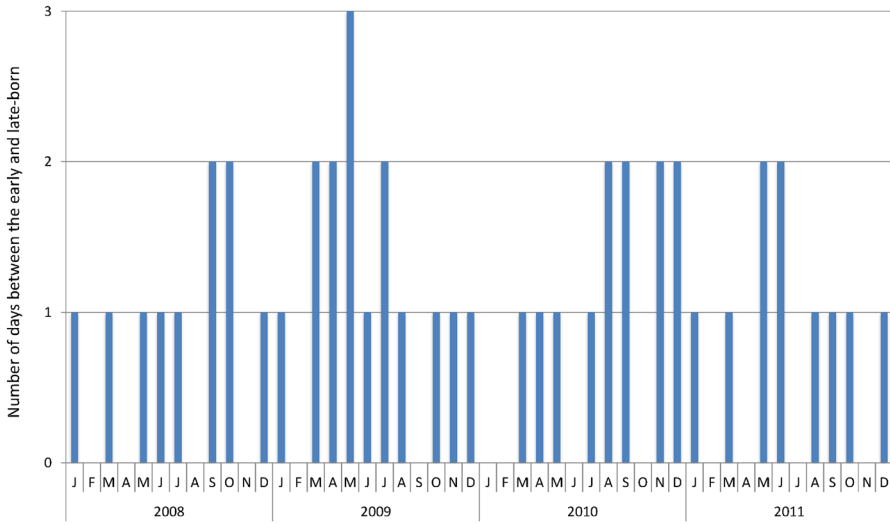
Fig. 2 Variation in the number of days between paydays. This figure depicts the absolute value of the difference in the number of days between the early and late-born groups within each payday cycle. Variation in the number of days between two consecutive paydays is provided by a shift away from the 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

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 last week of the payday cycle relative to the prior 2 weeks.[12] We follow Carvalho et al. (2016) in that we define 7 days before payday as the scarce period and 2 weeks before that as the non-scarce period.

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 credit decisions. The identification assumption is that any difference in borrowing behavior in scarce periods relative to non-scarce periods is

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[12] We use a 7-day cutoff for three reasons. 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 7 days before payday are parallel, after which divergence occurs (see Fig. A1). Finally, we follow Carvalho et al. (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 A6.

driven only by the difference in the degree of scarcity before payday. In Sect. 3.1 we provide evidence that supports this assumption.

2.1.3 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% of the pawn borrower population pledges gold as collateral.

Upon entering the pawn shop, the broker values the collateral, and customers choose how much to borrow. The loan to value (LTV) ratio expresses the loan amount relative to the assessed value of the collateral. The standard contract term is 3–4 months, and interest rates are approximately 3.5% per month. 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 3–4 months into the future. Rolling over is a common phenomenon, and can occur many times for the same loan, making pawn credit an expensive source of funds. Hence, the mechanisms behind the decision to participate in this credit market can have substantial economic implications for low-income borrowers.

2.2 Data

We utilize a sample of Swedish pawn borrowers. The pawn register data contains information about all transactions 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 4 years from 2008 to 2011, with indicators for taking a pawn loan and the corresponding LTV ratio[15] as outcomes of interest. During the window of our panel, the average principal loan amount is around 4000

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[13] See Bos et al. (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.

[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.

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%.

For these 4 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 registry data from the Swedish tax authority and other government agencies. The credit bureau data lists all outstanding loans (credit cards, installment loans, mortgage loans) within the mainstream banking sector. Furthermore, we observe each individual's credit score, which reflects the probability of default ranging from 0 to 100.[16]

To determine the type of income (social transfers or income from work), we match the pawn and credit bureau data with information obtained from Statistics Sweden, using the unique identifiers for Swedish residents. 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 exact dates 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.

2.3 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 7 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 21–8 days before payday (the pre-period) in both the long and short 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 (event) time trends to analyze differences in borrowing decisions between early and late-born individuals within a specific payment period.

We denote the treated 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 last 7 days before the next payday, and 0 during 21–8 days

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[16] The probabilities of default are estimated by the credit bureau, with a model based on data from the entire Swedish adult population. 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.

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:

$$1(\text{takepawnloan}_{i,t,\tau} > 0) = \theta_i + \theta_t + \theta_\tau + \gamma \text{treated}_{i,t} \times post_\tau \\ + \mu \text{treated}_{i,t} + \varepsilon_{i,t}. \tag{1}$$

Note that the event time fixed effect θ_τ absorbs the baseline coefficient of $post_\tau$. The coefficient γ measures the differential probability of participating in the pawn credit market during the treated and control payment periods, during 7 days before the next payday. This coefficient is the causal effect of payday shifts on pawn borrowing, which we report with our regression output below.

2.4 Present-bias, sophistication and scarcity

The literature studying consumer credit decisions often postulates that behavioral biases can explain the observed demand for credit and repayment decisions. For instance, Meier and Sprenger (2010) show that experimentally elicited measures of present bias are strong predictors of outstanding credit card balances.[18] Other papers suggest that awareness of biased time preferences is crucial for understanding borrowing patterns. Typically, the sophisticates understand their self-control problem and exploit commitment devices to avoid making costly mistakes, in contrast to naifs, who are unaware of their biased time preferences and incorrectly belief they will repay the loan next month [see for instance the theoretical framework developed by Heidhues and Kőszegi (2010)].[19]

A recent literature stresses that the consequences of behavioral biases depend on the level of resources available. Shah et al. (2012), Mani et al. (2013), Gabaix and Laibson (2017) argue that people will focus their attention on the scarce margin, and thereby neglect other margins, given a fixed brain bandwidth. In a recent controlled experiment, Haushofer and Fehr (2019) confirmed this link. Subjects seem to experience higher discounting just after a negative income shock. Following this line of reasoning, we hypothesize that borrowers are more present biased when their payday cycle is long and resource are scarce. However, this time-varying present bias (i.e., a lower discount rate in scarce periods) only matters if borrowers are aware of their bias. The naive borrower continues assuming away their self-control problem, and, therefore, makes the same credit decision regardless of scarcity. In contrast, the sophisticated borrower realizes that, during scarcity, her behavior might become more shortsighted. To make sure that she will credibly stick to her future repayment scheme, she reduces her demand for credit and optimally chooses a lower LTV ratio as a commitment device. This is a credible commitment, as lowering the LTV ratio implies higher costs of default. Given the intention to repay

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[18] An extensive theoretical literature has emerged studying the consequences of hyperbolic discounting for consumption choices. See, amongst others, Laibson (1997), Harris and Laibson (2001), Fehr (2002), DellaVigna and Malmendier (2004)

[19] Skiba and Tobacman (2008) find that a model with hyperbolic discounting and different degrees of sophistication matches the data on payday borrowing, rollover and default. The distinction between sophisticates and naifs is from the seminal article of O'Donoghue and Rabin (1999).

the loan by pawning rather than selling the collateral, a higher cost of default will reinforce the commitment to repay. On the contrary, contracts with higher LTV ratios will appeal to present-biased consumers in particular, since it yields more money to consume today. We provide a simple framework in Appendix A.2 to illustrate this point.

In our empirical analysis we use education as a proxy for the sophistication of the borrowers, as our data does not contain survey or experimental measures of this variable. We lean on the literature that documents a cross-sectional and panel relationship between education and sophistication. It has been shown that better educated households tend to be better diversified (Calvet et al., (2007; Goetzmann & Kumar, 2008), display less inertia (Agnew et al., 2003; Bilias et al., 2010; Campbell, 2006; Vissing-Jorgensen, 2002), and have a weaker disposition to hold losing and sell winning stocks (Dhar & Zhu, 2006) than other households. Calvet et al. (2009); show a similar positive (though weak) relationship between education and sophistication with respect to under diversification, inertia in risk taking, and the disposition effect in direct stockholdings utilizing a panel dataset for the total Swedish population. Furthermore, Brown et al. (2016) find that both mathematics and financial education, by and large, decrease reliance on nonstudent debt and improve repayment behavior. Urban et al. (2020) find that financial education requirements are associated with fewer defaults and higher credit scores among young adults. Lastly, Black et al. (2018) find that lower risk aversion is a potential channel through which education diminishes the risk of underinvestment.

We classify individuals with at least some college education as high educated and those with high school degree or less (at most 12 years of schooling) as low educated. At most 12 years of schooling corresponds to ISCED level 3 or lower. In Sweden, primary school takes 9 years to complete (age 7–16). Secondary school takes 3 years. The borrowers classified as high-educated, therefore, have at least some post-secondary schooling (ISCED levels 4 and above). We also report results with a specification linear in the years of schooling.[20] 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. Note that time-varying present bias (i.e., a lower discount rate in scarce periods) cannot be captured by borrower fixed effects (which are included in our regression) but rather correlates with scarcity periods.

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 regression:

$$
\begin{aligned}
1(\text{takepawnloan}_{i,t,\tau} > 0) = \ &\theta_i + \theta_t + \theta_\tau + \gamma \text{treated}_{i,t} \times \text{loweducated}_i \times \text{post}_\tau \\
&+ \delta \text{treated}_{i,t} \times \text{post}_\tau + \eta \text{loweducated}_i \times \text{post}_\tau \\
&+ \kappa \text{loweducated}_i \times \textit{treated}_{i,t} + \mu \text{treated}_{i,t} + \varepsilon_{i,t}.
\end{aligned} \quad (2)
$$

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

---

[20] Our main result is robust to defining 3 groups of education (primary, secondary and post-secondary).
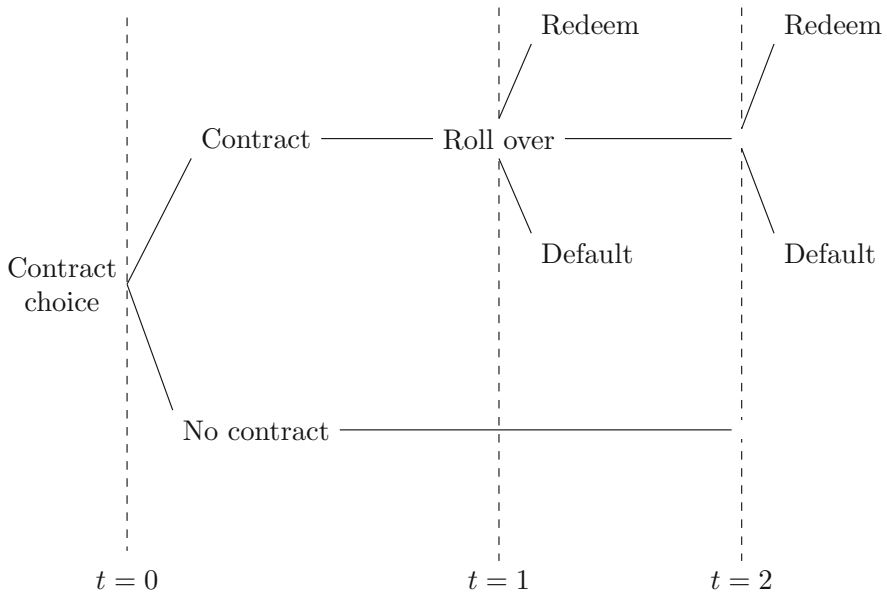
Fig. 3 Timing of credit decisions. This figure depicts the timing of credit decisions in the pawn credit market

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 last week of the payday cycle. The coefficient η captures differences in credit uptake between high and low educated individuals during 7 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 7 days before the next payday.

The key assumption we need 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 Sect. 3.1 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 0 to 3 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. We show this to be the case in Sect. 3.3.

Table 1 Variable definitions

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

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

2.5 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. There are no significant differences between the early and late-born individuals' borrowing behavior or individual characteristics, consistent with random assignment to treatment and control groups. We find that the daily probability of taking a pawn loan is around 0.20% with an LTV ratio of around 0.14%. While these numbers sound rather low,

Table 2 Summary statistics

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 ($N = 5182$)						
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	9900	9604	10,718	9987	10,938
Annual capital income (SEK)	3659	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 (PD)	28.3	19.2	28.4	28.3	19.0	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

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

note that these are unconditional averages, i.e., including the zeroes of the consumers who decided not to take a pawn loan on a particular day.

Conditional on taking a loan, the average LTV ratio equals 76%. Nearly a quarter of all loans end up not being repaid, and more than a quarter 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%. Monthly income is low by Swedish standards, at around 10,000 SEK (1,175 USD) per month.

3 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.

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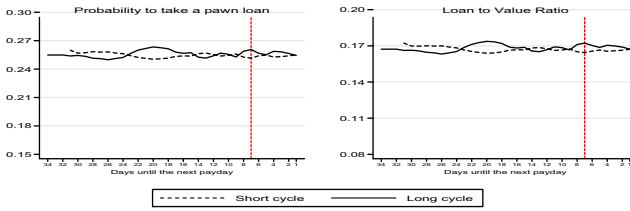
Panel B: The probability of taking a pawn loan (the left figure) and LTV ratio (the right figure) in short and long pay cycles, split by low and high-educated borrowers.

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.

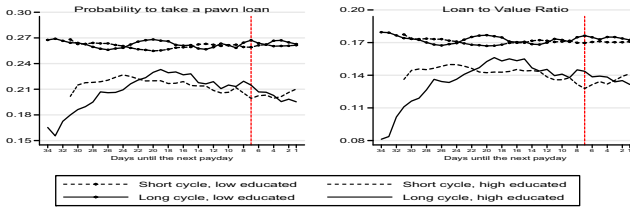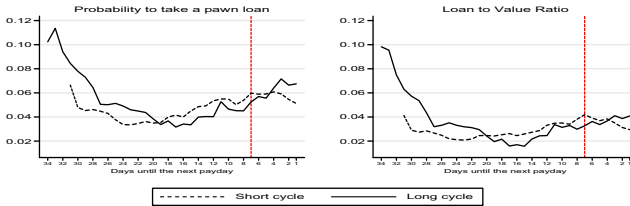**Fig. 4** Pre-trends for the probability of participating and loan-to-value ratio in the pawn credit market. **a** Shows the average probability of participating (left) and loan to value (LTV) ratio (right) in long (*treated*) versus short (control) (dashed) payday cycles, reflection regression 1. **b** Shows the same variables split by borrower education. **c** Shows the difference between the low and high-educated in long (treated) and short (control) payday cycles. **c** Thus reflects regression 2: a triple difference of (1) high versus low-educated; (2) 3 weeks (the pre-period) versus 1 week (the post-period) before payday; (3) in a long (treated) versus short (control) payday cycle. The red dashed vertical line marks the start of the last week before payday, which we denote the post-period. Note that the regressions 1 and 2 include only the last 3 weeks before payday

3.1 Graphical evidence

The identification assumption for regressions 1 and 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 Fig. 4 and we test (and cannot reject) the

parallel growth assumption statistically with a Wald test, see Online Appendix Fig. A1.

Panel a of Fig. 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 3 weeks before payday and ends 1 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. Put differently, low-educated borrowers do not respond to increased levels of scarcity. This lack of response is consistent with the notion that low-educated borrowers are less aware (naive) of their potential short-sighted behavior in general or any scarcity-induced increase in their behavior specifically; alternative mechanisms are discussed (and ruled out) in Sect. 4. 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 A1 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 7 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, the differential probability of taking loans and LTV ratio increases during the last week of long payday cycles, consistent with the high-educated individuals borrowing less as a commitment device.

3.2 Main results

3.2.1 Pooled sample

We quantify whether borrowers in long payday cycles have a significantly higher probability of taking loans before payday using regression 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 to have more contrast between treated and control (column 2), as well as when we use a specification linear in the number of days between early and late born (column 3).

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

Table 3 Baseline results: the effect of scarcity on borrowing

	(1)	(2)	(3)	(4)	(5)	(6)
	Prob(Take Pawn Loan)			Loan to Value		
Post*Treated	− 0.001 (0.004)	− 0.005 (0.004)	− 0.002 (0.002)	− 0.001 (0.003)	− 0.003 (0.003)	− 0.001 (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

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 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% significance levels, respectively. All coefficients are in percentage terms (scaled by 100)

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.

3.2.2 Low versus high educated

Motivated by the findings in the literature[21] that stresses the importance of consumers level of awareness of their self-control problems in understanding consumers' financial decision making, we present in Table 4 the coefficient of a difference-in-difference regression with heterogeneity in the level of education (specification 2).[22] We proxy this awareness with the borrowers' education level, supported by, e.g., Ru and Schoar (2016) and Calvet et al. (2009).

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 relative to non scarce (control) periods. We estimate that low-educated borrowers, relative to high-educated individuals, are 0.02% points more likely to participate per day during scarcity, which is statistically

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[21] See for example Heidhues and Kőszegi (2010), Skiba and Tobacman (2008), Kuchler and Pagel (2018)

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

Table 4 Heterogeneity: the effect of scarcity on borrowing, by education

	(1)	(2)	(3)	(4)
Panel a: probability of taking a pawn loan				
Prob(Take Pawn Loan)				
Low-educated*Post*Treated	0.023** (0.010)	0.026** (0.011)	0.013** (0.006)	
Years of schooling*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				
Loan to value				
Low-educated*Post*Treated	0.016** (0.008)	0.020** (0.009)	0.011*** (0.005)	
Years of schooling*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

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 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% significance levels, respectively. All coefficients and pre-period means are in percentage terms (scaled by 100)

significant at the 5% level. As the average propensity to take loans in non-scarce periods for low-educated individuals is 0.22% per day, the effect is economically large: the coefficient implies a (0.02/0.22=) 10.7% increase.

This 10.7% relative increase for low-educated borrowers from the regression should be interpreted in light of the graphical evidence provided in Sect. 3.1.

Figure 4 shows that low-educated individuals do not borrow more towards the end of the payday cycle, but rather that the high-educated decrease their borrowing propensity. The cleanly identified difference in borrowing propensities is consistent with our hypothesis that high-educated, more sophisticated borrowers use commitment devices to offset temporary elevated levels of scarcity, while low-educated, more naive borrowers, are unaware of their potential self-control problems and thus do not adjust.

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% higher probability of participation for low-educated borrowers in periods of scarcity. This result adds confidence to our interpretation that, compared to the sophisticated 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% 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% level, implies that the likelihood of taking credit during scarce versus non-scarce periods decreases by 1.9% per additional year of schooling.[23]

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% points per day, significantly different from zero at the 5% level. Given the non-scarce mean of 0.15%, the coefficient implies a 10.9% 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%. Columns 3 and 4 document an increase in LTV by 7.7% per extra day between payday periods, and a decrease by 2.3% per additional year of schooling.

The higher LTV ratio chosen by low-educated borrowers, relative to high-educated, is driven by higher nominal loan amounts (see Table A3 in the Online Appendix). Although both the value and the grams of gold pledged by the low-educated in scarce periods increase as well, the loan amount increases more, implying higher LTV ratios. A lower LTV ratio chosen by sophisticated present-

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[23] 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.

biased consumers increases the cost of defaulting, acting as a commitment device to repay the loan.

3.3 Results by treatment intensity

Our identification strategy relies on variation in the length of a payday cycle. 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 for low-educated individuals relative to their high-educated counterparts. 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. Furthermore, the pattern is monotonic in extra days of scarcity: 2 days of scarcity corresponds to an increase of 11.9% in the likelihood of taking pawn loans, while 3 days of scarcity corresponds to an increase of 14.1%. Panel b of Fig. 5 is suggestive of a monotonic relationship between the length of payday periods and the LTV ratio as well.[24]

3.4 Maturity choice

During our sample period, some pawnbrokers increased the menu of contracts available to their borrowers. They introduced a new contract with 2-month maturity, while the standard contract in Swedish pawn shops has a maturity of 4 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 1 (column 1) and 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

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[24] 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.

Panel A: The probability of taking a pawn loan
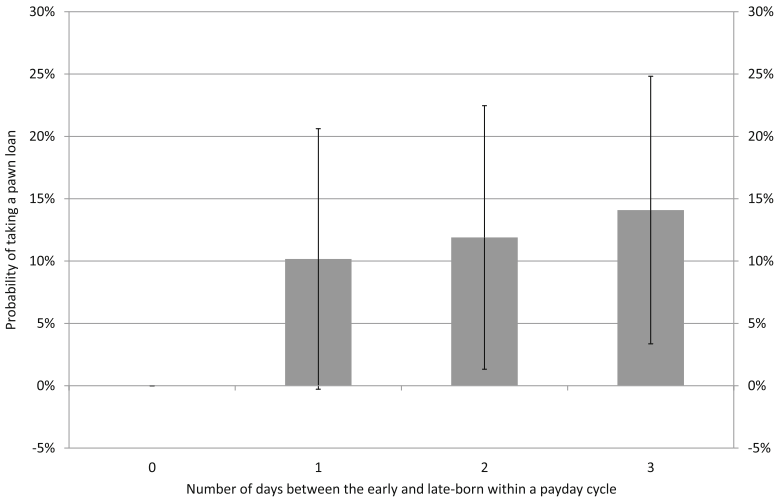
Panel B: The pawn loan to value ratio
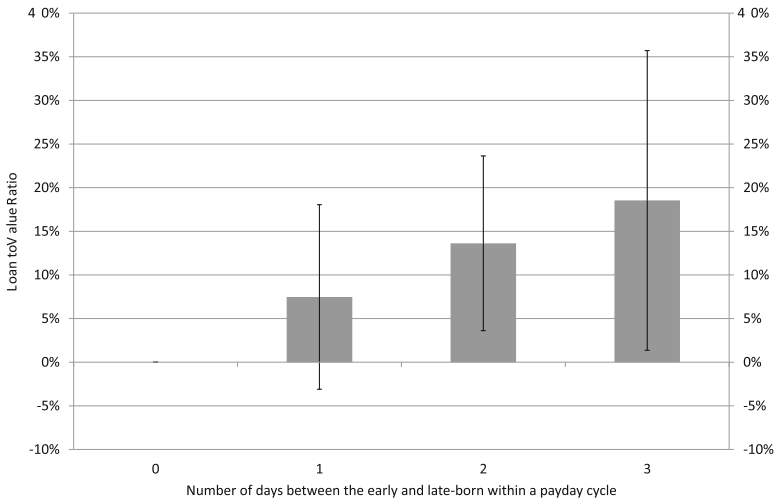
Fig. 5 Scarcity exposure and credit decisions. This figure displays evidence of a monotonic relationship between an additional day in a payday cycle and the likelihood of taking a pawn loan (**a**) and the loan to value ratio (**b**). The graphs show the estimated coefficients, scaled by the non-scarce mean, plus 90% confidence intervals, of separate regressions of regression model 2 for any possible difference in the number of days within a payday cycle between the early and late-born

Table 5 Effect of scarcity on maturity choice

	(1)	(2)
	Prob(Long Contract)	
Post∗Treated	0.034 (0.61)	
Low-educated∗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	5182	5182

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 months 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 1 with the probability of choosing a long contract as outcome variable. Column 2 uses regression 2. Standard errors are clustered at the individual level

*, **, and ***Represent 10, 5, and 1% significance levels, respectively. All coefficients are in percentage terms (scaled by 100)

selection into participation.[25] Column 1 (pooling education levels) shows no difference in the likelihood of taking long loans in scarce and non-scarce periods, parallel to our results on participation and LTV. Instead, column 2 shows that low-educated borrowers are 4.7% less likely to take long contracts relative to their high-educated counterparts in scarce periods.

3.5 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

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[25] 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.

Table 6 Consequences of credit decisions made during scarcity: repayment and default

	(1) Prob(Default Pawn)	(2) Prob(Rollover Pawn)	(3) Prob(Default Pawn)
Panel a: inside the pawn credit market			
Low-educated∗Post∗Treated	3.97* (2.39)	2.33 (2.98)	15.41*** (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

	(1) Prob(Arrear)	(2)	(3) Hazard(Arrear)
	60 days ahead	90 days ahead	180 days ahead
Panel b: outside the pawn credit market			
Low-educated∗Post∗Treated	0.09 (0.11)	– 0.17 (0.13)	
Low-educated∗Post∗Treated∗Take Pawn Loan			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

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 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 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 3 in column 3. Standard errors are clustered at the individual level

*, **, and ***Represent 10, 5, and 1% significance levels, respectively. All coefficients and pre-period means are in percentage terms (scaled by 100)

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).

3.5.1 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 6 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% 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% 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 the low educated borrowers fail to insure themselves against future self control problems due to their lack of awareness of their biased time preferences which exposes them to a higher default risk compared to the high educated counterparts. For more details see our simple framework in our online Appendix A.2,

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.[26]

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.

3.5.2 Consequences outside the pawn credit market

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, pawn borrowers may have managed to avoid arrears outside the pawn shop by exchanging their illiquid assets for cash.

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[26] 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 (Sect. 3.2) as well as a 4% points higher likelihood of defaulting. The repayment costs and default costs due to scarcity amount to $0.107 \times 4000 \times 0.25 \times 0.73 = 78$ SEK and $0.107 \times 4000 \times 0.27/0.76 = 152$ SEK, respectively. Hence, scarcity increases pawn credit costs by $100 \times (78 + 152)/(770 + 1211) = 11.6\%$.

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:

$$h(t) = h_0(t) \exp\big(\theta_t + \theta_\tau + \gamma \text{treated}_{i,t} \times \text{loweducated}_i \times \text{post}_\tau \times \text{takepawnloan}_{i,t,\tau} + \zeta x_{i,t}\big)$$

$$(3)$$

We utilize the credit bureau data that is matched to the pawn credit panel. In Sweden, 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 3 years.

In column 3 of panel b of Table 6, we present the results of our hazard regression, looking up to 6 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 2 or 3 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 et al. (2015). In addition, low-educated borrowers default more on their pawn loans. Together, these findings suggest that periods of increased scarcity reduce the low-educated individuals' welfare, as they could have obtained more cash in exchange for their gold by selling it outright rather than pawning their illiquid asset.

4 Mechanisms and additional findings

4.1 Difference in liquidity or present-bias?

The previous sections provide evidence consistent with the hypothesis that scarcity induces sophisticated individuals, but not naifs, to borrow less frequently, choose lower loan to value ratios and longer-maturity contracts. In this sub-section, we investigate other potential mechanisms that could generate these results. 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 et al. (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:

$$1(\text{takepawnloan}_{i,t,\tau} > 0) = \theta_i + \theta_t + \theta_\tau + \gamma \text{treated}_{i,t} \times \text{loweducated}_i \times \text{post}_\tau$$
$$+ \gamma_1 \text{treated}_{i,t} \times liquidity_{i,t} \times \text{post}_\tau + \zeta x_{i,t,\tau} + \varepsilon_{i,t} \quad (4)$$

All single and double interactions are included and captured in the variable x. The idea behind regression 4 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 5000 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 12 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.[27]

4.1.1 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 80of the credit limit, iii. the log of the credit score (defined as a probability to default, as estimated by the credit bureau), and iv. demand for mainstream credit.[28] 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

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[27] 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.

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

Table 7 Horse-racing education with liquidity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Prob(Take Pawn Loan)							
low_educ * post * treated	0.025** (0.010)	0.023** (0.010)	0.023** (0.010)	0.023** (0.010)	0.023** (0.010)	0.024** (0.010)	0.023** (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** (0.008)	0.017** (0.008)	0.017**(0.008)	0.016**(0.008)	0.016**(0.008)	0.017**(0.008)	0.016**(0.008)
x*post*treated	0.002*** (0.001)	0.004 (0.003)	0.000 (0.000)	0.003 (0.007)	– 0.004 (0.007)	– 0.002* (0.001)	– 0.079 (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						

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 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 4, 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% significance levels, respectively. All coefficients are in percentage terms (scaled by 100)

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.

4.1.2 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 A5 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 Fig. A1 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)]. In fact, we observe that the trend of the likelihood to borrow and the LTV ratio is hump-shaped for high-educated borrowers (see Fig. 4).[29] This is consistent with liquidity initially being high and, therefore, little borrowing shorty after the previous payday.

Note that borrowing in the beginning of the month could be a way to increase the likelihood of repaying next month shortly after receipt of a new welfare check. Hence, borrowing early in the month cycle may be another commitment device for sophisticated borrowers to ensure repayment. However we find no evidence that low-educated individuals borrow later in the cycle (or alternatively, high-educated individuals borrow earlier in the cycle). This is apparent in Table A1 in Online Appendix A, where the interaction term Low-educated*Treated is not significant.

4.2 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).

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[29] Using the full payday cycle, or the last 4 weeks, instead of the last 3 weeks, does not affect the results of our main regression (see Panel b of Table A6). The Wald test for parallel trends using the full payday cycle instead of the last 3 weeks does not reject the null hypothesis of parallel trends in the non-scarce period, for neither the probability to take a pawn loan ($p = 0.48$) nor the LTV ratio ($p = 0.30$).

4.2.1 Placebo treatment

The treatment variable exploits the specifics of the payment system in combination with the birthday of borrowers. As a robustness test, in Online Appendix Table A4 we present 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.

4.2.2 Alternative treatment

The treatment variable compares the length of the pay cycle of the early born compared to late born, and vice versa. As alternative approach is to define long cycles as those exceeding (365/12 ≈) 30 days.[30] Note that this approach still exploits the same variation in the length of pay cycles, but across payday cycles, instead of directly comparing the behavior of the early and late born within a payday cycle. We present the results with this alternative treatment indicator in Table A7 in the Online Appendix. Assuringly, we find very similar results as in our main tables. Although this definition of treatment may be more salient to the borrower (looking only at the borrowers' own length of the payday cycle rather than compared to the other group), we prefer to contrast early and late born directly within a payday cycle.

4.2.3 Sensitivity to cut-offs

An empirical choice that we made in our main analyses was to define the pre-period as the penultimate 2 weeks before the next payday. To verify that the results are not unique to the specific choice made, in Panel b of Appendix Table A6 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. Longer pre-periods of 4 weeks or even the full payday cycle imply somewhat smaller effects, but still we find significant borrowing by the low-educated in scarce periods. 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.

4.2.4 Expensive months

Finally, as expenditure needs may differ depending on holidays, panel c of Table A6 shows that our main results are not sensitive to excluding some payday cycles which are considered expensive. We exclude the payday cycles ending in December,

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[30] We thank the referee for this suggestion.

January and June, motivated by additional expenditures for Christmas and Midsummer, and find qualitatively no changes in the results.

5 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 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 high-educated consumers borrow less and choose a lower LTV, while low-educated borrowers do not respond to temporary elevated levels of scarcity. This lack of response by low-educated consumers translates into an increase in borrowing cost of 11.6% and an increased default risk of 4% points. Since we are able to infer their intention to repay from the fact that they have pawned their gold rather than selling it for more cash, we consider this increase in default not in line with their long run plan. 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. 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.

We interpret our findings through a framework, where the awareness of self-control problems is positively correlated with education. In this model, where myopia increases during periods of scarcity, high-educated individuals (aware of their self control problems) commit to repayment by borrowing less, and increase the cost of default by choosing a lower LTV. In contrast, low-educated borrowers (less aware of their self-control problems) do not respond and, therefore, ignore long-run costs when they are focusing on solving acute liquidity problems.

Our paper contributes to the understanding of seemingly inferior decisions made by low-income consumers that risk reinforcing the conditions of poverty. Our analysis introduces an alternative set of policies to consider by governments and regulators that aim to reduce the negative consequences of high interest rate borrowing. Our findings suggest that regulators might want to focus on reducing fluctuations in the levels of scarcity by paying out wages and social transfers at a more regularly-spaced, higher frequency. Lastly, education should aim to create an increased awareness of potential behavioral biases and the financial consequences that could follow.

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